TWENTY YEARS AFTER CHICO MENDES: EXTRACTIVE RESERVES' EXPANSION, CATTLE ADOPTION AND EVOLVING SELF-DEFINITION AMONG RUBBER TAPPERS IN THE BRAZILIAN AMAZON

By

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To the memory of my father, Carlos Maria da Silva Gomes. I know you were so proud of me. I wish I would have had the opportunity to give you this good news.

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By

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In the 20 years since the murder of rubber tapper leader Chico Mendes and subsequent creation of Extractive Reserves (ERs), ERs have become a popular conservation and development tool in the Brazilian Amazon. However, ER residents have faced challenges to improving their livelihoods based on sustainable use of the forest, leading to a shift towards cattle ranching and a questioning of rubber tappers' status as sustainable forest managers. This dissertation focuses on three core themes. The first examines overall ER policy evolution over two decades in the Amazon. The second examines issues of land-use/land-cover change and changing livelihoods among forest extractivists in the Chico Mendes Extractive Reserve (CMER) in Xapuri/Acre compared with cattle adoption by smallholder colonists. The third explores the implications of livelihood changes for the evolving self-definition of rubber tappers.

This dissertation is guided by theoretical perspectives of political ecology, environment and development, and land-use/land-cover science. It analyzes socioeconomic data gathered through multiple household surveys and government agencies, qualitative information from key informant interviews, and land-cover change detection.

Sixty-four ERs have been created in the Brazilian Amazon since 1990, spanning over 12 million hectares. Different waves of ER establishment responded to political and regional development dynamics at multiple scales that favored or constrained their implementation. In Xapuri, the size of cattle herds rose by 200% from 1990-2005, and throughout the CMER, land cover change detection from 1986-2003 showed some communities nearly surpassing the allowable limits of deforestation. Rubber tapper households have begun pursuing diverse livelihood activities that include not only extractivism, but also small-scale market cultivation, and increasingly, cattle production. Self-identification as a rubber tapper was positively correlated to larger landholding size, more knowledge of management rules, and participation in community activities. Conversely, more recent occupancy in the CMER and, surprisingly, involvement in the official social movement were negatively correlated with respondent's self-identification as a rubber tapper.

This dissertation contributes to the debate of ERs as an environmental policy in Amazon. Despite advances, challenges remain for ERs to promote sustainable development, particularly in light of changing livelihoods and continued pressure at development frontiers.

CHAPTER 1
INTRODUCTION

This dissertation focuses on provocative subjects in the debate about forest dwellers' conservation and development strategies, changing livelihoods conditions, and evolving self-definition in the Brazilian Amazon. These subjects are: 1) the evolution of the Extractive Reserve as a conservation and development policy; 2) land-use/land-cover change changes patterns, highlighting the adoption of cattle ranching by forest extractivists; and 3) the evolving self-definition of forest extractivists as sustainable forest managers in the context of their historical and current development trajectories.

The Amazon contains the largest remaining contiguous forest in the tropics, but also faces some of the strongest development pressures and one of the highest deforestation rates in the world. Development pressures are likely to increase with new large infrastructure projects such as highways and dams, and expansion of agribusiness due to increased demand for cattle, soy, and emerging biofuels. Access to and control of forest areas will continue to be highly contested by individual and organized smallholders, cattle ranchers, loggers, and agribusinesses. Finding solutions that protect forests and forest communities by guarding against both deforestation and displacement is one of the biggest challenges for balancing conservation and development in the Amazon, as well as in other tropical forest regions.

The state of Acre in the southwestern Brazilian Amazon is the birthplace of the rubber tapper movement, which was the first grassroots movement in Brazil to advocate conservation of Amazonian forests through the establishment of Extractive Reserves (ERs). Chico Mendes was the major force behind the movement and due to his campaign against forest destruction was killed by cattle ranchers in 1988. ERs, federal lands where non-indigenous forest smallholders hold usufruct rights to forest resources, were conceptualized as the "rubber tapper agrarian

reform" (CNS 1985). The ER concept's initial assumption was that an economy based on non-timber forest products could increase the economic value of forests and rural income, offering a variety of subsistence resources for extractivist communities, while ensuring ecological sustainability. In the past twenty years, ERs have gained a solid foothold in Amazonian forest policy and have be seen as a conservation model that "closes off the frontier" in contested forest areas by securing spaces for forest-dependent smallholders and stemming the advance of large-scale deforestation processes, thereby reducing the costs of regional development to forests and people. The ER has come to be seen as the ultimate, ultra-flexible conservation tool in the Brazilian Amazon. As a result, ER area has increased significantly; it encompasses a diversity of rural social groups with a variety of forest-based livelihood systems, a range of ecossistems, and strikingly different state political contexts. For example, both smallholder colonist farmers (e.g., Transamazon Highway) and traditional riverbank people in the eastern Amazon have successfully lobbied for ERs due to the continued pressure of large-scale cattle ranching and soybean production at development frontiers.

Although large-scale cattle ranching has historically been one of the most important land uses in the Amazon, leaving widespread deforestation in its wake and giving rise to the rubber tapper struggle, cattle ranching practices have continued to evolve in the region. Today, ranching is not limited to large-scale processes, but has become a practice among smallholders who employ diverse land tenure systems and come from a variety of cultural backgrounds – including in Extractive Reserves. While ERs have become pivotal to Amazonian conservation policy, cattle ranching has emerged among rubber tapper households in key ER areas, including the Chico Mendes Extractive Reserve (CMER), a symbolic site of the early struggles and social

movement's success. This marks an ironic departure from the ER's original role in closing the frontier and preventing large-scale cattle ranching expansion in the region.

During the past two decades of ER experience, rubber tapper communities' views of development and livelihood options have also evolved, continuing to respond to changing land uses and development trends occurring outside ER areas. ER populations have faced repeated challenges to improving their livelihoods based solely on sustainable use of the forest. Despite several political and development experiments to improve the economic viability of ERs by creating markets for new products extracted from the forest, forest communities continue to face economic hardship and encounter difficulties in both establishing market opportunities for extractivist products and maintaining consistent income throughout the year. Due to diminishing returns from extractivism and increasing pressure to diversify production and stabilize seasonal yield, rubber tappers are increasingly driven to small-scale cattle ranching and cash-crop agriculture practices, adopting land-use activities that have more destructive impacts on forest cover and exacerbating deforestation in ER areas. Cattle ranching in rubber tapper communities have become a major driver of land-cover change in ERs, despite the fact that it runs counter to the ecologically sustainable vision of the ER and the cultural history of rubber tapper communities in the region.

Cattle ranching among rubber tappers might represent the most important dilemma for Amazonian conservation because of its political implications for both the extractivist communities and for the ER model as a conservation strategy. Given its conflict with the theoretical underpinnings and ecological sustainability of ERs, cattle ranching challenges the conservation objectives of the ER model. Furthermore, it throws into question rubber tappers' traditional notion as successful forest managers living sustainably and peacefully with the forest,

and articulators of a powerful social and environmental justice movement in defense of the forest.

This rubber tapper definition was most actively vocalized when rubber tapper groups fought together against cattle ranchers and proposed the ER concept. As a marginalized social group, rubber tappers were relegated to an isolated, local arena for their grievances, but the urgent threat of large-scale cattle ranching sharpened their traditional definition and provided them a platform with which to lead a diverse group of allies across a mobilized global community committed to preserving the environment. In this new context, in which non-timber forest products have failed to be the panacea that was anticipated, the expectations assigned to the rubber tapper movement need to be revisited and potentially redefined. The stereotype of the rubber tappers as "forest stewards" could be called into question with their adoption of cattle ranching, but it could only be questioned with thoughtful consideration of the socio-economic and development factors that they are faced in Amazonia today.

Despite two decades of ER implementation and its centrality to people-based conservation, there has yet to be a region-wide analysis of this model. In order to fill this gap, this dissertation first examines ER evolution across space and time in the Amazon by analyzing the expansion of Extractive Reserves over a 20-year period with a multi-scale approach at the federal and state levels. This work also provides an analysis of the political and regional development dynamics, showing how these dynamics have affected ER policy and either favored or constrained the establishment of ERs.

Given the growing importance of cattle ranching in Amazonia and its expansion among diverse social groups, including many inhabitants of ERs, this dissertation then analyzes the emergence of cattle ranching among smallholders in two ways. First, I conduct a comparative

analysis of cattle ranching adoption among colonist smallholders and forest extractivists in the Amazon, exploring why livelihood strategies among heretofore distinct social actors are converging in a highly heterogeneous socio-economic region. To do this, I perform a comparative socio-economic study across space and time of two municipalities located in the eastern and western Brazilian Amazon, respectively: Uruará, in Pará state, comprised primarily of colonist farmers, and Xapuri, the birthplace of the rubber tappers' movement in the state of Acre. I address the shift toward cattle ranching among these two historically contrasting social groups, focusing on economic market forces and other socio-economic factors as explanations for expanding cattle raising among groups not previously noted for ranching in Amazonia. Second, I link land-use practices among rubber tappers to remote sensing data, addressing land-use/land-cover changes in the CMER that appear to be the result of forest dwellers' changing livelihoods, illustrating that as cattle ranching plays an increasingly important role in livelihood strategies, corresponding growth in pasture is trigging deforestation in the Reserve.

Finally, I consider the implications of changing livelihoods and land-use practices for rubber tapper definition in ERs. Since cattle ranching have emerged to challenge both the ecological sustainability of ERs and the popular cultural definition of rubber tappers, this dissertation addresses the historical-cultural trajectories and current livelihood practices of rubber tappers. I highlight historical-cultural factors that shape rubber tapper definition, systematically addressing a series of indicators that represent historically important strategies and contemporary changing socio-economic circumstances in the very place where the ER concept originated twenty years ago.

Research Questions

This dissertation examines key questions that are strongly linked to the central and evolving themes regarding the relationship between forest conservation and livelihood development of rural people in the Brazilian Amazon.

The first theme examines a major public policy for sustainable development by offering a temporal and spatial analysis of Extractive Reserve as a conservation and development strategy, along with current outcomes for continuing ER policy in the region. The second theme highlights livestock as the main driver of deforestation as land is occupied in frontier areas, from which emerged the Extractive Reserve concept as an alternate development strategy. While debates over cattle ranching in the Amazon have often focused on large properties, observers increasingly recognize that social actors aside from capitalist interests are buying cattle and converting forested land to pasture. As forest extractivists and small colonist farmers increasingly engage in cattle ranching, it is crucial to understand the factors that stimulate the expansion of cattle production among diverse groups, and the role that cattle production has in providing revenues for either subsistence or accumulation objectives among these groups. The third theme refers to the complex self-defintion of rubber tappers, which is shaped by their recognition as sustainable forest managers, but faces current controversy as land uses and livelihoods continue to evolve in Amazon Extractive Reserves. The central questions addressed in this dissertation are:

> (i) Given nearly two decades of Amazon Extractive Reserves, how has the ER model evolved in light of social movements, as well as federal and state policies, political and regional development dynamics and interactions among different actors at distinct levels? How have these elements favored or constrained the establishment of ERs in different states at different moments in the recent history of the Brazilian Amazon?
>
> (ii) Why do livelihood strategies converge toward cattle ranching among small-farm colonists and forest extractivists despite their profound historical and cultural differences

and far-flung locations in a highly heterogeneous socio-economic region such as the Brazilian Amazon?

(iii) What are the current dominant land use practices and livelihoods of extractivists in the Chico Mendes Extractive Reserve, and how do they affect the amounts and rates of deforestation in the reserve?

(iv) Given their complex historical livelihood trajectories and notable accomplishments as articulators of a successful social and environmental movement, which institutional-organizational, cultural and livelihoods factors currently shape rubber tapper self-definition in the face of evolving socioeconomic and development circumstances in the Amazon?

Addressing this study's research questions demands the adoption of an eclectic approach that relies on diverse disciplinary perspectives, a combination of qualitative and quantitative methodologies. In the following I will present an overview of both the research site and methodological procedures developed throughout each chapter of the dissertation.

Overview of Methods

This dissertation seeks to understand questions about socio-environmental processes underway at different scales in the Brazilian Amazon. The study draws on research methods from the social and land-use/land-cover sciences, involving multi-scalar qualitative and quantitative approach. The evolution of an ER model in Amazonia, involved a region-wide approach of data analysis. The comparison of livelihoods among colonist smallholders in Uruará (Pará) and forest extractivist in Xapuri (Acre), required the aggregation of multi-sited and temporal household surveys. The dynamics driving land-use land-cover changes and livelihood transformation within the CMER, relied on the analysis of household survey and quantitative approaches (key informant interviews), as well as land classifications and change detection.

Social Methods

In order to provide a region-wide analysis of the evolution of the ERs, I created/assembled a database of ERs created in Amazonia from 1990 to 2007. Information for the database was collected through a variety of sources: the Brazilian Environmental Institute (IBAMA) and other

state environmental agencies, and review of the literature, news reports and and internet sources. The database is composed of the following information about ERs: year of creation, status as state or federal, size, location, population, and main economic resources. It also contains a GIS based set of information of shape files.

For a comparative analysis of livelihoods between colonist families in Uruará and forest homesteads in Xapuri, this work draws on data for two time points in both sites, and featured households that received follow-up interviews, facilitating temporal comparisons. Survey data for Uruará refer to 1996 (261 households) and 2002 (143 households). For Xapuri, survey data refer to 2000, with an initial sample of 66 households, and 2004/2005 with a more extensive questionnaire and a larger sample, totaling 149 households. Panels were defined on the basis of whether a household was interviewed at both time points in the two data sets for both sites. The greater detail in the survey data and the ability to compare across sites and over time affords a richer portrayal of the circumstances and dynamics of livelihoods transformations among small farm colonists and forest extractivists in isolated areas of the Brazilian Amazon. More specific details about the survey and statistical techniques applied can be found in Chapter 3.

While this dissertation used multiple datasets (chapter 2 and 3), I only carried out fieldwork research in the CMER, which is explored in comparative terms in Chapter 3, and is the central theme for the next chapters (4 and 5). Those chapters includes more concentrated analyzes of the 2004/2005 survey data and are the result of my intensive fieldwork carried out in eight *seringais* (rubber estates) within three municipalities of the CMER: Assis Brasil (São Francisco, Icuriã, Paraguaçu), Brasiléia (Humaita, Porongaba, Filipinas) and Xapuri (São João do Iracema, Indêpendencia). *Seringais* were chosen with the assistance of reserve leaders, and were stratified based on traditional extractive orientation versus non-traditional market

orientations. The survey data were collected over almost two years of intensive fieldwork in the CMER between January 2003 and July 2005. A total of 149 household interviews were completed within the eight *seringais* by the author and field collaborator, J. Vadjunec, in conjunction with a local non-governmental organization (NGO), the Group for Research and Extension in Agroforestry Systems in Acre (PESACRE). Each interview took about three hours to complete, and contained open-ended and structured questions regarding specific land-use production and sale of agricultural and extractive products, small animal and cattle production, as well as specific questions regarding prospective scenarios, motivations for cattle ranching. Additionally, I gathered detailed data regarding labor and capital investments, as well as off-farm income from wage labor, government jobs, and social services. I also collected information about household characteristics and history such as household composition, gender, age, origin, wealth, and access transportation and markets. Finally, I recorded opinions of the householders' perceived advantages and disadvantages as residents of an Extractive Reserve, past and current roles of social movement organizations and potential development projects for improving householders' well-being.

Field research in these *seringais* required intensive fieldwork and comprised several interwoven activities. Field trips last for 8-12 days at a time with overnight homestays, which always facilitated the application of a mixed-methods quantitative and qualitative approach. The qualitative approach involved observations and informal conversation about controversial issues over land-use preferences, government agencies and institutions, and economic, social, political opportunities and constraints faced by residents of the CMER, as well as others aspects of daily life in the seringal. These conversations often provided important insight for the structured questions on the questionnaire. Various aspects of these mixed-methods approach inform each of

the three stand-alone articles. A series of quantitative methods are employed for data analysis, and qualitative information is used to provide a richer basis for the interpretation. The data were entered into an excel database and a codebook was created to facilitate statistical analysis with SPSS program. In the codebook, approximately 400 variables were defined. More specific details about the survey and methods of data analysis can be found in Chapters 3, 4, and, 5. A copy of the questionnaire utilized for the 2004/2005 household survey is provided in appendix C.

Remote Sensing

Linking remote sensing and social sciences is increasingly important due to its potential to understand processes of land-cover change over time and their relationship to socio-economic transformations on the ground. Remote sensing techniques were performed to address environmental implications of livelihood transformations on forest landscapes by explicitly looking at land-use change trajectories taking place in the CMER. Satellite imagery was used to analyze the amount and rates of forest change at the 30m pixel level in the study areas using a hybrid classification approach developed at the Anthropological Center for Training and Research on Global Environmental Change (ACT). Landsat 5-TM and 7-ETM+ imagery was obtained during the dry season (June-September) for 1986, 1992, 1996, 1999, and 2003. The remote sensing portion of the research is part of an on-going collaboration with J. Vadjunec, and was therefore carried out on the "footprint" level for Row 02/ Path 67 and Row 03/ Path 67. The remote sensing portion of this research informs the land-use paper. Details can be found in chapters 4.

Structure of the Dissertation

This dissertation is presented as four separate papers (Chapters 2-5), presented in publication style for submission to academic journals. Each paper is therefore a stand-alone document, addressing different aspects of ERs and forest dweller issues, utilizing both unique

and overlapping methodologies. Preceding these articles, the current chapter (Chapter 1) provides an introduction to the research problem and questions, an overview of the research site, and an overview of methods of data collection. It also outlines the theoretical foundations supporting the dissertation highlighting the debate of people-based models of conservation, in which the ER model has featured as a principal strategy, but could be undermined by cattle ranching, which is considered the main driver of land-use change in Amazonia, transforming landscapes and traditional livelihoods systems. Chapter 6 presents the main conclusions of this dissertation and explores further directions for research focused on Amazonian ERs and their inhabitants. Collaborations, co-authorship, and target journals are explained below, followed by a summary of each article.

The first article (Chapter 2), "Evolution of Extractive Reserves as a Conservation and Development Strategy in the Brazilian Amazon" is the result of on-going research I started as a TA for the class "Environment, Development and Social Movements: An Amazonian Perspective," taught by visiting professor Dr. Mary Allegretti at the Center for Latin American Studies at UF. In cooperation with other professors (e.g., Marianne Schmink, Christopher Baraloto) we established a group of researchers interested in Extractive Reserve issues, called the "Extractive Reserve Network" (http://reservasextrativistas.blogspot.com/). I created a database of information about ERs in Amazonia, and this chapter is a result of this effort. Drs. Marianne Schmink, Mary Allegretti and Christopher Baraloto are co-authors. Target journals are *World Development or Development and Change.*

The second article (Chapter 3), entitled "Adoption of Cattle Ranching Among Colonist Smallholders and Forest Extractivists in the Brazilian Amazon: Historical-Cultural Contrasts and Economic Explanations," is also led by me with co-authorship by Dr. Stephen Perz and Dr.

Jacqueline Vadjunec, which resulted from my participant in projects coordinated by Dr. Perz in Amazonia. We analyze cattle ranching by two different groups of rural groups - smallholder colonists and forest extractivists, combining our empirical research sites in two distinct part of Amazonia. Target journal is *Economic Geography*.

The third article, (Chapter 4) entitled "Land-Use / Land-Cover Change Among Rubber Tappers in the Chico Mendes Extractive Reserve, Acre, Brazil," is the result of an on-going collaboration on land-use land-cover research with Dr. Jacqueline Vadjunec, initiated while we both were developing doctoral field research in Acre (Gomes et al. 2004). First a doctoral student at Clark and then a professor in the Department of Geography at Oklahoma State University, Dr. Vadjunec and I developed our field research together and combined efforts on field surveys, database and land-use land-cover analyses in the CMER. We also shared ideas, collaborated with local institutions to generate results for local needs, and committed to publish papers together as a result of our joined dissertation efforts in the field. Dr. Vadjunec took a lead role on this paper and I am a second author. An early version of this paper was presented as a chapter of her dissertation (Vadjunec 2007) and a reviewed version was recently (06/08) submitted to the *Journal of Land Use Science*.

The last stand-alone paper (Chapter 5), "What Makes a Rubber Tapper in Southwestern Brazilian Amazon?: Cultural, Livelihoods and Institutional-Organizational Factors Underlying Self-Definition," is also a result of the collaboration (described above) with Dr. Jacqueline Vadjunec and Dr. Stephen Perz, both of whom are co-authors to my lead authorship, due to our shared interest in the intriguing question we have debated together about the idea of what it means to be a rubber tapper in Amazonia today.

As noted, this dissertation is the result of a collective effort, with contributions from my professors at UF and colleagues in the field from whom I have been fortunate to have the opportunity to share ideas and collaborative possibilities that have greatly improved the quality of this dissertation.

Evolution of Extractive Reserves as a Conservation and Development Strategy in the Brazilian Amazon. The Brazilian Amazon contains the largest remaining contiguous forest in the tropics, but it also faces strong development pressures and one of the highest rates of deforestation in the world. In the nearly 20 years since the murder of rubber tapper leader Chico Mendes and the subsequent creation of Extractive Reserves, ERs are alive as a conservation and development strategy that strives to secure lands for forest-dependent smallholders and stem the advance of large-scale deforestation. To date, 64 federal and state ERs have been created in the Brazilian Amazon, spanning over 12 million ha. Despite two decades of ER implementation and its centrality to people-based conservation, there has yet to be a region-wide analysis of this model. In order to fill this gap, we analyze the Brazilian ER experience, showing the growth of ERs over time by state. We emphasize the first and second waves of ER policies in the Brazilian Amazon, documenting the land area in each state under ER protection and focusing on the federal and state-level political and institutional dynamics that may have favored or limited the growth of the ER model. Although ERs have an impressive lineage and remain in the spotlight of environmental policy debates in Brazil, challenges exist to combat continued pressure at development frontiers. This paper contributes for understanding the current condition of the ER model and provides lessons for its future implementation in the Brazilian Amazon.

Adoption of Cattle Ranching Among Colonist Smallholders and Forest Extractivists in the Brazilian Amazon: Historical-Cultural Contrasts and Economic Explanations. In

recent years, the growth of cattle ranching among small-scale agriculturalists in the Brazilian Amazon has become a focus of policy debates about how to control deforestation. This paper engages this debate by addressing the shift toward cattle ranching by two historically contrasting social groups in the Brazilian Amazon: small-farm colonists and forest extractivists. We performed a comparative socio-economic study across space and time in two Amazonian municipalities: Uruará, in Pará state, comprised primarily of colonist farmers, and Xapuri, the birthplace of the rubber tappers movement in the western state of Acre. These two populations differ greatly with regard to their livelihood strategies, due in part to their geographic locations and distinct histories and cultures. Survey data from 1996 and 2002 were analyzed for 250 colonist households in Uruará, and from 2000 and 2004 for 150 households in Xapuri. Results reveal some similarities between colonist households and forest homesteads, including family size and association membership, but also differences, such as longer durations of residence in the older eastern frontier in Uruará. Although cattle ranching appear to be more predominant in Uruará when measured in pasture area and cattle herd size, there has been a recent expansion in cattle ranching at both sites: area of pasture increased by 20-30% in both Uruará and Xapuri over the respective study periods. However, in Xapuri the size of cattle herds rose by 200%, whereas in Uruará herds grew by 60%. These findings show that to promote sustainable development in the Amazon, policy makers will need to have greater understanding of cattle ranching dynamics among different smallholder groups, particularly ranching activity incentives for forest extractivists.

Land-Use / Land-Cover Change Among Rubber Tappers in the Chico Mendes Extractive Reserve, Acre, Brazil. The Extractive Reserve System is championed as a win-win model of sustainable development in which rubber tappers serve to protect the forest, while

improving economic growth and resident well-being. Recently, reserves are being questioned in terms of their environmental sustainability, as many rubber tappers increasingly turn to market agriculture in times of economic duress and instability. This study explores land-use /land-cover change (LUCC) in six rubber estates within the Chico Mendes Extractive Reserve, using both remote sensing analysis and household surveys, and addresses the differences in deforestation by livelihood trajectories. A remote sensing analysis between 1986 and 2003 shows that some communities are close to surpassing the allowable limits of deforestation. Rubber tapping plays less an important role in livelihood strategies, as welfare is linked to non-extractive activities. Households pursue diverse livelihood activities including extractivism, small-scale market cultivation, animal rearing, and cattle production. The results suggest that LUCC is highly dynamic in the reserve.

What Makes a Rubber Tapper in the Brazilian Amazon?: Cultural, Livelihoods and Institutional-Organizational Factors Underlying Self-Definition. The Brazilian Extractive Reserve System has been promoted as a sustainable development alternative for traditional rubber tappers. This paper explores how land-use, socio-economic and institutional dimensions within the Chico Mendes Extractive Reserve (CMER) impact traditional rubber tappper self-definition. We draw on household survey data to construct statistical models of who self-identifies as a rubber tapper, and employ qualitative information from key informant interviews to substantiate our interpretations of the models. The quantitative results reveal that larger size of land-holding, greater knowledge of management rules, and participation in community activities make identification as a rubber tapper more likely, while more recent occupancy in the CMER and involvement in the official movement have a negative impact on identification as a rubber tapper. The qualitative findings indicate that rubber tapper self-definition is a complex and ever-

changing idea, created over time, but strengthened at the height of the rubber tapper's movement in the 1980s and continuously evolving as land-use and livelihood issues continue to emerge.

Extractive Reserve and the People and Parks Debate

ERs represent one of the few models that are created not *despite* local people but *because* of them, being premised on and legitimized by the presence of local people and their social institutions (Ehringhaus 2005). ERs therefore lend themselves especially well to an analysis of people-based conservation that aims to secure resource access and local livelihoods as well as conserve natural resources. ERs have been a critical productive conservation strategy used by the Brazilian government and a preferred approach by the social movement, particularly in development frontier regions.

Despite its appeal and the large scale of impact of ERs, the model generated a polemic debate among promoters (Allegretti 1989; Allegretti 1990; Allegretti 1994; Anderson 1992; Clay 1992; Daly 1990; Schwartzman 1989; Schwartzman 1992) and critics of the model (Browder 1990a; Browder 1990b; Browder 1992a; Browder 1992b; Homma 1989; Homma 1992; Homma 1993; Salafsky et al. 1993) from the moment of its conception. More recently, ERs have also featured in the resurgence of the global debate regarding the legitimacy of indigenous and other local populations as stewards of protected lands (Oates 1999; Pimm et al. 2001; Terborgh 1999; Terborgh 2000; Wilkie et al. 2006), the impacts of protected areas on local communities (Adams 2004; Brockington et al. 2006; Cernea & Schmidt-Soltau 2006; Chapin 2004; Hutton et al. 2005; Schmidt-Soltau 2004; Schmidt-Soltau & Brockington 2007) and the conservation value and effectiveness of human-inhabited protected areas (e.g., Nepstad et al. 2006a; Schwartzman et al. 2000b; Schwartzman & Zimmerman 2005).

Within this context, ERs have been repeatedly used to illustrate points both by supporters of people-based conservation (Campos & Nepstad 2006; Schwartzman & Zimmerman 2005;

Schwartzmann et al. 2000a; Schwartzmann et al. 2000b), as well as defenders of more strict conservation areas (Redford et al. 2006; Redford & Sanderson 2000; Sanderson & Redford 2004; Terborgh 2000). Yet, the global debate continues to be highly dichotomous, with repeated cycles of "irresistible dialectic" (Redford & Painter 2006) pitting strict conservation on the one hand against human wellbeing on the other.

On the one hand conservation biologists argue that people-oriented approaches to conservation have largely failed to achieve their main goal - the protection of biological diversity - and advocate for increased efforts towards creating large areas for strict protection of biodiversity (e.g., Brandon 1998; Kramer et al. 1997; Oates 1999; Peres 2005; Terborgh 1999). These authors have embraced the demystification of ecologically friendly local communities and argue that increased population pressure, access to technology, as well as cultural and economic changes have led to practices that are less environmentally beneficial. These arguments clash with defendants of indigenous and local people's land rights (e.g., Brosius 2004; Ghimire 1994; Schmidt-Soltau & Brockington 2007; West et al. 2006; Wilshusen et al. 2002) and of the conservation value of human inhabited areas (Colchester 2000; Nepstad et al. 2006a; Schwartzman et al. 2000a; Schwartzman et al. 2000b). Defenders of indigenous and other human-inhabited area argue that protectionists undervalue the political strength of grassroots organizations to demand conservationist policies (Schwartzmann *et al.* 2000b) and ignore key social aspects of social and political processes that shape how conservation interventions happen in specific contexts (Wilshusen *et al.* 2002). These critics also argue that this approach neglects not only the history of local communities but also the history of the landscape in which people play a central role. Many authors stress the large-scale conservation value of indigenous areas, ERs, (Goeschl & Igliori 2004; Nepstad et al. 2006a; Peres 2005; Schwartzman & Zimmerman

2005) and other human-inhabited areas including private lands (West & Brockington 2006), although some of these authors tend to downplay the potential environmental impacts of rural communities through hunting, small-scale logging and agriculture. Specifically hunting has been the focus of the debate for the critics who are mostly concerned with effects on game, while defenders argue that these human-inhabited protected areas are avoiding much larger problems, such as deforestation.

The strong divide between hopeful promoters and cynical opponents of ERs erected steep walls of dichotomies between 'saving' and 'losing' the tropics and between 'success' and 'failure' (Browder 1990b; Salafsky *et al.* 1993), leaving little room for the discussion of intermediate possible outcomes and complex realities in which conservation and development efforts are situated. Recognizing the common goals of fighting against the larger threats from extensive agriculture, industrial forestry, plantation establishment, and broad–scale fires to both biodiversity and marginalized forest dwellers, authors are increasingly trying to escape this highly dichotomous debate (Redford & Painter 2006) around whether people should be included or excluded from protected areas.

An interdisciplinary middle-field is emerging that addresses the social, political, cultural and ecological complexities and contradictions in conservation and development efforts and attempts to eschew extreme simplifications (Berkes 2004; Brosius 2004; Redford & Brosius 2006; Redford & Painter 2006; Redford et al. 2006; Sanderson & Redford 2004; West & Brockington 2006). Those critical analyses of both conventional and community-based conservation are moving towards a more differentiated understanding of social-ecological interactions and the inevitable trade-offs between human use and biodiversity conservation and the equitable distribution of both benefits and costs of conservation.

While opinions on ERs on this debate have always been strong, few publications (Brown & Resende 2000a; Brown & Resende 2000b; Ruiz-Perez et al. 2005) have actually included on the ground, empirical research that evaluates ERs and only one looked at ERs in a comparative context (Nepstad *et al.* 2006a). Most of the protagonists of the large debates have never conducted research in ERs and base much of their argumentation on both outdated information and scientific hearsay, resulting in selective and skewed representation. Also, the recent debates of ERs refer almost exclusively to pre-extractive reserve papers (Ehringhaus 2005), not taking in account the now 20-year history of ERs and the significant changes in the process. In view of this dearth of published information and the influence that ERs had on people-based conservation debates, an update of the current state of the ER model is long overdue and critical for further discussions in the broader context of the 'people and parks debate'.

More recently, a significant body of literature representing a diversity of themes based on empirical studies has slowly documented the transformations of the ERs, revisiting old themes and emerging challenges surrounding forest dwellers' economic and forest resource management practice through the ER experience in Amazonia. Some of those aspects include transformation of traditional livelihoods strategies in ERs, and how these changes affect traditional livelihoods systems (Gomes 2001; Souza 2006; Wallace 2004); ecology and management of non-timber forest products, especially brazil nut, given its socioeconomic importance for ERs areas (Cotta et al. 2008; Kainer et al. 1998; Kainer et al. 2007; Wadt et al. 2005; Wadt et al. 2008); community-based timber management as an emerging economic option surrounding forest extractivist livelihoods strategies (Humphries & Kainer 2006; Rockwell et al. 2007a; Rockwell et al. 2007b; Stone 2003); in addition to the broader context of how changes in the larger political-economic context have affected rubber tappers in ER, the roles of grass-roots institutions in ER

management and governance, government incentives and political empowerment (Ehringhaus 2005; Vadjunec 2007).

Most of those studies have been carried out on the first ERs created; the ERs that played a pivotal role in the people-based conservation debate. As so, those empirical studies are significant not only to inform the main protagonists on the debate but also to provide a more realistic picture of transformations and rules that ERs have played out over the 20-year as a strategy for conservation and development of Amazonia. As ER area has increased significantly in recent years, it encompasses a diversity of populations with a variety of forest-based livelihood systems, a range of ecological niches and varied state political contexts. In this context, there is a great need for further research on ER areas and to synthesize the contribution of the diverse empirical studies carried out more recently and how they contribute to the needed region-wide analysis of the evolving ER model. Chapter 2 of this dissertation is an effort in that direction, as it analyzes the growth of ERs over twenty years, drawing on an analysis of the evolution of the model and discussing the diverse contexts in which ERs have been implemented in Amazonia. Chapter 3, 4 and 5 analyses emerging themes related to livelihoods transformations and land-use land-cover changes within the Chico Mendes Extractive Reserve as issues of central importance for the ER debate due to their potential lack of harmony with both the theoretical underpinnings and ecological sustainability of ER.

CHAPTER 2
EVOLUTION OF EXTRACTIVE RESERVES AS A CONSERVATION AND DEVELOPMENT STRATEGY IN THE BRAZILIAN AMAZONIA

Introduction

Brazil, as owner of both the largest portion of the world's rainforests and the highest absolute deforestation rate, is *de facto* a leader in both conservation and destruction of these forests. The state of Acre in the southwestern Brazilian Amazon is the birthplace of the rubber tapper movement, which originated in the late 1980s when a group of rubber tappers fought to protect their land against encroaching large scale cattle ranchers. This was the first grass-roots movement in Brazil to advocate conservation of Amazonian forests through the establishment of Extractive Reserves (ERs). ERs are forest areas inhabited by extractive populations granted long-term usufruct rights to resources which they manage (Allegretti 1989). Chico Mendes was the major force behind the movement and because of his campaign against forest destruction, he was killed by cattle ranchers in 1988. The creation of ERs as one of the first formalized systems of people-based protected areas in the Brazilian Amazon has marked an unprecedented success of both social movement mobilization and environmental policy-making in the Brazilian Amazon (Allegretti 1994; Schwartzman 1989), and has been promoted as a major strategy for forest conservation while simultaneously providing sustainable economic returns to local people.

Twenty years since the assassination of Chico Mendes and creation of the first ERs in the region, the model has gained a solid foothold in Amazonian forest policy, while at the same time evolving and diversifying significantly beyond the original concept. The question of what happened after establishment of first ERs is complex and needs to be addressed in a contemporary context. Since the creation of the first ER in1990 in the Western Amazon state of Acre, ERs today encompass a great diversity of populations, with a variety of forest-based livelihood systems, and living in a range of ecological niches and under varied state political

contexts. The model has been implemented in all Amazonian states as both federal and state level strategies, which have been used at different points in time and undergone important changes. More importantly, the ER model still maintains its key principal of land conflict resolution and has become a major land tenure strategy advocated by different socio-cultural groups in distinct Amazon ecosystems. ERs, are one of the few models created not *despite* local people but *because* of them (Ehringhaus 2005). More than in any other conservation and development approach, ERs are premised on and legitimized by the presence of local people and their social institutions.

Environmental legislation in Brazil has dramatically improved over the last few decades. The creation of ERs represented a huge change in environmental law in the Brazilian Amazon, and environmental legislation, governance and major governmental investment in conservation has improved substantially in the region with innovative policies observed at both federal and state levels. While the Brazilian national government takes a broad approach for conservation and development issues and has developed a major program for creating and supporting conservation units, state governments have specific development and environmental agendas that have both constrained and supported the ER model in the region. As federal and state environmental policies are increasingly integrated in the Brazilian Amazon, it has become important to understand how the ER model has evolved at different scales, and what role ERs have played in a more comprehensive conservation and development policy in Amazonia. Although considered a victory for forest dwellers, the evolving ER model has been fraught with challenges, and political support is key to its long-term success.

In view of almost two decades of existence of ERs, an analysis of their evolution and an update of the current state of the ER model is long overdue and critical for the further

discussions of the implication of current outcomes for continuing ER policy in the region. In this article we use a political ecology approach to explore what is happening in ERs by focusing on the evolution of the ER model through a multi-scale analysis at the federal and state levels. We offer an analysis of ERs evolution and a discussion of the political and regional development dynamics of each Amazonian state. We analyze how the ERs have evolved in light of social movements and political support that have favored or constrained the establishment of ERs in each state.

Evolution of the ERs Establishment: Contemporary Importance

Since the establishment of Brazil's first ER on the Upper Juruá River in Acre, the western most state of the Brazilian Amazon, the concept has spread east throughout the entire Amazon, stretching to the mouth of the Amazon River and the Atlantic coast in Pará. The first ER, Alto Jurúa, was created by presidential decree, imbuing it with a "special" status. The federal decree number 98. 987 (01/30/1990) was the first legal instrument to recognize ERs in Brazil, in which there was a co-management of the ERs by the Brazilian government and the resident associations, regulated by a Utilization Plan. The legal instruments of ER management evolved to the broad environmental regulatory law that now includes all conservation units in Brazil. In 2000, the National System of Protected Areas law (SNUC - law 9.985) was created, bringing together the diverse models of protected areas at the federal, state and municipal levels. These units were classified by two major categories: 1) the "strictly protected" model, with biodiversity conservation as the principal objective; and 2) the "sustainable use" model, which allows for varying forms and degrees of exploitation, and has biodiversity protection as a secondary objective (MMA 2000; MMA 2002; Rylands & Brandon 2005; Silva 2005).[1] The SNUC law

[1] The "strictly protected areas" (as defined by SNUC) include national parks, biological reserves, ecological stations, natural monuments and wildlife refuges. There are 111 of these federal areas totaling 28, 245.720 ha (42% of all

clearly differentiates when specific protected areas should focus on preserving areas of high biological importance or satisfy social demands, especially as development frontier expands in the Amazon. The terms "strictly protected" or "sustainable use" are also substitutes to the terms used before creation of the SNUC law: *conservation units of indirect use* (strictly protected) versus those of *direct use* (sustainable use). The ERs fall under the direct use model, or as some prefer to label them, "people-based conservation model". The SNUC law is innovative in its establishment of management plans and deliberative councils as the major instruments for regulation and decision making within ERs. These mechanisms bring together a diverse set of local and regional stakeholders, which provides a broad development perspective, but also diminish the role of local ER communities in resident associations.

From their conception, ERs have redefined the conventional goals of conservation. Over time, their implementation has brought local people to the forefront of conservation in protected areas and led to a restructuring of the national and state environmental institution apparatus, establishing the *traditional peoples* category as legitimate stakeholders in environmental policy and conservation strategies. The ER model has faced strong opposition, especially during its initial stages. The most strident critiques of ERs were produced by Browder (1990a; 1990b; 1992a; 1992b) and Homma (1989; 1993), and continue to be cited as grounds for criticism, despite the lack of updated information. Despite criticism, for the initial strongest proponents of the ER model, the Brazilian anthropologist Allegretti (1989; 1990; 1994; 1995) and the American sociologist Schwartzman (1989; 1991; 1992) who publicized the rubber tapper's

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federally protected areas) "The sustainable use areas" include environmental protection areas, areas of particular ecological interest, national forests, extractive reserves, fauna reserves, sustainable development reserves, and private natural heritage reserves; there are 141 federal protected areas for sustainable use totaling 30,194.984 ha or 58% of all federally protected areas (Rylands and Brandon 2005; Silva 2005). Those numbers show a balance in terms of area protected between those two categories. But there is a major difference when they are compared across biomes of the country, especially in the *Pantanal*, the *Cerrado* and the Atlantic Forest. Only in Amazonia is there an approximate balance between strict (49%) protection and sustainable use (51%) (Rylands and Brandon 2005).

cause, ERs continue to represent a very vibrant example of a innovative policy that balances conservation and development among traditional communities (Allegretti 2002; Schwartzman & Zimmerman 2005).

ERs were first thought of as a federal model of agrarian reform while promoting conservation. But soon after the first federal ERs were created, a state-level approach was created following the same principles as the federal model. The principal difference in the approach concerned the institutional arrangements for establishment and monitoring of ERs. While the federal ERs are created by presidential degree and the Ministry of the Environment plays a major role in their administration, State ERs are created by state governments with approval of the State House of Representatives. Both approaches, however, depend on the mobilization of social movements and their capacity to negotiate at both state and federal political arenas. In both cases, local political will is necessary to stabilize the ER.

In the Brazil Amazon, the ER model has paved the way for the creation of other people-based protected areas, as well as hybrid land tenure models (Ehringhaus 2005), that are being implemented by various institutions at both the federal and state level, and respond to changing political contexts and opportunities. These sustainable-use protected areas include marine ERs (in Amazonia and along the Atlantic coast of Brazil), Extractive Settlement Projects (PAE) which are forest-based, land reform areas that preceded ERs, Sustainable Development Reserves (RDS), Sustainable Settlement Projects (PDS) and more recently Forest Settlement Projects (PAF). Although the ER model associated with the Brazilian Institute of Environmental Protection (IBAMA) the implementation arm of the Ministry of the Environment (MMA), is still the most well-known type of sustainable use areas, today many state and federal institutions, including the National Agrarian Reform Institute (INCRA) of the Brazilian Ministry of Agrarian

Development (MDA), are involved in the architecture of institutional arrangements in defining and creating new sustainable use areas. In 2007, the MMA created the "Chico Mendes Institute" a government branch responsible for creating and managing all conservation units in Brazil, which seems to be a clear demonstration of the role ERs have played in influencing conservation policy in Amazonia, and demonstrates the political empowerment of grassroots social movements in the region. Despite the institute's naming after a rubber tapper martyr, the transformation of the ER model to a governmental institution can also be seen as a confused mix of government and social movement partnership configurations.

Furthermore, the ER model has been expanded and been applied to a diverse range of ecological and social contexts. It has moved beyond forest environments to riverine floodplains and marine ecosystems and now encompasses diverse social groups with distinct historical backgrounds. For instance, while originally only rubber tappers were entitled to ERs, today the concept has been applied to other extractivist rural workers in Amazonia. Given the increasing number of ERs of different types, there is a great diversity in size, population density and background, ecological and cultural context, livelihood strategies, social organization, market access and development pressure among the different ER sites.

Aside from proposing the ER model, the rubber tapper movement has evolved from being a movement of powerless workers to a powerhouse influencing both environmental policy and land reform with its activists operating in and contributing to local, regional and national governments, legitimizing its philosophy of social justice. Rubber tapper institutions are represented in Amazonian states and have helped to establish a broad network of rural worker's organizations, including the powerful *Grupo de Trabalho Amazonico* (Amazon Working Group),

created in 1992 with twenty grassroots organizations. Today, this group has over five hundred small organization members based on eighteen branches in Amazonia.

The rubber tapper movement's success has come as a result of its efforts to pioneer strategies to open new political spaces, create long-lasting partnerships with other social groups, to establish the successful and dynamic concept of ER, and develop the capacity and flexibility to adapt to diverse social and political contexts in Amazonia. In 2005, the rubber tapper movement celebrated twenty years, with the Congress of Extractivist Peoples of Amazonia. With the participation of over three hundred extractivists and representatives of a variety of institutions, the three-day meeting hold in Manaus focused on intense discussion about the experience and the future of ERs and other related protected model areas in Amazonia. Addressing old and new themes, the meeting addressed five central topics: (i) land tenure issues, (ii) production, credit and technical assistance, (iii) social organization and management, (iv) management plans, and (v) payment for environmental services. The discussion surrounding those themes demonstrates that in those twenty years, new and old challenges are intertwined within an agenda of a social movement still yearning for success, despite its accomplishment in those two decades.

Analytical Framework: A Political Ecology Multi-Scale Analysis

Advances and challenges to the ERs in Brazil have been the product of complex forces interacting over time at diverse levels. This complexity calls for a political ecology framework of analysis that considers the wide interactions of actors with each other and the environment (Bryant & Bailey 1997: 191). Political ecology acknowledges the human production of nature and political forces behind such production.

We present a multi-scale analysis of the ER model, focusing first on social movements that support them, as well as federal and state policies, international pressures, and how actors at

different levels interact in the creation of ERs. We take into account the changing dynamics of politics, policy, and social movement strength in explaining the different forms ERs have taking in different states at different moments in recent history.

Previous studies have shown the fundamental importance of social movements in creating the original ERs, as well as in proposals for other innovative social-environmental policies in Brazilian Amazonia (Allegretti 2002; Allegretti & Schmink forthcoming; Becker et al. 1990; Hall 1997). Our analysis therefore examines to what extent the implementation of ERs has been associated with strong social movements in different states at different periods.

Favorable political support at federal, state, and local levels, as they interact with international political pressures, also plays an important role in determining policy outcomes. We therefore play close attention to power relations and to the role of the state, over time, in promoting development initiatives that may directly or indirectly lead to success or failure of ER policy.

Many of the outcomes of Amazon development policy can be understood as the outcome of social conflicts and disputes over development models and practices (Schmink & Wood 1992). ERs were created because of people and have been implemented in a very politicized environment that often involved disputes and power relations among distinct political forces and social actors. The study therefore focuses on ERs as part of emerging negotiations among different interests regarding the future of Amazonian territories.

We explore the evolution of three key themes related to the political ecology of ERs in Brazil – social movement strength; political will at diverse levels, and emerging forms of negotiation – as they help to explain the evolution of ER policies in different Amazonian states over the past two decades. The findings suggest that ER policies have contributed not only to the

land tenure security of forest peoples in Amazonia, but also to the emergence of new forms of dialogue over Amazonian policy.

Data and Methods

We elaborated a database of ERs created in Amazonia from 1990 to 2007. Information for the database was collected through a variety of sources: requests for information from the Brazilian Environmental Institute (IBAMA) and state environmental agencies, attendance at local meetings and workshops, and review of the literature, news reports and data found on the internet. In addition, interviews with key informants were conducted, including government officials and social movement leaders. The database is composed of a series of information about ERs: year of creation, status/state or federal, size, location, population, main economic activities among others. Geo-referenced information (shape files) was also collected through online database of the IBAMA and database from the Institute for Amazonian Research (IPAM).

We analyze the evolution of ERs temporally, in addition to spatially across all states in the Brazilian Amazon. We first provide an overall cross state analysis of growth and distribution of ER. Then, we further disaggregate the data through examining time of ER creation focusing our analysis on temporal progression of ER implementation. We discuss the evolution of ER over three time periods: 1) First wave of ERs (1990-1995); 2) Transition period (1996-2000); and 3) Second wave of ERs (2001-2007).

Results

Cross State Analysis: Federal and State Extractive Reserves

The Brazilian legal Amazon, a concept created for economic development planning in the region, includes all states in northern Brazil, as well as the state of Mato Grosso and a portion of Maranhão. This corresponds to approximately 5 million km^2, which constitute 60% of the total Brazilian territory. As of January 2008, there were 39 federal Extractive Reserves in Amazonia

covering an area of almost 10 million ha and 25 state reserves covering approximately 2.4 million ha. This is a total of 64 ERs that encompass an area of more than 12 million ha in eight states of the Brazilian Amazon, as observed in Table 2-1. This figure, which shows the distribution of ERs by state, reveals the following: Acre has 5 federal ERs, Amapá has 1 federal ER, Rondônia has 22 state and 4 federal ERs, Maranhão has 4 federal ERs, Tocantins has 1 federal ER, Mato Grosso has 1 state ER, Pará has 17 federal ERs, and Amazonas has 2 state and 7 federal ERs. This figure shows a varying approach of ER establishment in the region, as observed through the creation of 22 state level ERs in Rondônia and 2 in Amazonas, as well as the creation of Marine ERs on the Atlantic coast of Pará and Maranhão states.

Moreover, this figure shows the absolute area under ERs in each state and what this represents in percentage of state territory. It reveals that the state of Pará with approximately 3.8 million of ha under federal ERs, has the highest absolute amount of land under ERs, followed by Acre with 2.7 million of ha of federal ERs. The states of Amazonas and Rondônia, which initiated the creation of ERs at the state level, appear with similar figures in terms of land protected under ERs, with 2.5 million and 2.4 million ha respectively. Nonetheless, Rondônia has the greatest amount of area under state level ER protection (over 1.9 million ha), while in Amazonas the vast majority of ER lands are federal (over 2.1 million ha). This figure changes when comparing which states have the highest percentage of their territory under ERs. The state of Acre, the birthplace of the ER model, appears with 17.7% of its territory in ERs, the largest percentage of all Amazon states, followed by the state of Rondônia with 10.1%, and Amapá with 3.4%. Those are all relatively small states in the Brazilian Amazon and where the ER model was first implemented, starting in 1990. Pará and Amazonas, with 3% and 1.6% respectively, on the other hand, are the two largest Amazonian states and only in the later 1990's did the ER model

expand to those states. These features do not allow for further discussion of the evolution and recent trends of ERs establishment in the region and thus require further disaggregation of the data through examining time of ER creation.

Table 2-1. Number and area of federal and state ERs in the Brazilian Amazon

Amazonia States	Level	Number	State area (%)	Area (ha)
Acre	Federal	5	17.73	2,704,353
Amapá	Federal	1	3.37	481,650
Rondônia	State	22	8.25	1,959,473
	Federal	4	1.87	444,011
Maranhão	Federal	3	0.09	29,628
	Marine	1	0.56	185,186
Tocantins	Federal	1	0.03	9,280
Mato Grosso	State	1	0.05	49,029
Pará	Federal	7	2.64	3,288,229
	Marine	10	0.36	443,451
Amazonas	State	2	0.23	367,339
	Federal	7	1.38	2,163,529
Sub-total	State	25	-	2,375,841
	Federal	39	-	9,749,317
	Marine	11	-	628,637
	Forest	53	-	11,496,521
Total		64	-	12,125,158

The Evolution of Extractive Reserves Policy: Three Stages

In this section, we focus on the temporal progression of ERs implementation throughout the Brazilian Amazon. Figure 2-1 shows the ages of federal and state ERs, and Figure 2-2 gives a temporal and spatial distribution of ERs across states over three times periods. The first wave of ERs (1990-95) is viewed as an innovative, bottom-up policy process that, despite the debate stemming from this conservation and development strategy, the potential of the ER model did not reach a large scale. The first wave period represented an initial push in 1990 and led to the creation of four federal ERs in three different states; two in Acre (the Upper Juruá River and Chico Mendes), one in Amapá (Rio Cajari) and one in Rondônia (Rio Ouro Preto), which cover approximately 2.2 million ha. After this first push, the total area of land under federal ERs

changed very little, despite the creation of four new federal ERs in two states in 1992. In the state of Maranhão, three small ERs were created, covering a total of approximately 30.000 ha, while in the state of Tocantins an ER of approximately 10.000 ha was created. The biggest change during those five years came with the adoption of the model to create the first state level ER in Rondônia, which in 1995 alone, created 22 state ERs covering approximately two million ha. Therefore, the first five years of ER experience were characterized by an initial push of establishment of four ERs in three different states, and an adaptation of the federal model, represented by the creation of state level ERs in Rondônia.

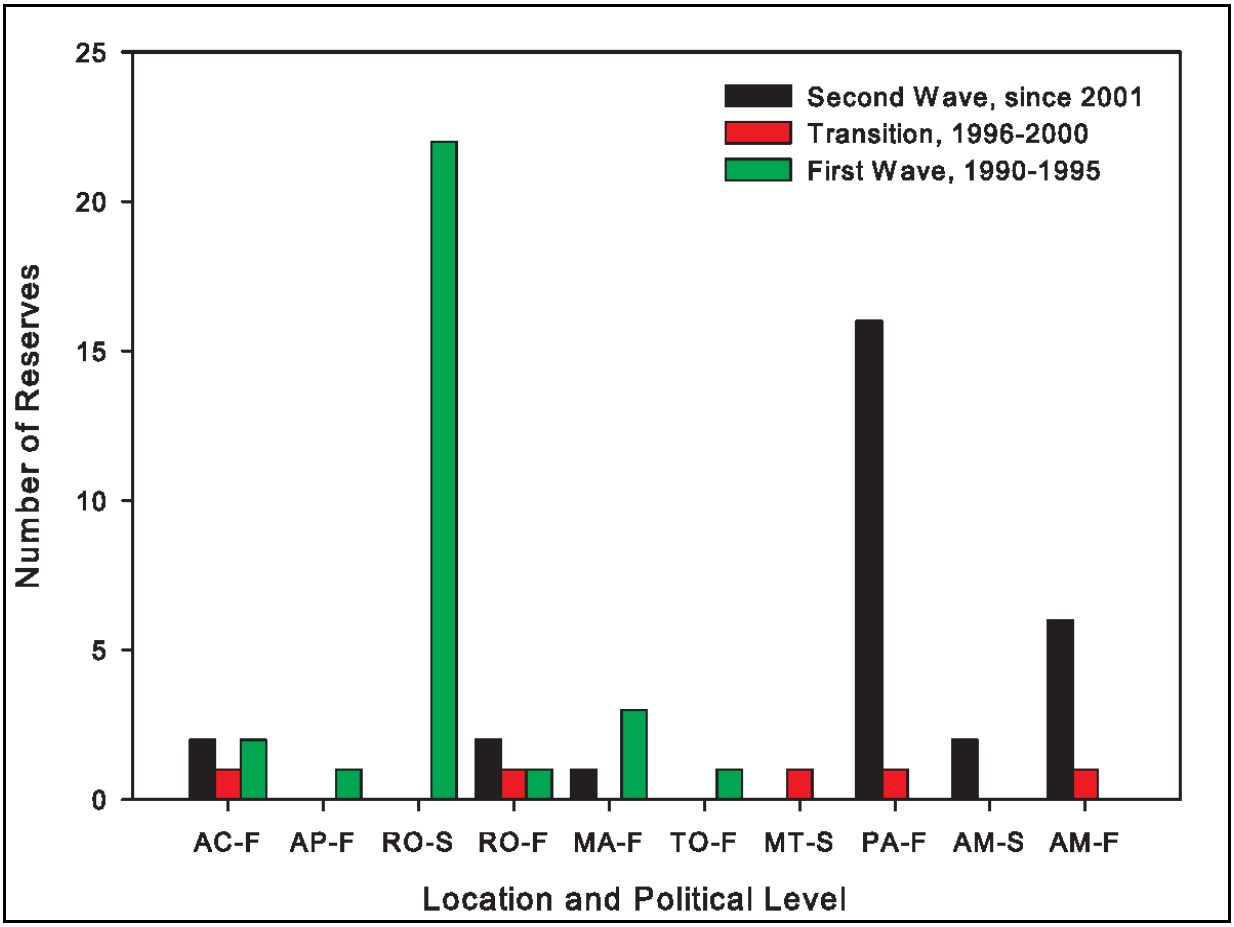

Figure 2-1. Number and age of federal and state extractive reserves in Amazonia: abbreviations of the names of Amazonian states are as follows: Acre-AC, Amapá-AP, Rondônia-RO, Maranhão-MA, Tocantins-TO, Mato Grosso-MT, Pará-PA, and Amazonas-AM. The F or S following the abbreviations stands for federal or state-level ERs.

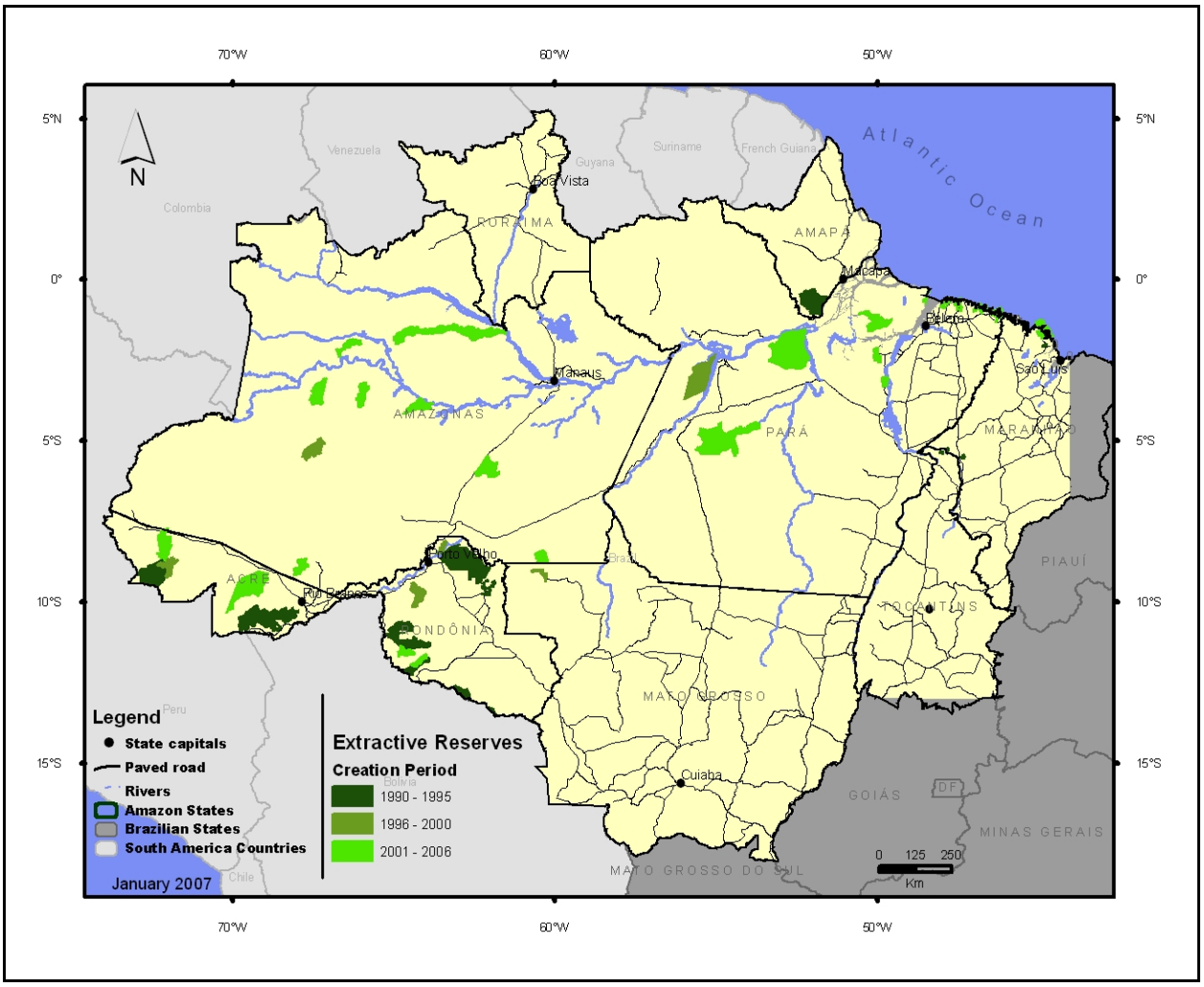

Figure 2-2. Spatial distribution and age of federal and state extractive reserves in Amazonia

During the transition period (1996-2000), an additional four federal ERs were created, covering an area of over 1.2 million ha. This period of ERs is characterized by the application of ER systems in the two biggest states in Amazonia where no previous ERs had been before. In 1997, the state of Amazonas created its first ER, Médio Juruá with an area of over 250 thousands ha. Then, in 1998, the 674,000 ha Tapajós-Arapiuns ER was created in the state of Pará. Another characteristic of this period was that in 2000, completing ten years of ER experience in Amazonia, the federal model was applied again in the first time in two of the states where it was first established, when the Alto Tarauacá ER with approximately 180,000 ha was created in Acre

and the Lago Cuniã ER with over 50,000 ha in Rondônia. This period is considered a transition, because there was little change in ER area in the first wave states, but the model began to be applied on the two largest states in the region, making a huge contribution to the expansion of the ER model during the following period. In the transition period, the social movements created an agenda for the broad application of ERs in the region. This was a period in which the concept spread and generated discussion among actors on multiple scales, from traditional communities to political decision-makers.

The second wave of ERs (2000-07) represented a huge increase in ER areas with the establishment of 29 ERs covering approximately 6.9 million ha of land. This represented an increase of over 50% land under ERs system on the previous two periods. During this period, only in 2007 were neither Federal nor State ERs implemented in the region, while in all other years there was significant establishment. 2003 represents the year in which the least amount of land (216,874 ha) was designated as ERs, with the implementation of only one state level ER in the state of Amazonas, and 2004 shows the highest amount with over 2.5 million ha of land designed as ERs. This represented an increase of over 1.1 million ha of land designed as ERs every year during this period. It can be observed that the state of Pará alone provided an important contribution to this large increase: 16 federal ERs were created covering an area of approximately 3.1 million ha. This included the creation of 10 Marine ERs in mangroves of approximately half million ha. Nine of Pará's ERs were created between 2005-07, representing more than half its total ERs thus far.

Following the trends of Pará state is the state of Amazonas, although with less extension. During the second wave period, there were six federal ERs created, covering an area over 1.9 million ha. In addition, Amazonas state took a state level approach, as formerly observed in

Rondônia and created two state level ERs, covering an area of 368,000 ha. This increase in ER land during that period was also a result of two new ERs established in Acre, Cazumbá-Iracema and the Riozinho da Liberdade, which were created respectively 2002 and 2005. This increased the state area under federal ER by over one million ha. Small changes were also observed in the state of Rondônia with the establishment of two small federal ERs in 2001, covering an area of 183,578 ha. Despite of almost two decades of ER experience in Amazonia, the average ER is only four years old, demonstrating that the concept has just recently taken off.

During this final period, we observe a widespread application of the ER model in the states of Pará and Amazonas, where the model did not originate, but incorporated the policy during the transition phase. It is also observed that ER concept gained differentiation in its application as seen through the creation of marine ERs in Pará. The approach of ER implementation was increasingly top-down despite continued engagement of the social movement in the process. This is likely a result of the popularization of ERs model at multiple scales, from regional grassroots organizations to governmental acceptance of the ER model as a productive conservation and development strategy for the region.

Current Trends: the First Wave States vs the Second Wave

Figure 2-3 shows that in seventeen years of ERs policy in the first wave states a total of 5,862,610 ha have been designated under ER, while the second wave states with one decade of ER policy history have reached a total of 6,262,549 ha of land under the ER system. While the concept is very much alive in the first wave states, such as Acre, the biggest expansion of the model took place in the second wave states, especially in the last six years. In terms of percentage of land under ER, the first wave states show a greater percentage than the second wave states. When it comes to absolute number of area under ERs, the second wave states have a greater number than the first wave states. This information gives us insight into future trends for

ER growth. It is unlikely that ERs will continue to grow in number in the first wave states, such as in Acre where almost 20% of its territory is under ER area. Time (almost two decades) and the political context in Rondônia give no indication of a continuing establishment of ERs in this state. The ER model in the small, first wave states could be exhausted, while in the second wave states, the model will continue to be considered. Despite the impressive advantage of absolute land area, the second wave states have recently created, especially in Pará, it is far below what the state of Acre has already done in dedicating a larger percentage of its territory under the ER system.

This discussion of ERs does not intend to infer about which state in the region has made a greater contribution to the system of conservation units in the Brazilian Amazon, but instead to compare where and when ERs have been demanded. For the former debate, a much broader perspective on all models of conservation units under the SNUC law would need to be taken under consideration. The ER system is a pioneer model under the "direct-use protected areas," however there has also been an advancement of "strict protected areas" in the region (Silva 2005, Rylands and Brandon 2005, Ribeiro et al 2005, and Borges et al 2007). However, under the "direct-use protected areas" the ER system as a pioneer has paved the way for the creation of other direct use conservation unites. In this context, if ER is not exactly the choice model of direct conservation units in some states, it provided the foundation for the creation of several other conservation unit models in the region. This is an important advantage of the ER system, but can also represent a loss for what ERs predict for sustainable use of forest resources. The state of Amazonas, for example, has made an important contribution in the expansion of the Sustainable Development Reserve (SDR), which was created under the foundation of the ER system, with a focus on state level initiatives. Since 2003 the state of Amazonas has created

seven SDRs covering an area of approximately 4.7 million ha of forest. This represents an area 86% bigger than all the federal and state level ERs in the state, although the ER system has a longer history in the state. This is a clear demonstration that the ER model is not the only option available, and that there is a competition of "direct-use protected areas" occurring and that state governments in the region are also making political choices for designation of a specific model.

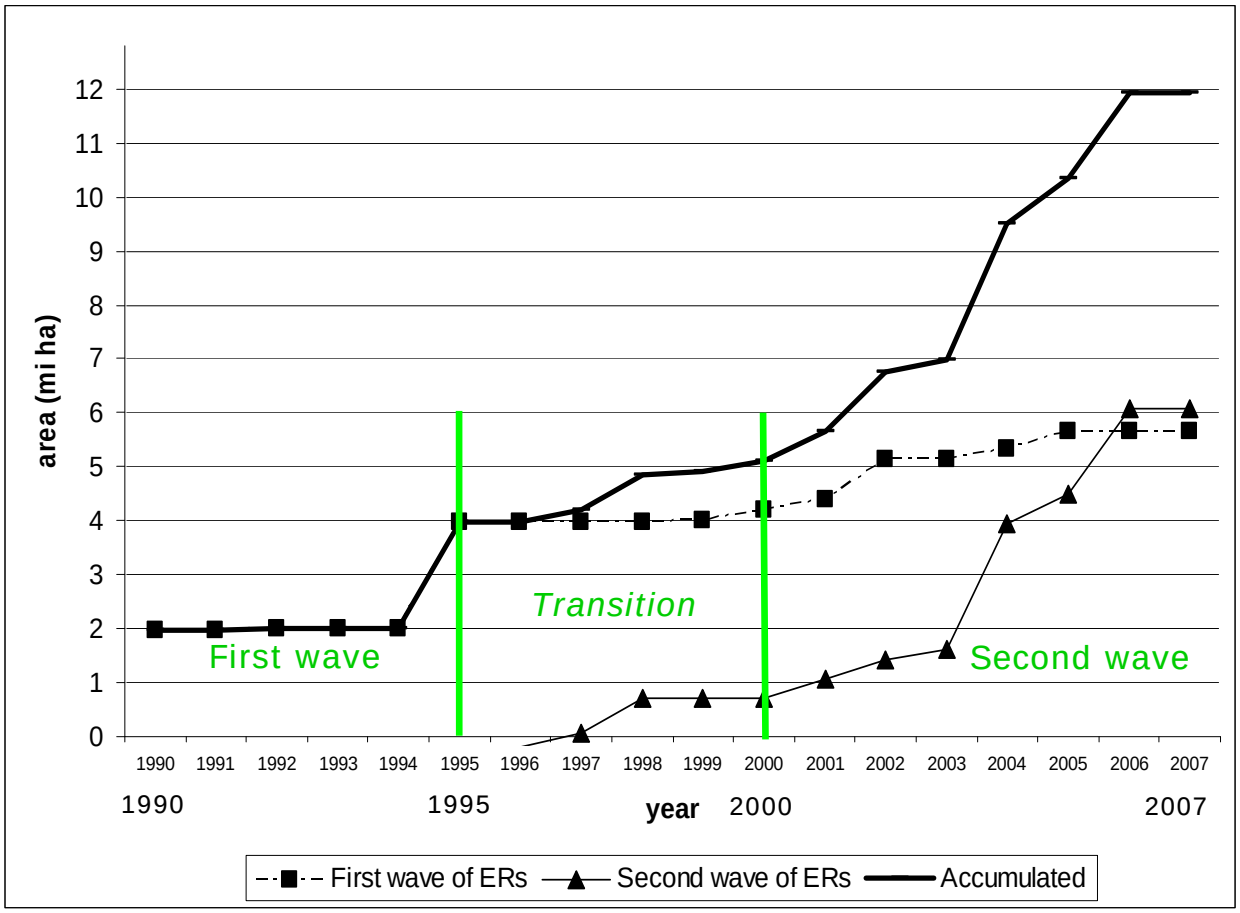

Figure 2-3. Evolution of land under ER in the first and second wave states of ER system

Regional Development Dynamics' Favoring or Constraining ER

The ER model was initially implemented in the first wave states due to land use conflicts provoked by sponsored government programs. While in Acre, the state government promoted the occupation of former rubber tapper estates to migrant cattle ranchers from southern Brazil, Rondônia was under alarming deforestation rates and land conflict with indigenous peoples and

rubber tapper population due to the paving of the BR-364 highway funded by the World Bank. Meanwhile, on the opposite side of the Brazilian Amazon, Brazil nut collectors in Amapá were being threated by "project Jari," a major cellulose production project in the southern portion of the state where the greater majority of rural households as well as the greater expanses of Brazil nut groves were located – the major forest extractivist product in the state. Of the three first wave states of ER establishment, Acre has shown the strongest commitment to the ER policy. While the ER policy has evolved over the past 15 years, in Rondônia it shows there was only a brief period of ER establishment, as well as in Amapá, where the establishment of ERs did not evolve at all.

The political success of the rubber tapper movement in creating the concept of ERs transformed politics in the state of Acre. Jorge Viana, a forester and one-time close adviser to Chico Mendes, was elected governor in 1998 and reelected in 2002. In the last decade, Acre government launched innovative policies to strengthen the extractivist economy within the state (Kainer et al. 2003). Support of ERs are a major component of goverment approach, and thus from 2000 to 2006, a new cycle of establishment of ERs blossomed as three new federal ERs were created. Acre's forest government highlighted the social component of local and regional development, as evidenced in the government's innovative forest conservation and development paradigm – "Florestania" or forest citizenship, built around a recognition and appreciation for local knowledge systems. Acre policies greatly increased representation of forest peoples in regional politics, involved rubber tappers and other extractivists populations more directly in the administration of forest resources and development initiatives, and integrated rubber tapper culture into regional society, creating a spirit of participation, collaboration and social awareness of what is becoming a shining example of governance sparked by the movement initiated by

Chico Mendes. It is fair to say that Acre exemplifies the most vivid scenario of the ERs model in the Amazon. It is unlikely that the focus of the new policies will be in creating new ERs areas, but rather to improve livelihood conditions of the extractivist population living in established areas.

Rondônia took steps of not only becoming the first state to adopt the state-level ER approach, but also designated a relatively larger area for this first initiative. In Rondônia, this initial government policy apparently demonstrates that the Rondônian state government of the mid-1990s was committed to the development goals of ERs. One must ask what factors in political development brought about this remarkable course of action, since then there has been no indication of continuity in the process of the establishment of reserves.

These state ERs were created in the context of the Planafloro Program (1993-2002) which was funded by the World Bank as a response to previous major investments by the Bank that had major environmental and social impacts in the region[2]. The major goal of the program was to protect biodiversity through a zoning program and create a diverse system of conservation units: the state ERs were one of the models proposed by the social movement.

The option for state-level reserves was also a source of debate; even though the areas designed for the state reserves were federal land, the decision to state-level approach was due Federal ER would take longer to be implemented and grassroots organization could lose the political momentum of social movement pressure supported by external donors on the state government for the legal designation of those areas. By adopting an innovative state-level model, the local social movement guaranteed that at least the rubber tapper communities would acquire

[2] In the late 1980's, the Bank's POLONOROESTE road construction (highway BR 364) project that opened the western Brazilian Amazon to slash-and-burn agriculture, logging, and cattle ranching gained international attention due to the environmental and social damage it provoked in the region and is widely considered today one of the worst ecological disasters ever supported by the Bank.

immediate rights to the land. As Ademir de Melo Uchoa, a leader of the Organization of the Rubber Tapper of Rondônia, stated in a personnal interview, "if we had not created those state reserves, today all this area would already be pasture land and our families would be leaving in slums in urban areas".

Despite an active social movement resistance, there is a lack of local government's commitment with ER policy, leaving little room on the local political development agenda for the rubber tappers demands, which are often seen by local economic elite and government as antagonist to the state-wide development goals. This, in turn, has resulted in a political and institutional fragility that have made them difficult to consolidate over the long term. ERs in Rondônia have likely had to face the greatest pressures of all the ERs in the Amazon. Rubber tapper leaders are still living in an atmosphere of sustained rural conflicts, constantly harassed by local opposition pushing for other land uses, resulting in constant illegal practices (specially logging), and deforestation in the state's ERs (Euler et al. 2008; Ribeiro et al. 2005). Rondônia's experience with creating and managing state ERs is a valuable lesson for federal and state policy makers. Local political dynamics show that state level' ERs are more vulnerable in terms of applying and consolidating the concept of the ERs as sustainable environmental policy.

The rural workers union of Amapá led an important social movement against the "Jari Project" a major cellulose production project in the southern part of the state, which resulted creation of the Extractivist Settlement Projects in 1988, and then creating the Cajari ER in 1990. The creation of the Rio Cajari reserve was strongly supported by pressure of the social movement in the region, especially the Brazil nut collectors.

Amapá is one of the smallest states in the region, located on the Amazon estuary and the forest product economy is more centered in the southern part of the states. Because of its social

and ecological characteristics, Amapá's southern region became the center of the direct-use conservation units in the state. Three protected areas dominate the state's extractivist production are located in the south. The central region is the Cajari ER, the 860,000-ha Iratapurú River State Sustainable Development Reserve (RDS), established in 1996, on the northern border of the Cajari ER. The 600- ha Extractivist Settlement Project of Maracá was created in 1988, on what was to become the Cajari ER's southern border.

Moreover, Amapá is not located within "frontier expansion areas", which in turn, may have led to reduced social movement pressure and land tenure conflicts over resources. Nevertheless, it seems that the social movement in the region has received political support for establishment extractivist development initiative, although not advocating for creation of new ERs over the last decades.

According to Pedro Ramos (65), an important extractivist leader, "when João Alberto Capiberibe was elected governor of Amapá (1994/1998/2002), the concept of sustainable development came to governmental agenda, and the government launched the Sustainable Development Program of Amapá (PDSA), creating Sustainable Development Reserves (SDRs) rather than ERs." Today with the new government (Valdez Goes, 2006) there is increasing endorsement of a broader policy that indicates continued support for extractivist development, which led to greater support for extractive communities living in ERs and other models of direct-use conservation units. Recently, the state government launched a planning strategy called the "Biodiversity Corridor," which advances an integrated management policy for conservation units, respecting the goals of each model and promoting the creation of protected areas, in which new ERs are planned. The unchangeable scenery of ERs establishment in Amapá since the creating of the Rio Cajari in 1990, does not illustrate the picture of scenarios of extractive

development in Amapá; it merely shows that the ER model has not grown in terms of number. Amapá shows an interesting scenery of extractivist development initiatives, one in which the ERs has not being applied, but has borrowed its central principals.

The evolution of ERs in the second wave states in the late 1990s is a reflection of improvement of environmental policy in Amazonia. Although the ERs are in their preliminary stages in Pará, they are likely to be a result of a strong social movement mobilizing in the region. This social movement, which stated in early 1980s (Campos & Nepstad 2006), has only recently found the right arena to propose its ideas for forest conservation and rural development based on sustainable agriculture and extractivist livelihood systems.

Local extractivist communities and colonist small farmers suffering from an absence of state assistance developed an important resistance with support of the Catholic Church and Rural Workers Unions creating the "Movimento Pelo Desenvolvimento da Transamazônica e Xingu"(MDTX); a coalition of grassroots organizations of sustainable development groups, involving grassroots organizations of rural worker unions, colonist organizations and organizations of forest dwellers. This movement has a broad green agenda that includes demands for technical assistance, credits, market access, infrastructure improvement, and basic social services (FVPP 2000). The agenda clamored for a development plan that reconciles forest conservation with rural development in the eixo North and South of the Transamazônica highway. In the northern part, the ER Verde Para Sempre (Forever Green), the largest ER in Amazonia today, was created, while in the southern part the "Terra do Meio" conservation mosaic was created, which includes other small ERs (eg., ER of Iriri) and other restricted use conservation units (Nepstad et al. 2006a).

The MDTX constructed a common agenda among different groups and stgrengthened its local and regional alliances in order to demand concrete changes in government policies in the region. The Fundação Viver, Produzir and Preservar-FVPP (Foundation for Living, Producing and Preserving) connected over fifty grassroots organizations and became the operational arm of the movement, in addition to bringing financial support and technical assistance for the groups. Its strongest period in building bridges to consolidate its voice took place through the "mobilization" for the paving of the Cuiabá-Santarém Highway (BR-163), a road connecting soy bean producers from the state of Mato Grosso to the port of Santarém. Its increased social network resulted in bigger role and pressure for the federal government to develop effective territorial planning actions to mitigate deforestation in the region. The MDTX network and articulation process in addition to the join support of environmental NGOs were fundamental to the proposal of creating a conservation unit mosaic in the region, which came together with the governmental initiatives to mitigate deforestation and solve drastic land tenure conflict in the Terra do Meio region. This resulted in a socio-environmental zoning program for the region, bringing together diverse stakeholders and institutions in an innovative forum of debates on development and forest conservation, and environmental governance in the region (IPAM 2004; ISA 2004). Establishment of federal forest ERs in Pará represents a complex context of negotiation in Amazonia, one which has alleviated long standing land tenure problems and agrarian conflicts[3]. It also represent a important example of increased environmental governance through dialogue and negotiation between different development interests, continuing coalition

[3] Tarcísio Feitosa da Silva (35) - a key leader of the MDTX who was awarded one of six 2006 Goldman Environmental Prices for his work on defending local communities against land grabs, illegal illegal logging and human rights - was emphatic when asked "what were the advantages today of the creation of those ERs in the region:I am going to answer your question in a very simple way and will use a phase from "senhor Manelito" when he found out that the ER of the Iriri was created in June/06: "now I can sleep with tranquility in the ER of Iriri. I never expected that the government would give this area for me and my family. Now we have to continue work here to solve our problems related to economy, education and health. We need also to continue to guarantee our organization here….the threats are gone."

of social movements, and the increased presence of federal government institutions in frontier areas.

Continued Demands and New Frontiers for ERs

The demand for ERs by local populations and their supporters has increased significantly, demonstrating the "popularization" of ERs and the acceptance of this model as an important conservation and land tenure strategy used by forest peoples to gain rights to land and resources. Nevertheless, the process for establishment of federal ER is complex and can take years.[4] As of January 2008, there were five federal ER processes concluded and waiting for federal decree to be officially created in Amazonia, all of them in the second wave state of ER systems. In the state of Pará, the *Montanha-Mangabal* ER in the municipality of Itaituba, in the region of the upper Tapajós river; and the *Médio Xingu* ER, in the municipality of Altamira, in the basin of the Xingu river will be created. In the state of Amazonas the *Médio Purus* ER and the *Ituxi* ER will be created, in the municipalities of Lábrea and Pauini respectively; as will the *Baixo Rio Branco-Jauaperi* ER in the border of the state of Amazonas with Roraima in the municipalities of Rorainopolis and Novo Airão. This is an indication that the ER system will soon have important increment in land in those second wave states. In addition, there are several other on-going processes for creation of ER in both first and second wave states as following: Acre (4), Amapá (3), Rondônia (3), Tocantins (13), Amazonas (9), and Pará (15). This suggest that in the next coming years ER will continue to growth, as it is expected to be created 23 ER in the first wave state and 29 in the second wave states.

[4] It starts with an official request of population organization for the government. Then, a land tenure inventory, followed by a socio-economic survey of the region coordinated by the government. Then, a public consult is carried out at the municipalities where the ER will be created. The final process depends on the federal decree signed by the Brazilian President.

Moreover, the ER system has started to be implemented in the *cerrado*, or savanna, biome in central Brazil. This is an important move forward that will likely represent a new frontier for ER expansion in the future. In central Brazil, the ER model is being claimed by the *cerrado* extractivists' groups that face similar problems to the Amazonian groups, which are related to land conflicts and maintenance of an extractivist economy due to the expansion of agricultural frontier in the region. The *cerrado* is the second biggest biome in Brazil with an area of approximately 2 million km² and is one of the most threatened in the country as it is Brazil's principal area for agricultural expansion. It is a biome that encompasses eleven states in the country, including vast areas of what is considered the legal Amazon, particularly in the state of Mato Grosso, Tocantins and Maranhão. The *cerrado* had recently become an immense agricultural frontier, which in some aspects has substituted Amazonia as open space for economic expansion. Contrary to Amazonia, where resource preservation has become an international concern, the *cerrado* has been overlooked as an important biome. In this manner both the *cerrado* and the Amazon were seen as empty economic space to be explored, with the *cerrado* offering the advantage that its openness has led to faster economic occupation. From an internal and external political point of view, the environmental issues in the *cerrado* ecosystems have not appeared polemic, whereas in the Amazon imperative environmental concern is at the forefront.

In 2006, the first two ERs created in the *cerrado* biome, the *Recanto das Araras da Terra Ronca* with 11.964 ha and *Lago do Cedro* with 17,337, both located at the state of Goiás. In 2007, the Chapada Limpa ER with 11,971 ha was created in the state of Maranhão, the first ER on *cerrado* ecossytem in the state. The adaptation of ER in the *cerrado* has been thought to be a

strategy for extractivist groups and a barrier to the expansion of the agricultural frontier in specific parts of the region.

The Brazilian Environmental Agency has received eighteen requests from extractivist groups for continued establishment of new ER are in the *cerrado* region. The creation of ERs in central Brazil, incite a debate in the *cerrado* that was initiated twenty years ago in Amazonia, but has only recently gained political power as observed with the creation of many ERs in Amazonia in the last few years. Whether or not ERs will take off as an instrument for conservation in central Brazil is still in doubt, but its implementation, at least in the short run, will have an immediate impact on halting more destructive land use practices, in addition to preserving traditional extractvist land use practices that have been lost to large-scale agricultural activities. With the implementation of the first ERs in the *cerrado*, it is also expected that government and other social groups will learn and unmask much of what is still little known about the traditional extractivist economy in the Central region of Brazil.

Conclusions

What have ERs contributed to conservation and development in Amazonia in the past two decades? And what will the coming decades hold for the Extractive Reserve system? In the first wave states, despite stagnation in Rondônia, both Rondônia and Acre have placed a significant percentage of their territory under ERs. Rondônia's state reserves may be the most paradigmatic in their application of the model after twelve years; a typical case of struggle between the economic development and environmental protection camps, in which the winner is usually determined by the group that has more political weight. In sum, the status of ERs in Acre appears to be solid, in terms of territory and political support while in Rondônia, it is stagnated in growth and there is a profound lack of government support for ERs. Another first wave state, Amapá,

appears stagnated in terms of numbers, despite the fact that "extractivism development" and "environmental protection concerns" have a presence in the state governmental agenda.

The situation in the second wave states looks promising if recent advances continue in coming years; it is very likely they will. Pará and Amazonas are far from reaching some of the first wave states in percentage of land under ERs, but have demonstrated a consistent process of establishing ERs since the early 2000s, representing the trend for continuing growth of ERs areas.

ERs as a public policy is widely considered one of the options to simultaneously decrease deforestation rates in the region while responding to social group demands, especially in frontier areas. Most of the states in the Brazilian Amazon have adopted this policy, especially in recent years. The creation of ERs should not be seen as static or synonymous of forest protection, rather, it is protection for a much longer time. Taking into consideration that most ERs are created in frontier regions, three elements should be essential to all ER efforts: 1) the improvement of living conditions for the extractive population; 2) a strong monitoring process; and 3) an active and continuous social movement in the area. The biggest challenges might be not overcome with the establishment of an ER, but occur in the years following its creation. In many cases, the creation of an ER means the immediate resolution to land conflict. However, ER residents cannot be left alone with little or no governmental policies/support in place to help them improve their economic and social well-being, as have been the case in several of the first ER implemented in the region. This is especially likely if the social movement views the creation of an ER as an end of an end in itself.

Federal ERs appear to be less vulnerable to state political interferences, while the state-level approach seems to depend on closer alignment with the goals of state government's

development agenda. The general focus of both social movement institutions and government has been to create new ERs areas, and pay less attention to elaborating public policies for socio-economic growth within ERs. This perspective need to be reviewed in order to guarantee sustainable future for already established ERs in Amazonia.

CHAPTER 3
ADOPTION OF CATTLE RANCHING AMONG COLONIST SMALLHOLDERS AND FOREST EXTRACTIVISTS IN THE BRAZILIAN AMAZON: HISTORICAL-CULTURAL CONTRASTS AND ECONOMIC EXPLANATIONS

Introduction

The recent explosion of research on the environmental and economic costs and benefits of land use and land cover change in the Amazon has often featured the central role of cattle ranching activities (e.g., Barreto et al. 2005; Faminow 1998; Nepstad et al. 2006b; Smeraldi & May 2008; Veiga et al. 2004; Wood & Porro 2002). Pastures cover the large majority of deforested land in agricultural use in the Brazilian Amazon (Arima et al. 2006; IBGE 1998), and substantial areas that appear to be secondary vegetation when viewed in satellite images are actually "dirty" or degraded pastures (e.g., Perz & Walker 2002). While debate over cattle ranching in the Amazon has often centered on the large properties that contain a considerable share of the pastures in the region, observers increasingly recognize that social actors aside from capitalized interests are buying cattle and converting other land uses to pasture (e.g., Barreto et al. 2005; Mertens et al. 2002; Tourrand & Veiga 2003; Walker et al. 2000). This shift toward cattle, a process called pecuarização or "cattle-ization," raises questions about why livelihood strategies among heretofore distinct social actors would converge in a highly heterogeneous socio-economic region such as the Amazon.

Two historically contrasting social groups who are increasingly engaged in cattle ranching are small-scale colonists and forest extractivists. Initially upon arrival in frontier areas of the Amazon, colonists focused on producing food crops and engaged in ranching mainly for subsistence purposes (Fearnside 1986; Moran 1981). For different reasons, forest extractivists such as rubber tappers also had little history of raising cattle (e.g., Dean 1987; Weinstein 1983). But by the 1990s, the livelihood systems and land use profiles of both groups were changing.

Cattle ownership among small-farm colonists in the Amazon grew faster than herds on large properties (e.g., Perz 2002). And rubber tappers, who in the 1970s and 1980s constituted a grassroots social movement to forestall deforestation and the expansion of ranching, were adopting cattle and forming pastures (e.g., Gomes 2001; Gomes 2005). This parallel trend toward cattle ranching occurred despite profound historical and cultural differences among colonists and rubber tappers in different portions of the Amazon.

This paper addresses the shift toward ranching among small-farm colonists and rubber tappers in the Brazilian Amazon. We first provide a background discussion on the debate over the environmental and economic benefits and costs of ranching in the Amazon. We then introduce the two study cases: Uruará, a small farm colony located in the Brazilian state of Pará, and Xapuri, the birthplace of the rubber tappers' movement and gateway to the Chico Mendes Extractive Reserve (CMER) in the state of Acre. We emphasize how the two populations differ deeply with regard to their livelihood strategies due to their far-flung locations and their distinct histories and cultures. The third part of the paper provides documentation of the continuing shift from other land-use activities toward cattle ranching in the two sites since the late 1990s. We draw on survey data for two time points from both study sites to explore reasons for the common trend toward cattle. While economic explanations are important, other factors also emerge as relevant to cattle adoption in the two sites. We conclude by discussing the implications of the shift toward cattle ranching by small farm colonists and forest extractivists for the economy and environment in the contemporary Amazon.

Cattle Ranching in the Brazilian Amazon

A large body of literature has emerged since the 1980s on the expanding ranching sector in the Brazilian Amazon. Here we briefly review the impetus behind frontier expansion in Brazil and the consequent discussions concerning cattle ranching in Amazonia.

In the 1960s, Brazil's then-military government prioritized frontier expansion as a means of integrating the Amazon with the rest of the country while also stimulating economic growth via resource extraction (Guimarães 1991; Mahar 1979). On the one hand, the government sought to avoid agrarian reform in long-settled regions by instituting colonization projects in the Amazon; on the other, the state motivated capital investment in frontier areas with fiscal incentives (Schmink & Wood 1992). By the 1970s, migration by farm families into colonization areas proceeded alongside the establishment of large ranches by investors.

In this context, the ranching sector in the Brazilian Amazon expanded.[1] From 1985 to 1996, the cattle herd in the Brazilian Amazon roughly doubled in size from about 18.5 million to 35.2 million heads. While the overall Brazilian herd also grew, the non-Amazon herd grew very little during this period; most growth in Brazil's cattle herd occurred in the Amazon. As a result, the Amazon herd rose from 14% to 24% of Brazil's overall herd during 1985-1995 (IBGE 1998). During the same period, the land area under natural and planted pasture also grew in the Amazon, from roughly 42 million to 51 million hectares. Meanwhile, overall pasture area in Brazil stagnated in area, and pasture in non-Amazonian Brazil actually declined. Consequently, the Brazilian Amazon's percentage of pasture also rose, from 24% to 29% of the total pasture area in Brazil. These data (Table 3-1) indicate the spatial expansion of ranching, and especially rising stocking densities, and the growing importance of cattle ranching in the Amazon for Brazil overall.

The growth of the cattle herd and the prevalence of pasture in the Brazilian Amazon stimulated considerable debate about the social and ecological consequences of ranching on the frontier. Socially, ranching in the Amazon and elsewhere in Brazil has long been associated

[1] By "Brazilian Amazon" we refer to the "Legal" Amazon, a state planning region that encompasses nine states in the Amazon biome in Brazil as well as portions of the savannah ("cerrado") along the Amazonian fringe (IBGE 1998).

Table 3-1. Cattle herds and pasture areas in the legal Amazon and Brazil, 1985-1995

	Cattle (000s heads)			Pasture (000s ha)		
State	1985	1995	1995 / 1985	1985	1995	1995 / 1985
Rondonia	771	3,937	5.1	1,101	2,922	2.7
Acre	334	847	2.5	326	614	1.9
Amazonas	425	734	1.7	476	529	1.1
Roraima	306	400	1.3	1,247	1,543	1.2
Pará	3,487	6,080	1.7	6,612	7,456	1.1
Amapá	47	60	1.3	479	245	0.5
Tocantins	3,604	5,218	1.4	10,651	11,078	1.0
Maranhão	2,973	3,619	1.2	5,027	5,311	1.1
Mato Grosso	6,547	14,330	2.2	16,405	21,281	1.3
Brazilian Amazon	18,494	35,226	1.9	42,323	50,978	1.2
Brazil	128,042	153,058	1.2	179,188	177,700	1.0
Brazil Non-Amazon	109,548	117,832	1.1	136,865	126,722	0.9
Pct. Amazon	14.4	23.0	1.6	23.6	28.7	1.2

Sources: IBGE agricultural censuses (IBGE 2005).

with concentrated land ownership, rural exodus, and urban poverty because ranching is land-extensive but requires little labor (Hecht 1985; Hecht & Cockburn 1990). Where landless families arrived alongside land companies and other capitalized interest groups, land conflicts have often arisen. These groups often encountered indigenous tribes and traditional forest extractivists in the process, leading to conflicting land claims and rural violence (Almeida 1995; Branford & Glock 1985; Schmink & Wood 1992). The "Parrot's Beak" in Eastern Amazonia is one such region, and it became infamous for rural violence by gunmen and police supported by well-connected ranchers who sought to defend large land claims. This and other parts of the Amazon have a record of human rights abuses, including assassinations of rural labor leaders, clergy, and others who sought to resist land concentration in large cattle ranches (Simmons *et al.* 2007). This stimulated debate over the question of whether the expansion of extensive cattle ranching on large properties constitutes social development in the Amazon. A second social

consequence has concerned the economic issue of productivity per hectare in extensive ranching, as opposed to alternative land uses such as non-timber forest production, agroforestry, and intensified agricultural systems. More diversified agricultural systems produce higher incomes per hectare (Perz 2004; Tourrand & Veiga 2003), as do intensive systems that focus on multicropping, improved fallows, and the like (Almeida 1996). This has raised questions about the economic wisdom of extensive ranching as compared to alternative land uses that could produce more value on less deforested land.

Debate has also transpired over the ecological impacts of cattle ranching in the Amazon. One key issue has concerned doubts about pasture sustainability due to soil degradation. Whereas early research suggested that clearing forest for pasture increased soil fertility (Serrão *et al.* 1978), more recent work indicated that the increase was due to burning vegetation and its effects were thus temporary (Barbosa & Fearnside 1996; Fearnside & Barbosa 1998). As a consequence, pasture productivity declines over time, such that 8-15 years later, pastures must either be abandoned due to weeds and soil compaction or renovated via tillage and investments in improved pasture grasses. By the early 1990s, 50% of pastures in the Amazon were considered degraded, and in many parts of the region, pastures had very low stocking rates and beef productivity per hectare (Serrão & Homma 1993). The reliance on fire to clear secondary vegetation has the economic advantage of being low-cost, but carries the disadvantages of destroying seed stocks for future forest regeneration and facilitating regrowth of fire-adapted plant species which prompts the need for more pasture burning. Another ecological problem with cattle ranching concerns microclimatic change (Buschbacher 1986). Temperatures of surface soils under pasture are much higher than in primary or secondary forest, which destroys microorganisms important for soil health (Nepstad *et al.* 1998). Further, heat rising from pastures

can generate locally strong winds and may be altering local precipitation (Wu *et al.* 2000). Finally, pastures support much less biodiversity than primary or secondary forest. Many species of vertebrates will not cross pastures, and many plant species will not grow in pastures if pioneer species are prevented from colonizing and initiating the process of succession. Furthermore, fragmentation or edge effects have been shown to impact even greater areas beyond those deforested, expanding the areas negatively affected beyond the pastures themselves (e.g., Laurance et al. 2002; Laurance et al. 2000; Skole & Tucker 1993).

In the context of these doubts, pasture and cattle management in the Amazon changed considerably in the 1990s, and revisionist perspectives about cattle ranching in the region consequently emerged to question the conventional wisdom. A key change has involved improvements in pasture management, partly due to landholder experimentation, and partly due to considerable extension research on pasture sustainability (e.g., Rueda et al. 2003; Smith et al. 1995; Valentim & Andrade 2005). The incorporation of new and improved grass varieties better suited to the Amazonian biophysical environment has afforded pastures a longer use life and hindered soil degradation and erosion, as well as weed invasions. At the same time, the urbanization of Amazonian populations and the limited stocking densities in other regions of Brazil have impelled both regional and national demand for beef from the region (Faminow 1998). Such demand allowed beef prices to remain stable even as Brazil's ranching sector has expanded, motivating the expansion of ranching in frontier areas of the Amazon. This increasingly calls into question older arguments that ranching in the Amazon could only persist with the support of state tax breaks and subsidies. Another factor has been the enormous effort to control hoof-and-mouth and other cattle diseases via vaccination programs (MAPA 2005). Even in frontier areas of the Amazon, there are cattle vaccination and hygiene programs, part of

Brazil's objective of increasing the exporting of beef products once they meet international sanitation standards (Lima *et al.* 2005; Smeraldi & May 2008). The prospect of beef exports from the Amazon is of fundamental importance, since Amazonian beef is cheaper to produce than that elsewhere in Brazil and most of the rest of the world, making it eminently competitive globally (Nepstad et al. 2006b). Since Brazil has become one of the top exporters of beef worldwide, Brazilian investors are increasingly looking to the Amazon frontier for continued expansion as well as improvement of cattle ranching.

In this context, cattle ranching is increasingly being adopted by groups other than corporate and individual large landholders in the Amazon. Smallholder colonists, who originally came to northern Brazil to engage primarily in production of annual and perennial crops, are increasingly turning to cattle (Ludewigs 2006; Pacheco 2005; e.g., Walker et al. 2000). Similarly, forest extractivists, often the descendants of rubber tappers during the Rubber Boom a century ago, are also clearing forest and breeding cattle and other livestock (e.g., Gomes 2001 and 2005; Ehringhaus 2005;Vadjunec 2007). Consequently, despite the Amazon's land abundance, cattle ranching is no longer the purview of large capitalized operations. This raises questions about the specific economic processes at work that prompt cattle adoption for smallholder colonists and forest extractivists have very different cultures and histories, and rather different avenues for market access. In the next section, we focus on two concrete study cases, one involving smallholder colonists and the other featuring forest extractivists.

Study Cases

Our two study cases are the municipalities of Uruará, in the state of Pará in the eastern Brazilian Amazon, and Xapuri, in the state of Acre in the western Brazilian Amazon (Figure 3-1). While such choices might seem capricious or arbitrary, we selected these two sites for four reasons.

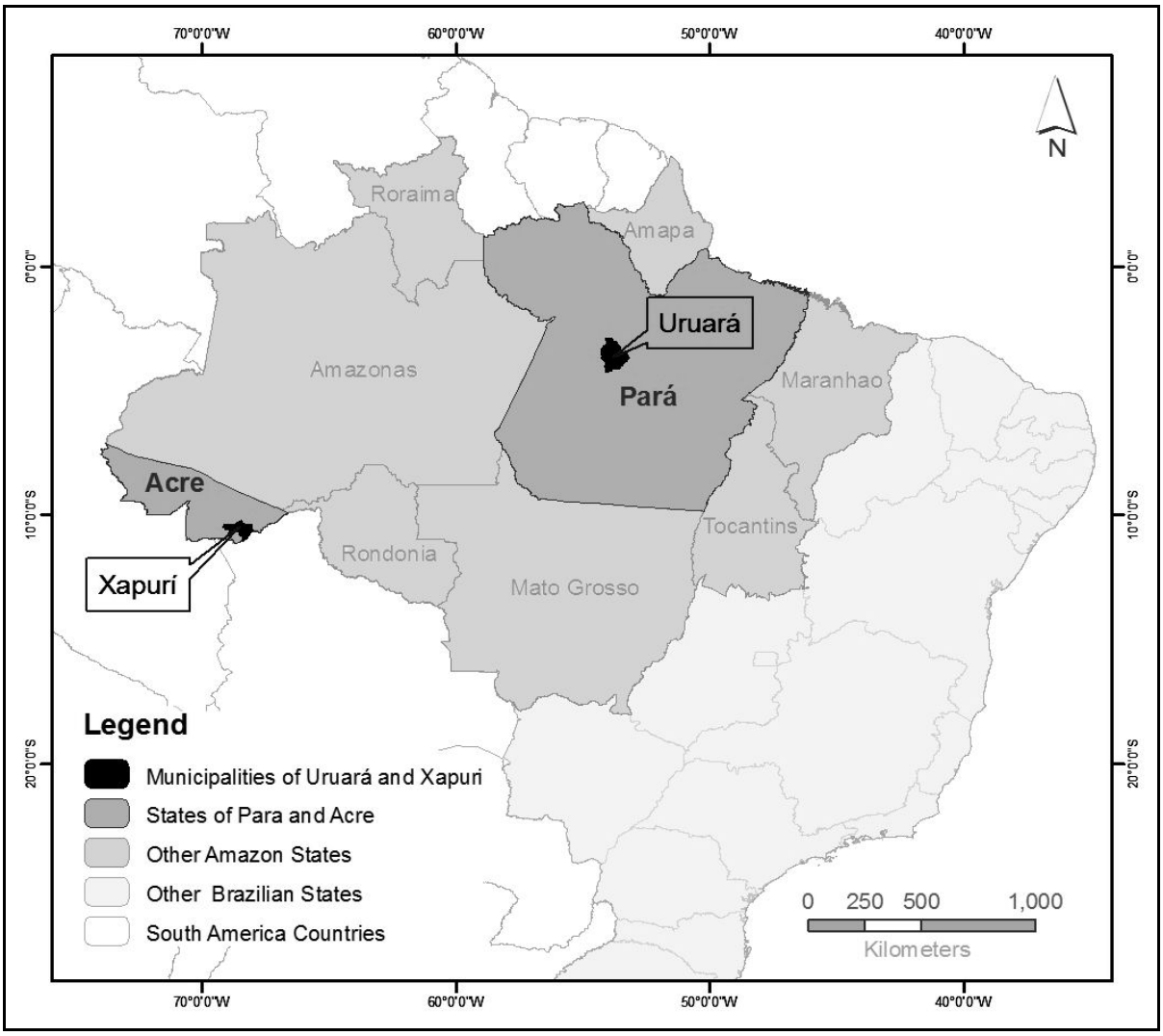

Figure 3-1. Map of the two study cases in the Brazilian Amazon

First, we have fairly recent multi-temporal data about land use for both sites, which makes possible the analysis we pursue. Second, the two sites are located far apart in opposite ends of the Brazilian Amazon. This means that they are, in effect, independent of one another, such that the changes they incur can be viewed as occurring in parallel, whether influenced by a common external factor or not. This makes it possible to argue that similar processes such as cattle adoption are not due to one case influencing the other. Third, as a result of their geographic separation, Uruará and Xapuri have very different histories, being founded at different times for contrasting purposes and attracting distinct interest groups. And fourth, the cultures and

production systems in these two locations differ substantially in terms of the use of forests and cleared land. Thus, it is possible to document contrasts in past land use and livelihoods in the two sites in order to argue that their similarity in terms of cattle adoption is a culturally unexpected phenomenon. That in turn prompts our attention to economic and other factors as explanations for expanding cattle and pasture among groups not previously noted for cattle ranching.

In this section, we provide brief historical overviews of our two cases, highlighting their differences. Whereas Uruará is a young roadside frontier town, Xapuri has a history that extends back over a century and began as a riverside entrepot for forest product marketing.

We highlight contrasts in resource management in these two study areas by paying close attention to the current dynamics of key economic products. First, in order to facilitate some initial comparison between our study sites, we rely on secondary data sources from Brazilian censuses and production annuals for municipal-level data (IBGE 1998; IBGE 2007).

Uruará

Uruará is a colonist community in the Brazilian state of Pará situated on the Transamazon highway (IDESP 1990). Uruará was founded in the early 1970s as a roadside colonization project to resettle rural families from the Brazilian Northeast. The state agency for colonization and land titling, INCRA, surveyed and distributed lots of 100 hectares (ha) to a first wave of colonists, who began to develop small farms. Colonists first planted annual crops, later followed by perennials. This formed a relatively homogeneous social structure in Uruará, where small-scale family farms still predominate. By the end of the 1970s, local churches provided support to incipient small producer organizations (Toni 2003).

In the early 1980s, Brazil's economic crisis led the state to effectively abandon official colonization, leaving the smallholder colonists to fend for themselves. But in the mid-1980s, perennials such as cocoa and black pepper commanded high regional prices, which prompted

households to expand their clearings for cash crops (IDESP 1990). This stimulated a second wave of in-migration, raising the municipality's population to 25,000 by 1991 (IBGE 1996). Growth during the 1980s prompted church leaders and producer groups to lobby for the colony to become a new municipality, which occurred in 1987 (IDESP 1990; Toni 2003). The municipality of Uruará covers an area of about 10,066 km^2.

Economic dynamism in Uruará in the 1980s gave way to difficulties in the 1990s (Nascimento and Drummond 2003). Pests attacked cocoa and black pepper, reducing cash crop production. This occurred at the same time as perennial crops also incurred price declines, which reduced agricultural incomes. These difficulties stimulated political mobilization in Uruará, as small producer organizations as well as business interests and local politicians sought new directions for community development (Toni 2003). This period also witnessed the emergence of the MPST (Movimento pela Sobrevivencia da Transamazonica, or Movement for Transamazon Survival), which helped form alliances among municipal producer groups (Nascimento and Drummond 2003). In Uruará, a series of municipal workshops resulted in the PGDU, or Global Plan for Uruará Development, which identifies various strategies for sustainable development as via agroforestry and reforestation (FUNDASUR 1996).

At the same time, the Amazon Development Bank, BASA, made available a special credit line for small producers, FNO (Fundo Constitucional de Financiamento do Norte). Many local organizations moved quickly to obtain FNO funds, and used the financing for pasture expansion and livestock purchases (Toni 1999). As a result, cattle ranching expanded in Uruará during the 1990s. Smallholders shifted to cattle due to the more stable prices than those for perennials, the ability to sell cattle year-round instead of at harvest as with perennials, and easier commercialization due to trucking lines from slaughterhouses with refrigeration (Tourrand &

Veiga 2003). Establishment of a vaccination program in Uruará improved cattle health and survival, and made ranching more profitable.

During the 1990s, Uruará's population continued to grow, reaching 45,000 by 2000 (IBGE 2000). By 2000, 23% of the forests in the municipality had been cleared (Nepstad *et al.* 2000, cited in Nascimento and Drummond 2003: 126).

The 2000 elections again shifted the political affiliations of those in local power back to supporters of the PGDU (Toni 2003). This coincided with a series of new (or belatedly implemented) initiatives such as for soil recuperation, forestation with economically valuable species (timber and non-timber). As a result, since 2000, Uruará has exhibited more complex dynamics in terms of its land use and livelihood systems.

Table 3-2 summarizes changes in 5-year increments for selected indicators of key economic activities in Uruará from 1990 to 2005 (IBGE 2007). Similarly, Figure 3-2 shows trend lines for annual changes over the same period. In brief, annual crops (i.e., subsistence food crops such as rice, beans, corn, manioc, etc.) declined and then rose, but did not return to their 1990 level by 2005. Preliminary figures for 2006 (not presented) indicate a rapid decline to a level below 1990. Perennial crops (i.e. tree crops for commercial products, such as cocoa, coffee, and black pepper) rose in importance, but most of the rise occurred in the early 1990s, as Figure 3-2 makes evident. However, it was the cattle herd which grew fastest, from roughly 43,000 head in 1990 to over 250,000 in 2005. There was a surge in the early 1990s that corresponds with difficulties in crops, but most of the expansion in cattle in Uruará has happened since 2000. Timber extraction, performed by local sawmills in cooperation with landowners, also rose, from roughly 16,000 m^3 in logs in 1990 to 56,000 in 2005. It is worth noting, however, as shown in Figure 3-2, that this value was a decline from 2004, as 2005 witnessed government inspections

and closings in sawmills due to illegal timber extraction. Non-timber forest products associated with traditional extractivism (such as rubber and Brazil-nuts) were insignificant or in terminal decline in Uruará**.**

Together, these indicators portray a young frontier community with a declining focus on annual crops, slow growth in perennials, but rapid growth in cattle, an important timber sector perhaps with an uncertain future, and little by way of non-timber forest extractivism. As Figure 3-2 shows, from 1990 to 2005, it is cattle that grew the most in Uruará.

Table 3-2. Crop cultivation, cattle ranching, and forest extractivism in Uruará and Xapuri, 1990-2005

	Annual Crops (ha)	Perennial Crops (ha)	Cattle (heads)	Timber (m^3)	Rubber (T)	Brazil Nut (T)
Uruará						
1990	11,663	7,771	43,200	16,500	0	350
1995	7,014	9,923	110,000	40,410	0	28
2000	7,851	9,573	95,345	37,970	0	55
2005	9,348	11,465	250,739	56,100	0	4
Xapuri						
1990	8,083	310	61,171	10,210	773	1,270
1995	3,325	255	61,204	10,930	638	1,019
2000	2,594	334	76,200	11,430	302	636
2005	3,791	241	190,986	12,720	479	2,007

Source: IBGE agricultural production annuals (IBGE 2005).

Xapuri

Xapuri is located in the far western Brazilian state of Acre, in the southeastern or "Alto Acre" portion of the state at the convergence of the Acre and Xapuri Rivers. Historically, the municipality of Xapuri covered about 8,137 km^2 until 1999, when it was divided and reduced to 4,705 km^2 (Toni & Souza 2003). Xapuri was founded in 1905 and is the second-oldest city in Acre after the state capital, Rio Branco. Both towns emerged as market centers along rivers, which served as the main means of transport during the Rubber Boom (1880-1920). As a port for

rubber and a longstanding town along the river, Xapuri came to be known as the "little princess of Acre" ("*a Princesinha do Acre*").

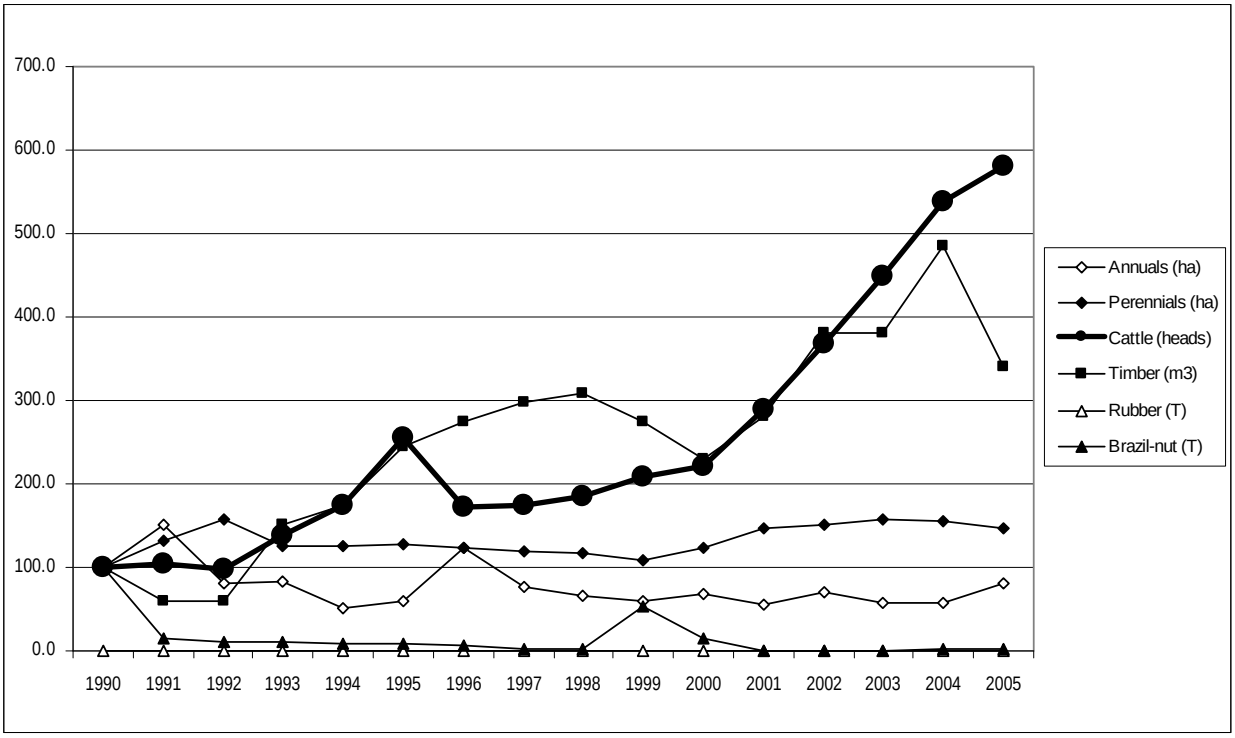

Figure: 3-2. Change in crop cultivation, cattle ranching, and forest extractivism, Uruará, PA 1990-2005 (1990=100). Source: IBGE Agricultural Production Annuals (IBGE 2005)

Xapuri was once inhabited by indigenous tribes such as the Xapuri, Catiana and Meneteri, who were joined and then replaced in the 19th century by migrants mainly from the Brazilian northeast, who came to the region attracted by the great promise of wealth and prosperity from the rubber industry (Rancy 1992). The high density of rubber trees found in the Alto Acre region made Xapuri a zone for extraction and a starting point in the chain of rubber production downstream for export to North Atlantic economies. During the rubber boom, real estate in Xapuri was highly valued and among the lands contested between Brazil and Bolivia in the 1902

"Acre Revolution," in which a brief conflict resulted in Brazil acquiring Acre and the official control of important rubber tapping territories (Bakx 1988).

A key hallmark of rubber tapping during the boom years was the *aviamento* system of debt-peonage between *seringueiros* (rubber tappers) and their *patrões* (rubber barons) (Weinstein 1983). Rubber barons claimed large land areas called *seringais* (rubber estates) which they divided up among rubber tappers, who each had access rights to a *colocação* (forest homestead) amidst several trails in the forest that passed by rubber trees. Rubber tappers arrived in Acre, however, in debt to the rubber baron for the price of their passage, and were prohibited from growing their own food crops or breeding their own livestock. This went hand-in-hand with the additional requirement that rubber tappers could only buy subsistence goods from the rubber baron on whose land they worked. Furthermore, rubber tappers could only sell their rubber to their particular rubber baron. These rules, along with falsified bookkeeping, ensured continued debt for rubber tappers and a focus on rubber extractivism to the exclusion of agriculture or ranching.

Brazil's monopoly on rubber production was broken when an English botanist smuggled rubber seeds out of the Brazilian Amazon to the Royal Botanic Garden in Kew, outside London, which were later introduced in Malaysia (Dean 1987). Such plantations were free of pests of rubber endemic in the Amazon and yielded production at much lower prices. Malaysian plantations exhibited rapidly rising production in the 1900s, and by the 1910s, rubber from the Amazon was being outcompeted, causing the boom to go bust. With the collapse of the rubber trade in Amazonia, by the 1920s, Xapuri town and the residents of the nearby rubber estates entered into a deep economic crisis (Tocantins 1979). This resulted in the total abandonment of many rubber estates by the rubber barons, leaving the rubber tappers in the forest to fend for

themselves. The rubber economy experienced a short resurgence in Brazil during World War II, when the United States and its allies were cut off from the Malaysian rubber trade when the Japanese occupied Malaya (Corrêa 1967). Xapuri saw a short period of growth during this time. It appeared that the old "Princess of Acre" was re-awakening as new migrants from the Northeast began to flock to the region to work on the rubber estates as "rubber soldiers" recruited by the Brazilian government for the war effort (Martinello 1988).

After the war, however, the rubber economy in the region once again collapsed, leaving the rubber tappers all but forgotten by Brazilian society. Without many livelihood options, but having established a strong identity with forest extractivism, rubber tappers responded to the crisis by staying into the forest. However, these boom-bust dynamics, along with a newfound freedom from the *aviamento* system, led to the diversification of livelihoods among rural communities around Xapuri and other parts of the Acre. During the post-boom period, other forest products such as Brazil-nuts became more important, and rubber tappers began to engage in small-scale subsistence agriculture (e.g., Campbell 1996). By 1960, the municipality of Xapuri had a population of 13,256 (IBGE 1973).

Xapuri and the rest of eastern Acre were to undergo further changes in the 1970s, when Brazil's government built highways such as the Transamazon to facilitate the establishment of frontier towns like Uruará. Another highway, the BR-364 through neighboring Rondônia, connected Acre to southern Brazil. While migrants from the south flooded into Rondônia by the thousands beginning in the 1970s, the governor of Acre, Wanderlei Dantas (1971-74), gave a speech before investors in São Paulo, extolling the virtues of Acre's relatively cheap and extensive land, long since abandoned by the rubber barons (Bakx 1988; Silva 1990). Overlooked, however, were the forest communities that formed after the rubber barons departed. The arrival

of roads and investors led to conflicts over the organization of space as defined by key natural resources. Whereas rubber tappers still viewed the area around Xapuri in terms of rubber estates and forest homesteads defined by the location of rubber trees, large ranchers defined properties by geographic boundaries in terms of cleared land with good access to roads. By the 1980s, forgotten rubber soldiers found themselves confronting cattle ranchers who sought evictions of forest-based communities in ostensibly empty rubber estates.

Rubber tappers fought back, mobilizing forest communities and rural workers to engage in non-violent forms of resistance beginning in Xapuri, making it the birthplace of the rubber tappers movement (Calaça 1993; Sobrinho 1992). In 1977, a rural workers union formed in Xapuri to resist encroachment by ranchers and other outsiders. In the 1980s, rural violence elsewhere in the Amazon proceeded alongside intensifying land conflicts in Acre. The murder of Chico Mendes on December 22 1988, a year of unprecedented levels of deforestation and burning, catapulted the rubber tappers into international headlines as defenders of the Amazon rain forest (Allegretti 1989; Hecht & Cockburn 1990; Schwartzman 1989).

In this context, growing recognition of the social and ecological consequences of deforestation for large-scale ranching prompted the creation of federal Extractive Reserves (ERs) (Allegretti 1990; Schwartzman 1992). Since the late 1980s, the ER concept first gained currency in Brazil and today there are 64 ERs in Amazonia covering an area of over 12 million hectares. The ER model has paved the way for the creation of people-based protected areas (Ehringhaus 2005) that are being implemented by various institutions at both the federal and state levels in response to changing political contexts and opportunities for Amazon conservation. ERs recognized the productive activities of rubber tappers, thus allowing for the productive use of standing forest per traditional livelihoods. Rubber tapper communities collectively manage areas

corresponding to old rubber estates, whereas each rubber tapper household retains access rights to the rubber trails around their homestead. Federal ER land belongs to the federal government, but families have rights to use the forest for their livelihoods. In general, ER families engage in sustainable activities such as the extraction of non-timber forest products (NTFPs), including rubber and Brazil-nuts. ER rules impose a deforestation limit of 10% of the total area of a reserve, along with a 5% limit on pasture area, and commercial timber extraction is prohibited, though debated. The first federal ER was the Chico Mendes Extractive Reserve, or CMER, established in 1990, which currently encompasses 930,985 ha, or nearly 1,000 km^2 (GovernmentofAcre 2000). The CMER spans several municipalities in Acre, but its main market gateway is the town of Xapuri. Now linked by both river and road, Xapuri remains a market center for forest-based production despite roadside deforestation in cattle ranches that border the CMER. By 2000, Xapuri had a population of 11,956, roughly the size it had 40 years before.

Establishment of the CMER opened a new chapter in Xapuri's history, namely that of the struggle to make the ER model economically as well as socially and environmentally viable (Cavalcanti 2002; Rego 1999). Rubber prices went into decline in the 1980s, and this continued into the 1990s. Low market prices and organizational difficulties threatened the viability of administering the ERs and supporting forest communities (Anderson 1994).

The killing of Chico Mendes seemed to fracture the rubber tapper movement and its battle against cattle ranchers, who believed they would go unpunished. But Mendes' ideas led to continued social mobilization during the 1990s that generated new organizations to support forest communities in Xapuri and other municipalities encompassing the CMER. By 2000, the agroextractive cooperative in Xapuri, AMOREX, experienced substantial success, having grown to 360 members with a strong political voice in organizing extractivism at the municipal level

(Michelotti 2000). In addition, Julio Barbosa de Aquino, a rubber tapper who stood shoulder to shoulder with Chico Mendes in the confrontations with ranchers, won office as mayor of Xapuri in 1996. He was reelected in 2000.

In the 1998 state and national elections, movement leaders won seats in the state and national congress, and a forester and former political advisor of Mendes, Jorge Viana, was elected Acre's governor (1998-2006). The daughter of a rubber tapper from Acre, Marina Silva, was elected Senator and became Brazil's Minister of the Environment after the Presidential election in 2002, when Luis Inácio Lula da Silva, a union labor leader from the south who had supported Chico Mendes to organize rubber tappers in Acre, became president of Brazil.

In light of these victories, support of forest extractivism in Acre has grown considerably. The new state government in Acre, known as the "Forest Government," pursued numerous policy initiatives to capitalize on Acre's comparative advantage – forest resources – by improving infrastructure, subsidizing the processing and commercialization of NTFPs, and strengthening certification of sustainably harvested timber (GovernmentofAcre 2005; GovernmentofAcre 2006; Viana 2004). In the 2000 municipal elections, politicians supported by social movements won several offices in Xapuri, consolidating their grip on local power.

Xapuri politicians and movement leaders have since engaged in local planning in support of forest extractivism. These efforts resulted in the PDLIS (*Plano de Desenvolvimento Local Integrado e Sustentavel de Xapuri*), a sustainable development plan for the municipality (Toni & Souza 2003). Xapuri has consequently become the focus of several green development projects. The forest government has invested in the local processing of Brazil-nut production. It has financed a condom factory in Xapuri to use locally produced "green" latex to supply condoms in conjunction with the Federal Ministry of Health in an attempt to revitalize the local rubber

industry. The long story of forest extractivism and political struggle in Acre was recently portrayed in Brazil with the Globo network's *telenovela* (an extended nightly television mini-series) celebrating the rich history of the region, featuring the town of Xapuri.

But regardless of these many changes in support of forest extractivism, cattle ranching is expanding in Acre (Toni 2007; Valentim et al. 2002; see also Table 1). What is more, this land use activity is not confined to larger-scale landowners but is growing among colonists and erstwhile rubber tappers (Gomes 2001; Ludewigs 2006; Rêgo et al. 2003). During the 1990s, deforestation rose in the CMER (Sassagawa 1999). Analysis of land-use change in six rubber estates with high deforestation rates indicate that during the period of 1986 to 2003, deforestation accelerated over time, mostly for pasture creation.

Cattle ranching is expanding in the municipality of Xapuri, where the rubber tapper movement first emerged. Table 3-2 and Figure 3-3 provide indicators of key rural economic activities in the municipality of Xapuri, from 1990 to 2005, allowing comparisons and contrasts over time and with the case of Uruará. During this period, the land area in Xapuri under annual crops declined, while perennials varied without exhibiting a distinct trend. The number of cattle did not change during the early 1990s, but in the late 1990s and especially since 2000, growth has accelerated. As Figure 3-3 shows that by 2005 Xapuri had more than three times the number of cattle as it had in 1990 and more than twice the number in 2000. At the same time, timber extraction showed a moderate rise. Rubber, on the other hand, declined in importance during the 1990s, but has risen again since 2000, perhaps a result of rubber subsidies provided by the local forest government. Similarly, Brazil-nuts went into decline, but recovered by 2005, in part due to local government support for the commercialization of local cooperatives, and especially due to the rising price for Brazil-nut on the international market. What emerges from a review of rural

economic products in Xapuri is a picture somewhat different than in Uruará. Uruará has a population roughly four times that of Xapuri. Perennial crops are more important in Uruará, whereas NTFPs are more important in Xapuri. But in both places, cattle is expanding rapidly, and faster than any other of the key economic products reviewed here.

The timing of the expansion of cattle in Xapuri raises very interesting questions. Many analysts, including ourselves, have argued that the rise in cattle was due to declines in prices (and therefore extraction and commercialization) for rubber, Brazil-nuts, and other NTFPs (e.g., Gomes 2001; Toni 2007). But as Table 3-2 and Figure 3-3 show, cattle herds in Xapuri have expanded since 2000 alongside the expansion of both rubber and Brazil-nut extraction. It is likely that livelihood diversification among forest communities in the ER, particularly in the CMER, may help explain the dynamics of these products (e.g., Ehringhaus 2005; Vadjunec 2007; Wallace 2004). However, the municipal-level census data do not allow a breakdown of cattle ownership and the other indicators among specific social groups such as rubber tappers in the CMER. This limitation motivates our analysis of field survey data, pursued for both small farm colonists in Uruará and families in the CMER.

Field Survey Methods and Data

In this section we provide a more in-depth exploration of rural households and their livelihoods, comparing colonist families in Uruará to forest homesteads in the CMER in Xapuri and neighboring municipalities. In particular, we draw on data for two time points in both sites, and feature households that were re-interviewed, which facilitates temporal comparisons. The greater detail in our survey data and the ability to compare across sites and over time affords a richer portrayal of the circumstances and dynamics of cattle adoption among small farm colonists and forest extractivists, even in far-flung portions of the Brazilian Amazon.

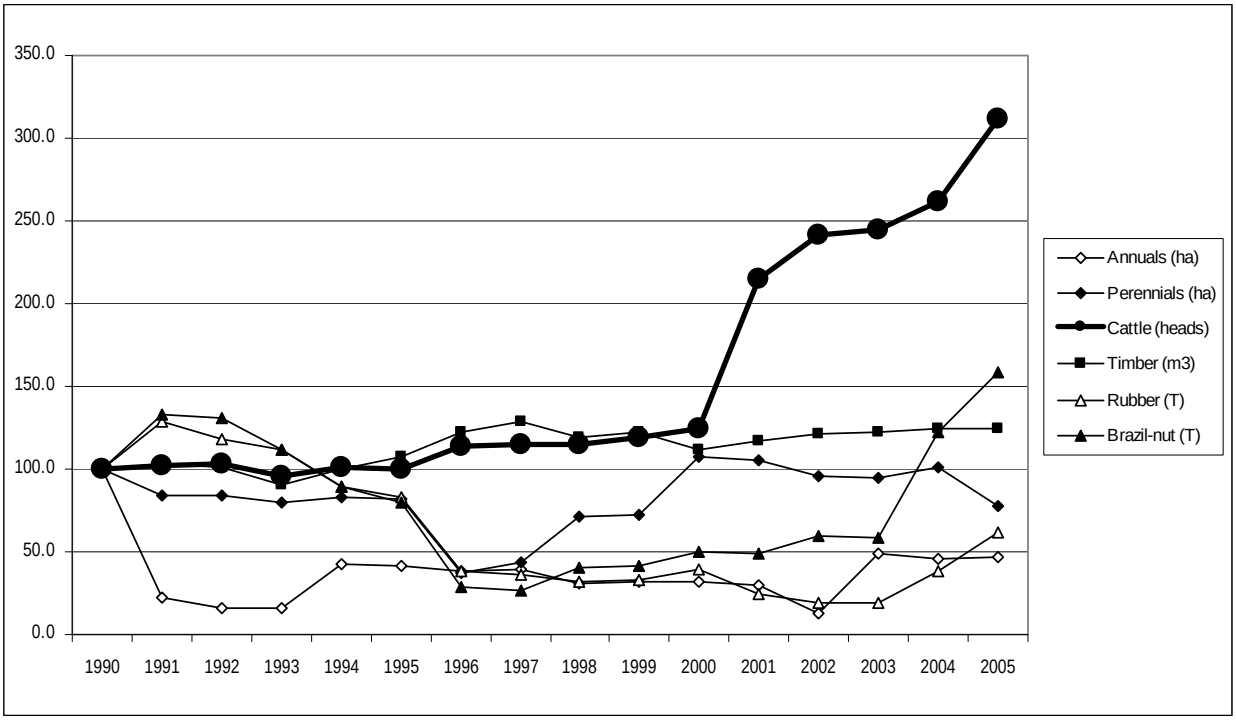

Figure 3-3. Change in crop cultivation, cattle ranching, and forest extractivism, Xapuri, AC 1990-2005 (1990=100). Source: IBGE Agricultural Production Annuals (IBGE 2005)

Uruará

Survey data for Uruará refer to 1996 and 2002. In June and July 1996, the second author participated in a nine-member research team consisting of North American and Brazilian social and agricultural scientists from the University of Texas-Austin, Florida State University, and EMBRAPA/CPATU who administered a survey questionnaire to farm households in Uruará (Perz et al. 2006; e.g., Walker et al. 2000). The questionnaire was divided into two components, where the first addressed household characteristics and the second concerned the lot(s) held by households. The household component included items such as family age composition, sources of income, and material wealth. The lot component included items such as land use, access to credit, use of agricultural technologies, and distance to market. It also included numerous

questions on resource use, including agriculture and ranching, which in turn included questions on pasture formation as well as cattle management.

Systematic sampling of farm lots proved intractable because not all lots had houses. Moreover, systematic sampling of houses encountered was problematic because residents were sometimes absent. We therefore sampled by "first opportunity" of residents encountered on their lot. We employed a cadastral map of Uruará from the Pará state office of Brazil's agricultural research agency, EMBRAPA/ CPATU, as our sampling frame, to ensure that sampling was not clustered spatially or selective of households by socioeconomic status[2] .The 1996 sample includes 261 households, or 12% of all rural establishments in Uruará at the time (IBGE 1998). The sample also includes 347 lots, as 25% of households held more than one lot, and the same questions were asked about each lot.

In 2002, another team of North American and Brazilian social and agricultural scientists from Michigan State University, IMAZON, and the Federal University of Bahia administered a similar questionnaire in Uruará (Aldrich *et al.* 2006). This questionnaire had many of the same items as the 1996 instrument, but was more extensive and included additional questions about pasture and cattle, including commercialization of cattle. A key goal of the 2002 fieldwork was to locate lots and households sampled in 1996 in order to constitute a panel for temporal comparisons. While a lot is a geographic entity, a household may possess one or more lots that in turn comprise a property. The 2002 sample includes 143 households, which held 170 lots in 1996 and 221 lots in 2002. The difference is due to sales and especially purchases of lots during the interim. We defined the panel on the basis of whether a lot had been in the 1996 sample. This

[2] The 1996 Brazilian population count (IBGE 1998b) and 1995/96 Brazilian agricultural census (IBGE 1998a) allow for comparisons to assess sampling bias. In terms of household size and land allocation, the survey data are very similar to census data for Uruará sample. For more, see e.g. Perz, et al. Perz, S. G., Walker, R. T. & Caldas, M. M. 2006 Beyond population and environment: Household demographic life cycles and land use allocation among small farms in the Amazon. *Human Ecology* **34**, 829-849..

therefore includes lots in a given property in both 1996 and 2002, as well as lots in one property in 1996 and another in 2002. While this hinders the correspondence somewhat, it helps capture dynamics on both lots and properties from the 1996 sample to the 2002 sample.[3]

Xapuri/Chico Mendes Ertractive Reserve

The first and third authors conducted interviews with families in the CMER in 2000 (Gomes 2001) and 2004 as part of their graduate research (Gomes 2008; Vadjunec 2007; Vadjunec et al. nd). In May through August of 2000, the first author employed a questionnaire containing items on migration history, association memberships, land use and forest extractivism, and assets and wealth. The initial sample included 66 households in four *seringais* (old rubber estates) of the CMER in Xapuri and two neighboring municipalities, Brasileia and Assis Brasil. These locations were selected for variability in terms of their distance to Xapuri town and various levels of deforestation (Sassagawa 1999). While this does not guarantee representativeness of all households in the CMER, it does capture much of the heterogeneity in the reserve.[4]

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[3] One might argue that because the lots included in the panel for the two dates are different, the panel is not comparable. But if we link data for the two dates in terms of production systems, in the presence of an active land market, the result will necessarily be different lots in the household panel at different moments, which itself is necessary to capture in order to observe the changes in production systems over time. See Aldrich, et al. 2006 for more.

[4] In terms of basic variables such as household size and resource management activities, the data reported here are broadly similar to data collected by others in the CMER for similar dates. For example, government data for the entire CMER indicate that forest homesteads average 671.7 ha per household, a figure somewhat higher than the averages for our full CMER samples and but similar to the CMER panel IBAMA/CNPT. 1999 Projeto RESEX: Um Futuro Sustentável para a Amazônia, pp. 30. Brasilia: Ministério do Meio Ambiente - MMA; IBAMA/CNPT.. Data from 1996/1997 for another sample from the CMER Cavalcanti, F. d. S. 2002 A política ambiental da Amazônia: Um estudo sobre as reservas extrativistas Campinas, SP: Universidade Estadual de Campinas, Rêgo, J. F., Costa Filho, O. S. & Braga, R. R. A. 2003 *Análise econômica dos sistemas de produção familiar rural da região do Vale do Acre, 1996/1997*. Rio Branco, Acre, Brazil: UFAC/SEBRAE/Ford Foundation. indicate average brazil nut extraction of 2178 kg per household, which is similar to our values for 2000, especially the panel data. Rubber extraction reported in the same sources for 1996/1997 was around 633 kg, higher than we report in 2000, but that is consistent with the ongoing decline during the 1995-2000 period as reported in those sources as well as in state data (see Figure 3-3). Finally, the other sample reports an average of 3.6 heads of cattle per CMER household, a value lower than we report, but also consistent with state data indicating a rapid rise in cattle since the mid-1990s (Figure 3-3).

In 2004 and 2005, the first and third authors conducted interviews with households in the CMER. They jointly designed a more extensive questionnaire with additional items on commercialization of agricultural production, forest extractivism, and livestock, as well as land tenure rules for resource use in the CMER. These researchers also obtained a larger sample, totaling 149 households in eight *seringai*s (four of the same seringais of 2000) in the reserve in Xapuri, Brasiléia, and Assis Brasil. Selection criteria was based on the pre-processing of satellite imagery, and discussions with local leaders and NGOs operating in the region (Vadjunec *et al.* nd). We targeted a variety of communities that had both real and perceived differences regarding deforestation and productive activities ranging from NTFPs to commercial agriculture and cattle ranching.

The 2004/2005 sample includes some of the same households from the 2000 research, affording a panel for temporal comparisons. We compared the names of forest homesteads and their owners in the two data sets and identified 35 homesteads interviewed at both time points. Because this panel is smaller than both of the full samples for 2000 and 2004/2005, we will present data for both full samples as well as the panel homesteads at the two time points. This affords temporal comparisons among the panel homesteads as well as between the panel and the larger samples.

Cattle Adoption Among Smallholder Colonists and Forest Extractivists

We divided our analysis of the field survey data into three parts. First, we present socioeconomic indicators for the samples and panels in Uruará and the CMER to characterize the households. This provides some baseline comparisons across the sites and over time. The second part of the analysis then evaluates natural resource management in the two sites in terms of land use, forest extractivism, agricultural production, and cattle ranching. This enables comparisons across the sites and over time in terms of land use and resource management dynamics. The third

and final part of the analysis focuses on management of cattle and pasture. Here we examine the most recent data and compare the sites in terms of the prevalence of cattle ranching, use of inputs, herd composition, purchases and sales of cattle; we also evaluate certain site-specific issues, namely obedience to land-use restrictions (in the CMER) and future plans for ranching (in Uruará) and sustainable forestry (in the CMER).

Socioeconomic Comparisons

Table 3-3 presents full sample and panel data for the Uruará surveys in 1996 and 2002, and Table 3-4 does the same for the CMER surveys in 2000 and 2004/2005. Both tables provide basic and largely comparable indicators of household background, institutional context, and market access across the sites and survey years. Each table also provides p-values from t-tests comparing means for the two time points for which we have panel data. Moreover, Table 3-4 provides p-values for t-tests comparing the most recent samples for the two sites.[5]

By household background, we refer to length of residence, whether the household interviewed was the first occupant on that property or homestead, whether the household interviewed had acquired the site via inheritance, and the number of residents. Together these variables help characterize the tenure of the family on their property/homestead as well as the age of the place relative to the length of a family's occupation. We would expect families in Uruará, a relatively new frontier area, to have shorter residence durations and to be living on younger properties than the homesteads on rubber estates in the CMER. We also expect durations of residence to rise from the first time point of the surveys to the second, and for first occupancy to decline and inheritance to rise. Finally, we expect there to be large families

[5] All t-tests are two-tailed tests that do not assume equal variances in the two samples being compared.

(several members), due to the importance of family labor in small-scale rural production systems.

Tables 3-3 and 3-4 largely bear out these expectations. For Uruará, Table 3-3 compares the 1996 full and panel sample data to the 2002 panel data. It is worth noting that the values for the household background variables are similar between the full and panel data in 1996, though the panel is somewhat selective of older and larger households.

But there is a statistically significant rise in the length of residence in the panel from 1996 to 2002, though inheritance declined (albeit from an already very low level), and family size declined. Other research suggests that decreasing family size is due to aging and relocation of children, whether to Uruará town or their own properties (e.g., Perz *et al.* 2006). Table 3-4 presents the CMER comparisons for 2000 and 2004/2005. There, the panel also appears very similar to the full samples for both time points, though as in Uruará, the CMER panel appears somewhat selective of older, larger households. But whether we compare the full samples or the panel across time points, we find that length of residence rose over time, which perhaps is a positive indicator of the viability of ERs as a successful land tenure model, with little out-migration in the CMER. First occupancy also exhibits an increase over time, perhaps due to the division of homesteads in order to establish new family homesteads. Inheritance declined though the difference is not significant.

Finally, the number of residents rose significantly, perhaps due to in-migration, as living conditions have improved in the CMER, especially in the rubber estates bordering towns. Many family members, especially the younger ones, who may have previously moved to town looking for job opportunities and/or education, have returned to live in the CMER.

Table 3-3. Socioeconomic indicators, farm households in Uruará, Pará

	Uruará 1996 [1] Full Sample	Uruará 1996 Panel Sample	Uruará 2002 Panel Sample	p(t-test), 1996-2002
Household Background				
Length of Residence (Years)	12.05 (6.78) [2]	13.49 (7.14)	17.81 (13.56)	<0.01
First Occupancy (0=No, 1=Yes)	0.33 (0.47)	0.36 (0.48)	NI	N/A
Acquired via Inheritance (0=No, 1=Yes)	0.02 (0.15)	0.03 (0.16)	0.00 (0.00)	0.08
Residents on Property (Persons)	7.23 (4.58)	7.47 (5.01)	5.81 (4.80)	0.04
Institutional context				
Community Assoc. Member (0=No, 1=Yes)	0.32 (0.47)	0.26 (0.44)	0.60 (0.49)	<0.01
Labor Union Member (0=No, 1=Yes)	NI	NI	0.45 (0.50)	N/A
Credit (0=No, 1=Yes)	0.57 (0.50)	0.70 (0.46)	NI	N/A
Receiving Retirement Income (0=No, 1=Yes)	0.23 (0.42)	0.23 (0.42)	NI	N/A
Market Access				
Distance to Town (km)	28.09 (13.87)	25.12 (11.82)	24.98 (13.18)	0.93

Notes.
1. The full Uruará sample contains 261 households and 347 lots; the Uruará panel contains 143 households with 170 lots in 1996 and 221 lots in 2002.
2. Values shown are either proportions (for binomial variables) or arithmetic means (for continuous variables). Values in parentheses are standard deviations.

Table 3-4. Socioeconomic indicators, seringal households in the Chico Mendes Extractive Reserve, Acre

	2000 [1] Full Sample	2000 Panel Sample	2004/2005 Panel Sample	2004/2005 Full Sample	p(t-test), 2000-2004	p(t-test), Uruará
Household Background						
Length of Residence (Years)	12.12 (10.24)[2]	13.36 (10.87)	15.45 (9.49)	13.75 (12.43)	0.38	0.02
First Occupancy (0=No, 1=Yes)	0.09 (0.29)	0.11 (0.32)	0.14 (0.36)	0.27 (0.45)	0.69	N/A
Acquired via Inheritance (0=No, 1=Yes)	0.23 (0.42)	0.22 (0.42)	0.11 (0.32)	0.19 (0.40)	0.23	<0.01
Residents on Property (Persons)	5.52 (2.76)	6.22 (2.65)	7.89 (2.87)	5.86 (2.75)	0.01	0.91
Institutional context						
Community Assoc. Member (0=No, 1=Yes)	0.65 (0.48)	0.64 (0.49)	0.68 (0.47)	0.61 (0.49)	0.74	0.75
Labor Union Member (0=No, 1=Yes)	0.55 (0.50)	0.53 (0.51)	0.70 (0.47)	0.69 (0.46)	0.15	<0.01
Credit (0=No, 1=Yes)	0.36 (0.48)	0.47 (0.51)	0.51 (0.51)	0.49 (0.50)	0.72	N/A
Receiving Retirement Income (0=No, 1=Yes)	0.15 (0.36)	0.17 (0.38)	NI	NI	N/A	N/A
Market Access						
Distance to Town (km)	40.13 (59.45)	??	??	43.81 (22.42)	??	??

Notes.
1. The CMER panel contains 35 households, each with one colocação. The full CMER sample in 1999 includes 66 households, and the full sample in 2004 includes 149 households, each with one colocação.
2. Values shown are either proportions (for binomial variables) or arithmetic means (for continuous variables). Values in parentheses are standard deviations.

This may be because the government created subsidies for rubber production, Brazil nut prices increased substantially, there were improvements in transportation via opening of unpaved feeder roads in the CMER, and huge improvements in education programs for both younger and older residents.

Comparing the two sites, we find distinct durations of residence (though actually somewhat longer in Uruará), and greater first occupancy in Uruará than the CMER (as expected, though the lack of comparable households for similar time points hamper this comparison), no significant difference in inheritance (perhaps less in Uruará, due to an active land market there and the land tenure system of the CMER in which the government owns the land), and similar numbers of family members, though with different dynamics (a decline due to aging in Uruará and a rise perhaps due to returning migrants in the CMER). In terms of household background, the two sites differ in many ways, though not in labor availability.

We also make socioeconomic comparisons in terms of the institutional context in which families find themselves. By institutional context we mean whether a household is a member of a community or neighborhood association, whether it has one or more rural labor union members, whether it had received bank credit, and whether it received retirement income. We view the first two indicators in terms of social capital via solidarity and ties to social movements (Vadjunec 2007); we see the last two as key sources of financial capital, which can complement labor assets and alter resource use. In general we expect social capital to be important in both sites, but especially in the CMER given its history of successful grassroots social mobilization, though we expect access to capital to be greater in Uruará due to the importance of FNO-e in the 1990s.

Table 3-3 summarizes the institutional variables for Uruará and Table 3-4 does the same for the CMER. In Uruará, some differences appear between the full 1996 sample and the panel,

which suggests less membership in community organizations and more access to credit. Some lack of comparability hinders temporal comparisons, but it is evident that community organization membership rose significantly over time. In 1996, there was widespread but not universal access to credit, and roughly one in five households sampled were receiving retirement income. In the CMER, some differences also appear between the full samples and the panel, where there appears greater membership as well as credit. Community association membership levels were high and steady over time, labor union membership was somewhat less common but rose somewhat, and retirement income is infrequent (at least in 2000). It is important for the rubber tappers to be associated with the community association for economic and social purposes. Due to their dispersed location in the forest, it is of utmost economic importance to access the market through the association. Government incentives for extractivism require association membership to access the subsidized prices for rubber.

Comparing the two sites, it appears that association membership is similar, at least in more recent data. The same holds for credit, and again this may reflect a convergence in more recent data. Retirement income appears slightly more important in Uruará, at least for the earlier dates of the surveys. Those characteristics seem to illustrate interesting historical and cultural perspectives. While in Uruará colonists have more social benefits, the rubber tappers from Xapuri, on the other hand, are more marginalized and isolated in the forest and depend more on social institutions to access government benefits. This helps to explain why the data show strong social organization among the extractivists. The lack of basic citizenships benefits of the CMER extractivist population has been a major concern for the Forest Government, which highlights the social component of the local and regional development paradigm, "Florestania," or forest citizenship (GovernmentofAcre 2005).

Finally, we compare the two sites in terms of market access. By market access we refer to distance to the nearest town; in Uruará that is the town of Uruará, and in the CMER, it is usually Xapuri but in some cases Brasiléia or Assis Brasil. Market distance allows a proxy appraisal of the costs of transport to market (Caldas *et al.* 2007), and thus the feasibility of commercializing cattle and other products. In Uruará (Table 3-3) the panel appears selective of properties closer to town for 1996, but a comparison of the panel cases with 2002 indicates a slight increase in market distance. This is due to acquisition of new lots somewhat farther from town, a strategy for expanding production systems fostered by unofficial road extensions (Perz *et al.* 2007). In Xapuri (Table 3-4), we observe a minor increase in market distance when comparing full samples from 2000 and 2004/2005. This increase is due to households from one seringal in the 2004/2005 sample, Icuriã, having a much greater distance to market than other households in the sample, with a distance of about 80 kilometers of road to access the closest city, Assis Brasil. As a result of the geographically-dispersed characteristics of extractivist households, they depend on multiple means of transportation, usually by animal from the homestead to the association nucleus with access to road, and then by truck to access markets in the city. Such difficulties for selling forest products influences households' experimentation in new land uses, such as cattle ranching, which offers advantages in marketing access.[6]

In brief, a socioeconomic comparison of colonist households in Uruará to forest homesteads in the CMER reveals several similarities, such as family size and association

[6] For the 2000 data, household distance to market was calculated by adding the time spent on transportation by animal from each colocação to a central point (association nucleus) with road access and distance from the association nucleus to nearest town. Both distances were measured in time traveled, with subsequent conversion to kilometers. Time on trails from each colocação to association nucleus was transformed considering 1 hour animal transport = 5km; time from association nucleus to town was transformed considering 1 hour in truck = 40 km. For the 2004/2005 data set, distance from the colocação to the association nucleus was calculated in km using UTM coordinates collected with a GPS unit. From this point to the nearest town, distance was measured in km using our car odometer and/or GPS unit.

membership. However, there are also many differences, which largely follow expectations based on the distinct historical contexts in the two locations. Given these differences, we turn to a comparative analysis of natural resource management in the two places, focusing on cattle ranching.

Comparisons of Natural Resource Management

Table 3-5 presents indicators of natural resource management for households in Uruará, and Table 3-6 does the same for the CMER samples. In both, we first present data on land use: total area claimed, and land under primary forest, crops, pasture, and secondary vegetation. All land use data are based on areas reported by respondents. In Uruará (Table 3-5), the panel in 1996 shows larger properties than for the full sample, an indication of some selectivity of households with more lots. But in both, primary forest covered roughly 60% of properties in 1996, and of the remaining area, the largest land use category is pasture for cattle production, which averaged roughly 30 ha. By 2002, property sizes, forest cover, and cropland in the panel had not changed significantly, but pasture area and secondary growth had both risen significantly. In the CMER (Table 3-6), homesteads claimed much larger areas, a reflection of the extensive nature of forest extractivism, where rubber tappers originally extracted from trees along 4-6 trails, each covering roughly 100 ha (e.g., Gomes 2001). A comparison of panels to full samples indicates (as in Uruará) some selectivity of larger homesteads. CMER homesteads in the panel did not exhibit significant changes over time in total area, forest cover, or cropland. Interestingly, the apparent rise in pasture area was not statistically significant, though there was a rise in secondary growth.[7] These dynamics in the panel are not as pronounced as in the Uruará

[7] The results for secondary growth in the CMER may be an artifact of differences in the data. We estimated secondary growth for 2000, based on the area under cropland and assumptions about cultivation time (3 years) relative to fallowing durations (8 years), derived from observations by the first and third authors during fieldwork

panel, and caution is necessary about pasture expansion based on the CMER panel, though the full samples for 2000 and 2004 provide some additional though limited support for this interpretation.

Tables 3-5 and 3-6 also present indicators of forest extractivism, annual and perennial crop production, and cattle. In Uruará (Table 3-5), there is minimal extractivism, and never rubber extraction. On the other hand, despite some selectivity in the panel for larger production systems, there is considerable annual crop production (as indicated by rice and beans) as well as production of perennial crop commodities (indicated by cacao, coffee, and black pepper). From 1996 to 2002, according to the panel, rice production declined significantly, though bean production did not. But there were also significant declines in coffee and especially black pepper, though not in cocoa. Conversely, cattle herds rose significantly from 1996 to 2002, among cattle on a household's own properties as well as in terms of cattle grazing on other properties. Overall, the average cattle herd per property in the Uruará panel more than doubled, from roughly 33 heads in 1996 to 80 in 2002.

In the CMER (Table 3-6), forest extractivism is very important. There are differences between the full samples and panel and the resulting trends run in the opposite directions, so we emphasize the panel when making temporal comparisons. In brief, Brazil nut extraction[8] rose while rubber declined, but neither change was statistically significant. Interestingly, extraction of both Brazil nut and rubber continued as of 2004/2005. Production of annuals also exhibits a

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and from contacts with knowledgeable informants who have conducted extension work in the CMER. Data on secondary vegetation for 2004/2005 are areas reported by respondents.

[8] Note that brazil nut extraction is typically measured in "latas." We follow Wadt, et al. Wadt, L. H. O., Kainer, K. A. & Gomes-Silva, D. A. P. 2005 Population structure and nut yield of a Bertholletia excelsa stand in Southwestern Amazonia. *Forest Ecology and Management* **211**, 371-384. in converting latas to kg by assuming 11 kg per lata.

Table 3-5. Natural resource management, farm households in Uruará, Pará

	Uruará 1996 [1] Full Sample	Uruará 1996 Panel Sample	Uruará 2002 Panel Sample	p(t-test), 1996-2002
Land use (ha)				
Total Area Claimed	133.44 (83.03) [3]	151.37 (98.41)	151.78 (119.35)	0.85
Primary Forest	86.10 (67.49)	95.18 (82.07)	84.11 (63.92)	0.25
Annual, Perennial Crops	8.85 (8.80)	10.51 (9.11)	10.34 (13.30)	0.90
Cattle Pasture	29.48 (27.06)	34.79 (26.75)	46.92 (76.44)	0.02
Secondary Vegetation	9.02 (11.04)	10.89 (13.72)	16.50 (21.52)	<0.01
Forest Extractivism (kg)				
Brazil Nut	NI	NI	5.58 (29.43)	N/A
Rubber	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.00
Annual Crops (kg)				
Rice	3007.92 (3669.43)	3326.02 (4140.03)	1159.42 (2131.41)	<0.01
Beans	284.83 (481.32)	264.69 (441.08)	184.96 (619.69)	0.32
Perennial Crops (kg)				
Cocoa	816.59 (2537.62)	1196.55 (3212.84)	1147.05 (3757.70)	0.85
Coffee	394.63 (1304.90)	560.75 (1691.10)	524.89 (1657.41)	0.01
Black Pepper	658.40 (1241.93)	973.25 (1507.91)	366.93 (748.23)	<0.01
Cattle (heads)				
On Own Property	23.52 (38.30)	28.68 (32.33)	68.56 (150.04)	<0.01
On Other Properties	2.49 (8.04)	3.40 (10.14)	12.49 (48.99)	0.02

Notes.
1. The full Uruará sample contains 261 households and 347 lots; the Uruará panel contains 143 households with 170 lots in 1996 and 221 lots in 2002.
2. Values shown are either proportions (for binomial variables) or arithmetic means (for continuous variables). Values in parentheses are standard deviations.

Table 3-6. Natural resource management, seringal households in the Chico Mendes Extractive Reserve, Acre

	CMER 2000 Full Sample [1]	CMER 2000 Panel Sample	CMER 2004/5 Panel Sample	CMER 2004/5 Full Sample	p(t-test), 2000-2004	p(t-test), Uruará
Land use (ha)						
Total Area Claimed	566.67 (319.29) [2]	633.33 (360.16)	634.29 (335.14)	491.89 (459.89)	0.99	<0.01
Primary Forest	551.21 (318.04) [3]	616.80 (357.62)	612.41 (330.71)	469.09 (458.71)	0.87	<0.01
Annual, Perennial Crops	2.28 (1.59)	2.35 (1.78)	1.83 (0.99)	2.26 (1.60)	0.14	<0.01
Cattle Pasture	7.10 (10.06)	7.93 (9.96)	9.17 (7.48)	8.80 (7.62)	0.55	<0.01
Secondary Vegetation	6.08 (4.23)	6.26 (4.76)	11.19 (8.88)	12.04 (16.85)	<0.01	0.05
Forest Extractivism (kg)						
Brazil Nut	2499.67 (3134.72)	2070.44 (2732.79)	2441.06 (2665.33)	1686.25 (2680.94)	0.56	<0.01
Rubber	268.61 (418.36)	250.56 (378.43)	200.60 (312.91)	142.68 (269.91)	0.55	<0.01
Annual Crops (kg)						
Rice	1248.79 (1342.09)	1378.33 (1687.85)	948.00 (832.86)	937.78 (664.75)	0.18	0.24
Beans	495.61 (834.96)	554.44 (965.73)	537.14 (648.17)	393.21 (431.71)	0.93	<0.01
Perennial Crops (kg)						
Cocoa	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.00	<0.01
Coffee	NI	NI	49.03 (207.60)	45.11 (194.58)	N/A	<0.01
Black Pepper	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.00	<0.01
Cattle (heads)						
On Own Property	8.35 (10.32)	10.50 (12.10)	16.57 (17.48)	14.20 (17.57)	0.09	<0.01
On Other Property	NI	NI	1.71 (5.62)	1.27 (3.70)	N/A	<0.01

Notes.
1. The CMER panel contains 35 households, each with one colocação. The full CMER sample in 1999 includes 66 households, and the full sample in 2004 includes 149 households, each with one colocação.
2. Values shown are arithmetic means. Numbers in parentheses are standard deviations.
3. Values for primary and secondary forest in 1999 are estimates based on swidden area and assumptions about fallowing practices.

somewhat mixed picture, with rice in decline (though not significantly, at least in the panel) and beans holding steady. Cocoa, coffee, and black peppers are of little importance in the CMER, and this did not change after 2000. Cattle, on the other hand, rose in importance over time (though this was of marginal significance in the panel, a similar change appears if we compare the full samples for the two time points), and in 2004, we have evidence of households running cattle on other homesteads, a indication of rubber tapper's awareness regarding land-use regulations and the political repercussions of increasing cattle stocks in their homesteads. As their cattle stocks increase and there is a greater need to increase pasture land in the homesteads, some rubber tappers prefer to not increase their pasture land, which can lead to substantial fines, and instead transfer part of their stock to other homesteads, usually occupied by a family relative who may have pasture land but little cattle.

Overall, resource management in the two sites was very different, as indicated by significant differences in the most recent data sets. In Uruará, annual and perennial crops are relatively more important, while in the CMER, forest extractivism is much more important. While cattle ranching appears more important in Uruará than in the CMER, whether measured in terms of pasture area or cattle herds, in both sites, we find ranching in expansion, and at a faster rate than other productive activities involving natural resource management. Whereas pasture area in both sites rose by 20-30% over roughly five years, cattle herds increased faster, from 60-200%.

Comparisons of Pasture and Cattle Management

The first part of our analysis documented a rise in cattle herds in the municipalities most closely tied to our study sites (Table 3-2 and Figures 3-2 and 3-3); the second part provided additional data specifically for colonist and forest extractivist households, and documented

pasture expansion as well as growing cattle herds (Tables 3-5 and 3-6). The third and final part of the analysis now focuses on practices related to pasture and cattle management, in order to provide more insight into the processes at work and gain some inkling of the prospects for cattle ranching among these small-scale producers. We focus on the most recent survey data from the two sites, which refer to the 2002 panel in Uruará and the full sample for 2004/2005 in the CMER.

Table 3-7 presents a comparison of pasture and cattle management indicators, broken down into six groups: general, inputs and practices, cattle herd composition, purchases and sales of cattle, along with site-specific indicators for compliance with deforestation rules (in the CMER) and future planning (in Uruará). Our general indicators are simply whether a household had cattle, and (for the CMER only) the time since first acquisition of cattle. The data indicate widespread adoption of cattle, in fact slightly greater in the CMER than among colonists in Uruará, though the difference is insignificant. The onset of cattle acquisition in the CMER is about 7-8 years before the 2004/2005 survey, recent compared to the average length of residence, which was roughly 14 years (Table 3-4), suggesting again that ranching is a relatively recent activity among residents.

Technological inputs and management practices in Uruará and Xapuri reveal some key characteristics about ranching among these subpopulations. For one thing, there is somewhat limited capitalization, measured here in terms of whether a household owned a chainsaw. Roughly half did in Uruará, whereas only about one-third did in the CMER. Significant differences also appear for investments in enclosed pastures: households in Uruará had far more fencing than those in the CMER, and roughly half of households in Uruará had corrals while

Table 3-7. Cattle and pasture management, farm households in Uruará, Pará, and seringal households in the Chico Mendes Extractive Reserve, Acre

	Uruará 2002 Panel Sample [1]	CMER 2004/2005 Full Sample	p(t-test), Site Comparison
Cattle Raising (0=No, 1=Yes)	0.83 (0.37) [2]	0.87 (0.34)	0.29
Cattle Onset (Years Ago)	NI	7.46 (7.54)	N/A
Inputs and Practices			
Chainsaw (0=No, 1=Yes)	0.53 (0.50)	0.34 (0.47)	<0.01
Fencing (km)	39.92 (105.35)	0.25 (0.56)	<0.01
Corral (0=No, 1=Yes)	0.49 (0.50)	0.29 (0.46)	<0.01
Fire Maintenance (0=No, 1=Yes)	0.50 (0.50)	0.73 (0.44)	<0.01
Pasture Planting (0=No, 1=Yes)	0.80 (0.40)	0.92 (0.27)	<0.01
Pasture Fertilizers (0=No, 1=Yes)	0.04 (0.19)	NI	N/A
Vaccinations (0=No, 1=Yes)	0.82 (0.39)	0.78 (0.42)	0.35
Mineral Salt (0=No, 1=Yes)	0.81 (0.39)	NI	N/A
Cattle Herd Composition (Heads)			
Bulls	NI	0.62 (0.67)	N/A
Cows	NI	5.57 (7.59)	N/A
Calves	NI	8.01 (10.24)	N/A
Total (Own Property Only)	67.56 (150.04)	14.20 (17.57)	<0.01
Purchases and Sales, Previous Year (Heads)			
Total Cattle Purchased	NI	0.64 (1.70)	N/A
Bulls Sold	10.38 (71.68)	0.19 (0.60)	0.10
Cows Sold	4.81 (14.72)	0.45 (1.32)	<0.01
Calves Sold	28.42 (151.96)	2.17 (3.99)	0.04
Total Cattle Sold	43.62 (168.30)	2.84 (4.77)	<0.01
Deforestation Rules			
Agree with 10% Deforestation Rule (0=No, 1=Yes)	N/A	0.81 (0.39)	N/A
Agree with 5% Pasture Rule (0=No, 1=Yes)	N/A	0.62 (0.49)	N/A
Future Planning			
Plans for Pasture (0=Other, 1=Expand)	0.59 (0.49)	NI	N/A
Plans for Cattle (0=Other, 1=Expand)	0.77 (0.42)	NI	N/A

1. The Uruará panel in 2002 includes 143 households with 221 lots; the Chico Mendes full sample in 2004 includes 149 households, each with one colocação.
2. Values shown are either proportions (for binomial variables) or arithmetic means (for continuous variables). Values in parentheses are standard deviations.

about 30% did in the CMER. The greater degree of capitalization in Uruará reflects the somewhat more established state of ranching among colonists (more pasture area, more cattle, etc.). That said, differences do not appear as great for management practices. More households relied on fire for pasture maintenance in the CMER than in Uruará, but pasture planting (*roçagem*) was common in both places, and the use of fertilizers for pasture maintenance was rare in Uruará and unknown in the CMER. In addition, the use of cattle vaccinations was virtually the same among households in the two locations, and the use of mineral salts (in Uruará, at least) occurred on a comparable frequency as vaccinations.The high proportions for use of vaccinations is likely a result of government efforts to eradicate hoof-and-mouth disease in the Amazon (Smeraldi & May 2008). The picture that emerges here is one where capitalization is related to the scale of ranching activities (i.e., chainsaws are more common in Uruará, where pastures and herds are larger), while the use of specific management practices among these distinct groups does not appear to vary as much, in part due to co-occurrence in the same national context as concerns beef production.

Table 3-7 also presents data on cattle herd composition. Unfortunately, this was documented more systematically in the CMER than Uruará. That said, herd composition in the CMER and that anecdotally observed in Uruará appear fairly typical of breeding systems for beef that are constituted by herds with a few bulls, many cows and numerous calves (Tourrand & Veiga 2003; Veiga *et al.* 2004). There is considerable variability in herd size among households in both of the sites, and in the CMER this also applies to each category in the herd.

More illuminating are the data for purchases and especially sales of cattle. Whereas we have anecdotal evidence of considerable cattle purchasing in Uruará during the late 1990s (e.g., Toni 1999), data from the CMER suggest very limited acquisition of cattle via purchase (in the

year prior to the 2004/2005 survey). Similarly, whereas households in Uruará sold several bulls, a few cows, and many calves, totaling roughly half the herd size, in the CMER, sales were a relatively smaller proportion of the herd, especially for cows and calves. This suggests that cattle ranching among small farm colonists in Uruará is very focused on breeding for sales, whereas ranching in the CMER may be more focused on accumulation (where cattle is an investment) than liquidation per se. This is also an indication that cattle in the CMER is undergoing an initial stage of establishment having less economic importance for the household income composition than in Uruará. Nevertheless, it represents a stage of evolution in which cattle are increasingly gaining in economic importance in relation to the total annual income of a typical rubber tapper householder. Cattle are sold mostly in critical moments of household decision-making, including sickness of family members, housing improvements, equipment acquisition, to pay off a debt, among others. These findings raise interesting questions about buyers of cattle in the two sites, especially Uruará, where there is some indication that small-scale operations sell to buyers who then sell to larger operations that fatten cattle for the slaughterhouse (Veiga *et al.* 2004). In the CMER there are few "middlemen" operating inside the CMER, usually someone with connections to larger-scale cattle ranches in the region that fatten cattle for the slaughterhouse, like in Uruará. Middle-men offer advantages to rubber tappers, mainly freeing them of responsibility to pay transportation costs, in addition to cash on receipt.

The last two sections of Table 3-7 deal with issues specific to the two sites. In the CMER, a key issue concerning pasture formation for cattle ranching are the regulations limiting deforestation (up to 10% of the area of the CMER) and pasture (up to 5% of the CMER). While all available data indicate rising deforestation and expanding pasture areas in the CMER, a large majority of respondents in 2004/2005 supported the 10% deforestation rule (Vadjunec 2007).

However, a somewhat smaller majority supported the 5% pasture rule. Remote sensing data for the CMER (Vadjunec *et al.* nd) suggest that clearing (at least up until the late 1990s) had not yet approached the 10% limit, but if pasture continues to expand as a proportion of the area cleared, it was, in some instances, likely surpassing the 5% limit by the mid-2000s, which may help explain the lower degree of support for the 5% pasture rule.

In Uruará, a key issue concerns the future of ranching as a livelihood option, given problems with alternatives, access to special credit lines in the 1990s, and the rapid expansion of ranching there since 2000 (e.g., Table 3-2). In the 1996 survey, roughly half of the households interviewed (as well as half of the households re-interviewed and therefore included in the panel) indicated an intent to expand their cattle herd (not shown in Table 3-7). In the 2002 survey, such intentions had increased in frequency to 60-80%, especially for expanding cattle herds. This suggests that liquidation may be proceeding alongside expansion in herd size.

Discussion

These results raise many questions about cattle ranching among colonist smallholders and forest extractivists. Whereas ranching among colonists has already received attention (e.g., Walker et al. 2000; Tourrand and Veiga 2003), we focus here on interpreting the motives and process for the expansion of cattle herds in the CMER, followed by a comparative analysis of the processes at play in the Uruará colonization case.

Despite the 'theoretical' economic potential of NTFPs (e.g., Godoy et al. 1993; Grimes et al. 1994; Peters et al. 1989), the traditional livelihood system of forest people in the region suffer from limited options for extractivist diversification and development of value-added non-timber forest products. Most initiatives involving NTFPs have run into market obstacles that limit their economic benefit for local communities (e.g., Godoy 2000; Godoy et al. 1997). These profit-reducing barriers include: absence of demand, great distance to markets, lack of efficient

marketing structures, weak social institutions, and poor development incentives. These activities are increasingly abandoned once more rewarding alternatives become available and as increasing pressure on household labor resources make these low-value, labor-intensive activities no longer attractive. Given the difficulties securing markets for value-added extractivist products, forest people find themselves 'losing faith' in extractivism where they fail to see economic gains. As a result, forest residents have turned toward the short-term economic benefits of cattle raising.

It appears that decisions about cattle adoption among extractivists in the CMER reflect the economic value of cattle, the ability to avoid transportation and market access difficulties, and the lack of enforcement of restrictions on deforestation and pasture formation. Cattle are considered a means of storing and accumulating wealth, enabling extractivists to sell when cash is needed. This perpective is shared by an extractivist from the rubber estate Paraguaçu, who sees his cattle as a life insurance policy for himself and his children: "Extractivists are investing in cattle because it's the easiest product to sell and it can guarantee security for the producers, which you can't get with extractivist or agricultural products. They don't give you anywhere close to the same price or market [demand]."

Ranching is an attractive economic opportunity for CMER communities because of the easy market access for livestock. As the president of the Rural Workers' Union of Assis Brasil put it: "The Reserve didn't present the opportunity for rubber tappers to extract more profit from the forest. Cattle did, and they leave the forest on their own legs, so there are no problems with transport…So a lot of people found that they could make a living through cattle."

In addition, competing land tenure systems in the region influence forest extractivists' decision for cattle raising activities. Much of the CMER is surrounded by large cattle ranches and colonization projects with extensive pastures. Ranching is practically the sole activity

practiced in those neiboghboring areas, and forest extractivists perceive their neighbors practicing ranching with access to transportation, electricity, and housing, among other material goods, giving extra proof of the benefit of cattle for their economic well-being. Such perceptions, and weak enforcement of forest clearing and pasture establishment restrictions in the CMER, have thus also fostered adoption of cattle ranching there. As the president of the Rubber Tappers Association in Brasiléia explained: "The rubber tapper has thought a lot about his quality of life. They thought at first about their land that cattle ranchers were taking away from them. They thought about the land, but not about rubber prices. The rubber tappers were seeing this happen and seeing the condition they themselves were in - and what did they think? They thought about cattle ranching. Why not? The cattle ranchers and colonists raise cattle outside the reserve, and the rubber tappers who saw this began ranching, too. Thinking about it today, what makes the extractivists' deforest is the development of the reserve that never took off."

While raising a small number of cattle has always been defended by extractivist communities since cattle provide milk and transportation, herd size has steadily grown among forest people. As one Rubber Tappers Association leader explained, "How was the idea of raising cattle born for the extractivist? When everyone was engaged in tapping rubber and the price was very low, a rubber tapper had to tap 15 kilos of rubber to buy a jug of milk (*lata de leite*) in the city for his child. Everyone already has thoughts of keeping a few heads for milk and transportation. They then start to feed on this idea and begin to like raising cattle. Herds start becoming large, and the extractivist starts to dedicate himself to raising more cattle because of its economic attractiveness."

Pasture formation provides opportunities that do not necessary depend on cash surplus. When a householder has pasture land available, capital constraints can be overcome to initiate

ranching by renting the land through informal contract to a neighboring householder with growing herd size but limited pasture. A neighbor with an established cattle herd might also place cattle under the care of another household who performs the work of a *meeiro*, one who raises another's cattle, and will be responsible for the feeding, maintenance and care of the animals. Often these cattle are young females, which are mated with bulls, and the offspring are divided equally between the cattle owner and the pasture landowner. In addition, initial ranching might begin around family relations. For example, a newly married son is customarily granted a few heads of cattle if the family householder head is engaged in the activity.

Cattle trade is a year-around activity providing sustained cash influx for the CMER residents, although more intense during the dry season since transport is easier. Residents of the CMER also know that when they need cash they can go to the city to sell their cattle at any time. Another method that facilitates the cattle trade market all year around is through agreements that middlemen have developed with some residents of the reserve, usually someone who owns a larger cattle herd in specific areas. These residents buy cattle for the middlemen whenever a neighbor puts them up for sale. The middlemen provide some advance cash for their purchases and thereby dominate the market among householders. It is uncertain if forest extractivists will continue to increase ranching in the extractive reserve, as its controversial aspects have not yet been openly discussed among different actors of extractive reserve management. Although both deforestation and small-scale cattle ranching are on the rise in the CMER, this does not mean that traditional livelihoods systems offer no promise, as local governmental agendas have developed several experiments to strengthen the state extractivist economy.

Comparative Analysis

Regional market prices largely explain cattle adoption among smallholder colonists and forest extractivists, despite their cultural differences and contrasting historical trajectories.

Whereas Uruará colonists were settled in the region with the opening of the Transamazon Highway, forest extractivists in Xapuri were organizing against the very same policies of road construction and agricultural land settlement for cattle ranching Nonetheless, roads have played an important role connecting colonists as well as extractivists to local and regional markets, which has motivated shifts toward products easily transported and marketed, such as beef.

While there are important contrasts in the productive activities and the economic difficulties facing colonists in Uruará and extractivists in the CMER, they also found similar economic opportunities involving cattle ranching. The cyclical adaptation among colonists is not observed among forest extractivists, who practice subsistence agriculture, almost no perennial crop production for marketing, and have managed to maintain their traditional production system over the years. Cattle ranching nonetheless became an economically attractive livelihood option. Forest extractivists faced an option: to be part of the economic process with a different level of well-being in which forest products have a lesser role.

Such contrasts alongside the convergence around cattle ranching raise additional comparative questions about prospective changes among colonists in places like Uruará and extractivists such as those in the CMER. Smallholder colonists in Uruará have existed for three decades and have seen many changes in land use practices and economic fortunes (Perz 2003). With diversified market oriented land use practices, colonists have acquired important strategies to respond to fluctuating regional markets. With continued improvement of market links, agricultural technologies, and land consolidation, colonists tend to improve diversification with mechanized agriculture and intensive cattle production. The cattle sector will continue to increase in the regional economy, playing a larger role in the household economy. Land consolidation is likely to benefit households that intensify cattle raising, and colonists will

gradually turn into larger land holders, with pasture for cattle as the predominant land use (Aldrich, et al. 2006).

Government development policies in Acre are also encouraging the extractivist population to diversify modes of production, locally called neo-extractivism, which refers to an alternative vision of forest use and conservation that builds on the cultural, political, and economic context of local people (Rego 1999). Neo-extractivism argues that to improve the economic situation of extractivist families, alternative technologies that increase the marketing return for traditional non-timber forest products need to be combined with the incorporation of new extractive products. The government of Acre created a series of incentives for entrepreneurs to establish sustainable logging activities and for community-based timber management operations. Acre recently became the first state in Brazil to achieve Forest Stewardship Council (FSC) certification in a community-managed forest, to improve their access to national and international markets. Advocates of sustainable logging have argued that timber-management can play an important role in income generation, slowing down cattle expansion in the CMER, thereby rendering viable forest extractivism. However, the proposal for logging in the CMER has generated a polemic debate among extractivists due to concerns about damage to the forest and prohibitions on logging in the ERs. Furthermore, without proper management and monitoring, logging is unlikely to be an sustainable alternative. Any alternative to cattle expansion in the reserve has to build on a comprehensive understanding of the processes that have contributed to it, including limitation of diversified extractivist production, and the short-term economic benefits that cattle ranching provides. No single "solution" is likely to change this current economic trend of forest extractivists' economic development**.** There is an undercurrent of political anxiety in policy-makers and rubber tapper leadership about the growth and uncertainty

of cattle ranching in ERs, reflected in the feeling of symbolic discontinuity that cattle ranching represents for forest extractivism as a culture and the historical trajectory out of which it developed. While ranching is a reality among the productive activities practiced in the CMER, cattle has caused its own political controversy among the extractivist population. The debate over diversified extractivism with forward linkages under the neo-extractivist concept is likely to limit cattle expansion in Extractive Reserves over the long-run. But its current adoption shows immediate needs to specify the ways in which diversified development approaches affect forest conservation and the socio-economic well-being of communities in the region.

Conclusions

Showing similar trends regarding the growth of cattle raising in Xapuri and Uruara, the results suggest a regional push toward cattle ranching expansion among colonist smallholders and forest extractivists in the Brazilian Amazon. Cattle ranching among colonist and forest extractivists are driven by market forces, but also have distinct political development contexts. Smallholder colonists present a more diversified economy with greater market links in which cattle ranching is consolidated as a economic practice, while forest extractivists, regardless of the potential of forest products to improve local livelihoods, have more limited economies in which cattle represent a viable option under an uncertain economy, and they have not yet confronted the political and development controversies of cattle raising in Extractive Reserves.

Cattle ranching among forest extractivists in Xapuri is a challenge and may represent an opportunity to promote a broader debate to review forest resources co-management pacts by government institutions and grass-root organizations for Extractive Reserve administration in the very place where it was negotiated twenty years ago.

CHAPTER 4
LAND-USE/LAND-COVER CHANGE AMONG RUBBER TAPPERS IN THE CHICO MENDES EXTRACTIVE RESERVE, ACRE, BRAZIL

Introduction

Tropical deforestation is arguably the most significant type of land-use/cover change (henceforth, land change) underway globally, given its multi-scalar and -dimensional elements affecting a wide range of ecosystem services from landscape-level precipitation, to river basin hydrology, and to the functioning of the Earth system, including global climate change (Myers 2000, Watson *et al.* 2000, Steffen *et al*. 2004, Bunker *et al.* 2005, Lambin and Geist 2006). No region of tropical deforestation has drawn more concern than the Amazon basin, especially the Brazilian Amazon. The Amazon remains a hotspot for tropical deforestation (Achard *et al*. 2002; Asner *et al.* 2005) with profound, documented impacts on a full range of ecosystem to earth system concerns (Nobre et al. 1991, Salati and Nobre 1991, Gash *et al*. 1996, Laurence *et al*. 2000; 2002, Ferraz *et al*. 2003, Houghton *et al*. 2005). Deforestation follows the expansion of the logging and agricultural frontier, both increasingly driven by global markets (Faminow 1998, Mertens *et al.* 2001), while traditional people struggle over access to land and resources (Schmink and Wood 1992). Pan-Amazon and especially Brazilian policies, therefore, have the challenge of balancing environmental concerns with land reform while ensuring economic growth and development (Hecht and Cockburn 1990, Smith 2001, Kainer e*t al*. 2003).

The Brazilian Extractive Reserve System (ER) is one form of land use and entitlement seeking this balance. Threatened by cattle ranching and large-scale agricultural projects, traditional extractivists in the region—those who live mainly off of the extraction of non-timber forest products (NTFPs) such as rubber, Brazil nuts and hearts-of-palm — have fought for the legal recognition of their land rights. The ER was born out of the increasingly recognized need for sustainable development (WCED 1987, IUCN 1995), within the context of economic and

social justice, particularly for Chico Mendes and the Rubber Tappers Union (CNS 1985). Under this system the government holds the title to the land, while extractivist associations hold concessions to its use. The ER, therefore, has two complementary goals: (1) the conservation of important ecosystems, such as forests, and (2) the preservation of traditional extractive economies and cultures through sustainable development (MMA 2004).

Since its creation in 1990, ER has been championed by many as a win-win (sustainable development) model in which reserve residents conserve the forest in a form of sustainable use, which is expected to lead to economic growth and improved well-being (Murrieta and Rueda 1995). ER thus joins a litany of efforts worldwide to use "working preserves or parks" to maintain forest cover and ecosystem integrity through maintenance of "traditional" uses (Alcorn 1992, Gomez-Pompa and Kaus 1992, Terborgh and Van Schaik 2002, Tucker 2004, Zarin 2004). Recognizing that many forest lands are co-evolved landscapes (Alcorn and Lynch 1992, Clement *et al.* 2003), the win-win character of these efforts, especially regarding the material development of the peoples involved, remains an open question, with critics of parks citing problems of corruption, bureaucracy, political instability and the further marginalization of the poor, among others (Terborgh and Peres 2002, Van Schaik 2002, Van Schaik and Rijksen 2002).

This concern is muted by some advocates of the ER who, in their attempt to legitimize the rubber-tappers movement and alternative forms of development, may have overly romanticized both the rubber tappers and the main objectives of the extractive reserve model. Since his assassination in 1988, rubber tapper leader, Chico Mendes has himself reached almost mythic proportions, being described as an "ecologist," a "rain-forest Gandhi," an "eco-martyr," and one of the "50 most important environmental thinkers in history" (Gale 1998, Palmer 2002, Maxwell 2003, Revkin 2004). To others, he was a hard-hitting communist party labor leader and a

"radical political militant" (Hecht and Cockburn 1990, Maxwell 2003). Such extreme descriptions are not limited to Chico Mendes but to the rubber tappers themselves, and even to descriptions regarding the sustainability of the ER model.

A polemicized debate concerning the sustainability of the ER model has emerged with little common ground between advocates and critics. Proponents argue that ERs serve to lower deforestation rates, protect biodiversity and ecosystem integrity, and as buffers preventing or inhibiting land-cover destruction by fire, while preserving the culture and ensuring the economic livelihood of traditional forest-dwelling people (Allegretti and Schwartzman 1989, Anderson 1990, Hall 1997, Nepstad *et al.* 2006). Brazilian environmental policy makers, environmentalists, and the National Council of Rubber Tappers (CNS), often backed by financial support from the international community, have favored this type of "green" development and press for the creation of ERs and other conservation units to cover 10 % of the Brazilian Amazon, an estimated 500,000 square kilometers, or roughly the size of Spain.[1] By February 2008, 39 federal Extractive Reserves, and 25 state Extractive Reserves, covering an area of over 12 million hectares, had already been created in the Brazilian Amazon.

Critics question the reserves in terms of their economic, social, and environmental sustainability (Fearnside 1989, Browder 1992). Specifically, the reserves have been criticized on issues of biodiversity—that extractivists and extractive activities may have a negative, predatory affect on both flora (Moegenburg and Levey 2002) and fauna (Peres 2005). Furthermore, some economists suggest that, historically, extractivism has not been able to alleviate poverty, and this exclusive kind of economy will eventually disappear, as economically valuable forest products

[1] Increasingly, the concept of extractive reserves is expanding, being applied to a diverse range of ecological and social contexts outside of Amazonia, including non-rainforest environments, such as marine areas on the Atlantic coast of Brazil, and increasingly in savanna ecosystems where soy-bean expansion threatens both local environments and traditional populations (Theulen 2006).

inevitably end up being grown on plantations, at less cost and of higher quality (Homma 1989, Browder 1990, Homma 1994).

Much of this debate is theoretical in nature, lacking systematically collected socio-economic data collected on ERs. More recent studies in the Chico Mendes Extractive Reserve (CMER) have tried to ground these arguments by focusing on field-based data collection and analysis of both livelihood trajectories and the ecological impacts of such livelihood decisions by residents of the CMER (Sassagawa1999, Gomes 2001, Wallace 2004, Eringhaus 2005, Vadjunec 2007).

A deeper understanding of this debate, aided by the results of research being carried out in the CMER, is increasingly important because criticisms surrounding the ER system have been re-ignited. In August 2005, runaway fires ravaged the CMER for three weeks before they could be contained. The fact that it was the rubber tappers themselves who accidentally started the fires outraged much of the public, sparking tensions by some regarding the legitimacy of the entire ER model. As a result, the reserve's ability to perform as a conservation unit is currently under fire in the Brazilian national press, with a few critics accusing many ER parks as a "conservation lie", grounded in "pseudo science", and offering as 'proof' examples of (non-Federal, non-ER) state-run ERs in Rondônia, where between 60-100 % of forest cover has already been lost (Brito 2005b).[2]

The CMER has witnessed a substantial growth in pasture and small-scale cattle ranching triggering deforestation in some areas (Gomes 2001), although the scale of deforestation is low compared to the surrounding region. A three percent total forest-cover loss between 1986 and

[2] While we recognize that state-run extractive reserves in Rondônia are currently undergoing extreme land-use pressures (Euler et al. 2008), we argue that they should be considered an exception, not the norm, and addressed separately from the ER system.

1999 was recorded in the reserve by two remote sensing analyses (CNPT 1999), one of which suggests that some communities in the CMER are close to reaching their allowable limits of deforestation and would reach them by 2003 (Sassagawa 1999). While variation among rubber tapper communities is addressed in this last assessment, less attention has been given to explaining the reasons why such variation exists (Gomes 2001) and virtually no attention has been given to assessments of deforestation as associated with the variation in community livelihoods in the CMER. In fact, considerable variation in community economies has emerged in the reserve, with some communities focused more on extractivist activities and others more on agriculture and cattle rearing.

This paper compares deforestation in the communities in the CMER with their diverse livelihoods practices. This exercise is important because it helps to illuminate the relative impacts on forest conservation and household income of different human-environment conditions existing in the reserve, thus providing insights about the ideal conditions for sustainability of the CMER considering its dual purposes of forest conservation and sustainable development (economic growth and resident well-being). In order to explore this relationship, six communities are examined in the CMER, four of which were projected to surpass their legal deforestation limits by 2003. Using remote sensing and household surveys, this study asks the following sub-questions:

(i) What are the land-use practices in the six communities and how are they changing?

(ii) What are the amounts and rates of deforestation and secondary regrowth within the six communities between 1986-2003?

(iii) Have any of the six communities surpassed allowable deforestation limits within the reserve, thus compromising the reserve's role as a conservation unit?

Study Area

Chico Mendes Extractive Reserve

The CMER, located in southeastern Acre (also known as the Alto Acre Region), is the most famous of all the ERs. It was created on March 12, 1990 by Federal decree, comprises 970,570 hectares, and is located approximately between latitude 10˚ 05’ 41’’ S and 11˚ 00’ 00’’ S and longitude 67˚ 56’10’’ W and 69˚ 48’22’’ W (Figure 4-1). Approximately 12,000 people (about 2,000 households) live within 46 different *seringais*, or rubber tapper estates, within the reserve (CNPT 1995). The BR-317 highway runs along the eastern and southern boundaries of the reserve, connecting the capital of Rio Branco to Acre’s other major urban centers of Xapuri, Brasiléia, and Assis Brasil, and connecting Brazil to both Peru and Bolivia. The more isolated regions of the reserve can be accessed by the Acre, Xapuri and Iaco rivers.

The CMER is, for the most part (73%), an open tropical forest biome high in both palm and bamboo species diversity with an average annual rainfall of 2,200 mm, a mean temperature of 26˚ C, and a marked dry season (from May to August) where average temperatures climb to about 38˚ C. The remaining 27 % of the reserve is classified as dense tropical forest, which can mainly be found in the municipality of Brasiléia (CNPT 1999). This type of forest is often richer than open tropical forests in many key extractive species, such as açai and the Brazil-nut tree, thus providing some communities with inherently greater extractive potential. Topography of the region is slowly undulating, or “hilly,” and elevation varies between 100-300 m. In general, the reserve is dominated by a mix of mainly eutrophic and dystrophic soils, which, according to state authorities, provides workable soils and marked agricultural potential with the adoption of proper management practices (GovernmentofAcre 2000a).

Although the reserve’s title is held collectively by the reserve’s associations, individual resource parcels are given to each household, based on a traditional land-use system known as

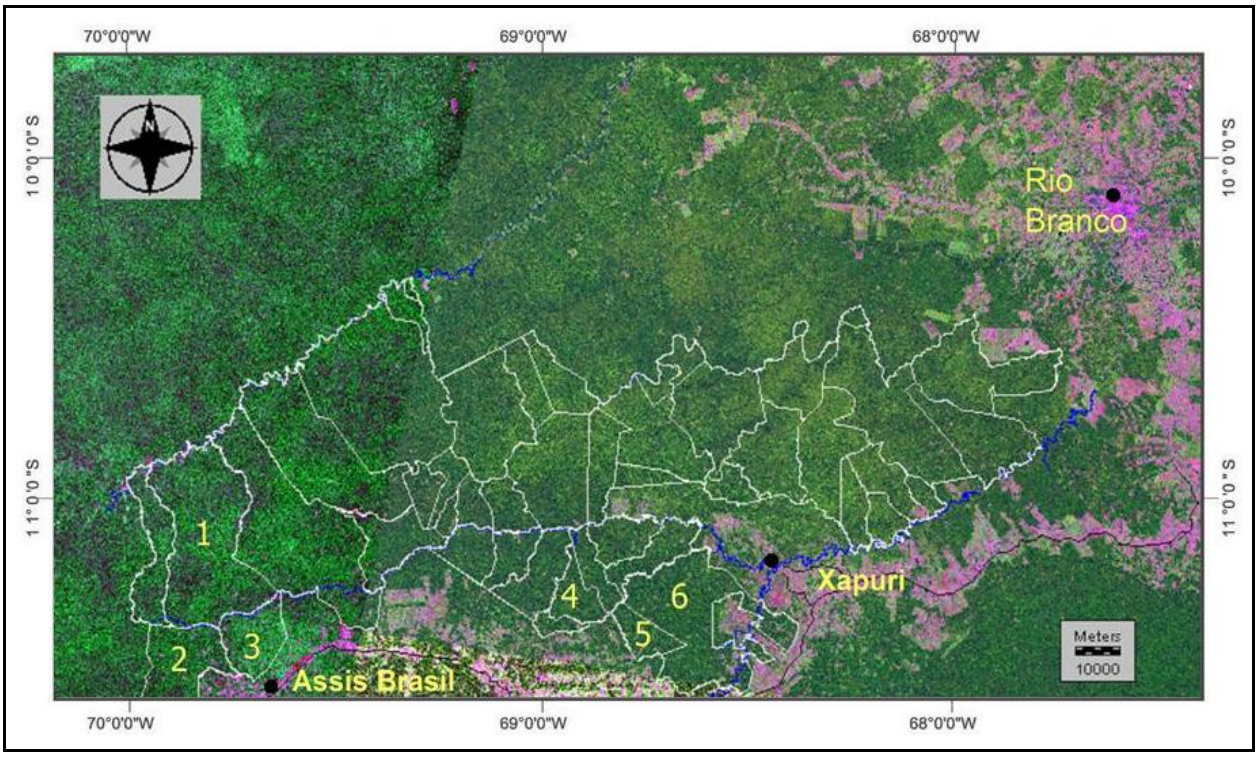

Figure 4-1. Study area:and study sites within the CMER: (1) Icuriã, (2) São Francisco, (3) Paraguaçu, (4) Humaitá, (5) Porongaba, (6) Filipinas

the "*colocação*," where the emphasis is on resources in the parcels, not on the land itself. A typical *colocação* contains the rubber tapper's house and other farm buildings, water well or small creek, patio garden, fruit orchard, agricultural plot, and pasture, if any. Historically, the most important asset in a *colocação* is the number of "*estradas de seringa,*" or rubber trails, held by each household. A household does not hold *de jure* title to the land, but instead possesses the right to use the resources found within the *colocação* and rubber trails (mainly Brazil nut and rubber trees, historically holding the most value).

At the reserve's creation, each rubber tapper was guaranteed at least three rubber trails, which is estimated to be roughly equivalent to 300 ha, although some families have more or less after trading, buying, or dividing up properties. In most *seringais* there is no communal forest as in a traditional common property regime; all forest is claimed by some household or another.

The Utilization Plan (PU) for the CMER, which was made by the rubber tappers themselves, sets the allowable deforestation limits at 10 % of the *colocação*, or theoretically 30 ha, with 5 % (or 15 ha) allowed for pasture conversion. The nature of the *colocação* makes it difficult to map as rubber trails often intersect and overlap. It is important to note that households do not have traditional geometrical plots that are easily mapped and bounded. Furthermore, the CMER is a common property system where enforcement and regulation occurs mainly through the social organization at the community level. As a result, most monitoring of the 10 and 5 % rules occurs at the community level, instead of the household level, if at all (Sassagawa 1999, Gomes 2001, Ankersen and Barnes 2004). Recently, the efficacy of the reserve has been questioned due to the expansion of small-scale cattle ranching within the reserve (Gomes 2001). In order to understand the controversy surrounding this recent land-use and livelihood change, it is important to look to the past. In the next section, we discuss the history of rubber in Acre, resulting in the CMER today, and the changes in land-use currently underway.

Land Use History and Livelihood Trajectories Among Rubber Tappers in Acre

Starting with the rubber boom of the late 19th century, the state of Acre has had a long and varied history of rubber tapping and latex production (Barnham and Coomes 1996). By the late 1880s, the rubber trade was so economically important to the local, regional, and global economies that, accordingly (Hecht and Cockburn 1990: 80, Stokes 2000: 232), Acre was claimed to be one of the most valuable and important pieces of commercial real estate on earth, where at its peak in 1912 was exporting approximately 1,200 tons a year to French, Belgian, British and American firms (Coêlho 1982: 68).

This booming economy required many workers in a place where populations were sparse, the landscape was unforgiving, and the labor supply scarce. As a result, the peasant poor from the drought-stricken areas of the Brazilian Northeast were encouraged by the Brazilian

government to migrate into the rubber territories of the Amazon. In the drought of 1877 alone, an estimated 100,000 North-easterners migrated into the Amazon region (Hecht and Cockburn 1990: 80). The rubber barons supplied the rubber tappers with trade goods, food, work supplies and even the cost of their passage on credit, thus keeping the tapper indebted to continue tapping rubber for a relatively low price. Rubber tappers were regularly discouraged and even banned from practicing agriculture in their *colocação*, resulting in both the protection of precious extractive species and historically low deforestation rates, while keeping the tappers dependent on the rubber barons and middle-men who delivered supplies.

The first rubber bust occurred in 1915 with the development of the Southeast Asian rubber plantations, when rubber exports for the whole of Amazonia fell to just under 30,000 tons annually (Coêlho 1982: 70). Not only was the cost of rubber production lower in Asia; Asian plantations also received a better price for a higher quality product, thus making it difficult for Brazilian-based firms to compete. By 1932 the market all but bottomed out, with the whole of Amazonia producing less than 5,000 tons of rubber annually (Dean 1987: 169).

The second and short-lived rubber boom came with the advent of the Second World War, and an urgent need for latex among the United States and its allies (Corrêa 1967; Martinello 1998). The Brazilian government was called upon to triple its latex production, creating the "Rubber Reserve" and calling for "*soldados de borracha,*" or rubber soldiers, to fulfill their patriotic duties, offering up promises of a soldier's respect as well as a pension (only recently realized) in return for their rubber tapping services. By 1947, the US and Brazilian governments had pulled funding for the "Rubber Reserve," and once again, the Amazonian rubber economy went bust, causing many rubber barons to abandon their rubber estates, leaving rubber tappers to fend for themselves.

While many rubber tappers fled to Acre's urban centers, many tappers stayed in the abandoned rubber estates supplying local and regional markets with latex (otherwise banned for importing into Brazil) and engaging in hunting, Brazil-nut collecting, and subsistence farming. The rubber tappers were left alone until the 1970s when the military government officially "opened" the Brazilian Amazon for development. In Acre, this new development policy often led to violent land conflicts between rubber tappers and cattle ranchers, where rubber tappers were evicted and former rubber estates were cleared by cattle ranchers. It was under the context of such conflicts, along with increasing environmental concerns, that both the CMER and the entire ER system were created (Allegretti 2002).

According to a reserve-wide study completed immediately following the reserve's creation, rubber was the main source of income for residents of the reserve, representing 44.7 % of the total household income, while 24.6 % of the household income came from Brazil-nut collection (in other words, almost 70 % of a household's income was derived from NTFP extraction) (Feitosa 1995: 70, see also CNS 1992). Agricultural production represented 21 % of the household income, while small animal breeding and cattle rearing represented 4.8 and 4.2 % of the total income respectively (Feitosa 1995: 70). At this time, not only was rubber production the most important economic activity, the CMER produced more rubber than any other extractive reserve, producing on average 714 kg of rubber per family per year (Feitosa 1995: 70).

Ironically, in the mid-1990s, just as the rubber tappers themselves were gaining the long overdue recognition they deserved, and as the CMER was being formalized, Brazilian policies ended the forced import bans and national subsidies placed on rubber. The rubber tappers finally gained land security, but at the same time lost many of the protections and incentives placed on their main source of livelihood. They also, during this time, gained autonomy to make their own

land-use decisions. As a result, many rubber tappers have abandoned latex production altogether and are increasingly drawn to small-scale agriculture, animal husbandry, and even cattle production, resulting in the deforestation of concern within the CMER.

With the creation of the reserve came the long overdue recognition and inclusion of rubber tappers in Amazonian development policy. On the one hand, rubber tappers are faced with long-term market challenges regarding latex production and other NTFPs. On the other hand, with the creation of the reserve, they also have increased road access and therefore opportunities to participate in more diverse markets. The dominant market opportunities available in Acre, despite the attempts of the pro-forest government to build a sound sustainable development policy, unfortunately, are often not based on sustainable strategies, but instead are influenced by local and regional economies operating outside of the reserve, which privilege cattle, and to a lesser extent, agriculture, over rubber and NTFPs. Overall, cattle ranching is now one of the most important economic activities in Acre and contributes more than 60% of the state tax revenue (Valentim et al. 2002). Furthermore, recent studies suggest that smallholders are responsible for roughly 62 percent of the new deforestation in Acre (Barreto et al. 2006).

Activities of large-holders are increasingly constrained by the large amount of protected areas in the region. This constraint, however, provides new opportunities for historically neglected smallholders to participate in these new market economies. As a result, extractivists are increasingly turning to more intensive land uses, such as market agriculture and cattle raising.

This brief overview of land use trajectories among the rubber tapper population points out the reality that the political economic conditions under which the original rubber tapper land holdings and economic livelihood orientations were established may no longer exist. Many of the rules and regulations applied to their *seringais* remain, however, based on the assumption

that the extractive reserve model can improve resident well-being while protecting the majority of the forested area—the win-win solution.

Methods

Site Selection

Research was carried out in a total of six rubber estates within the two municipalities of Assis Brasil and Brasiléia (three estates each) of the reserve (Figure 4-2). The base characteristics of each rubber estate are provided in Table 4-1.

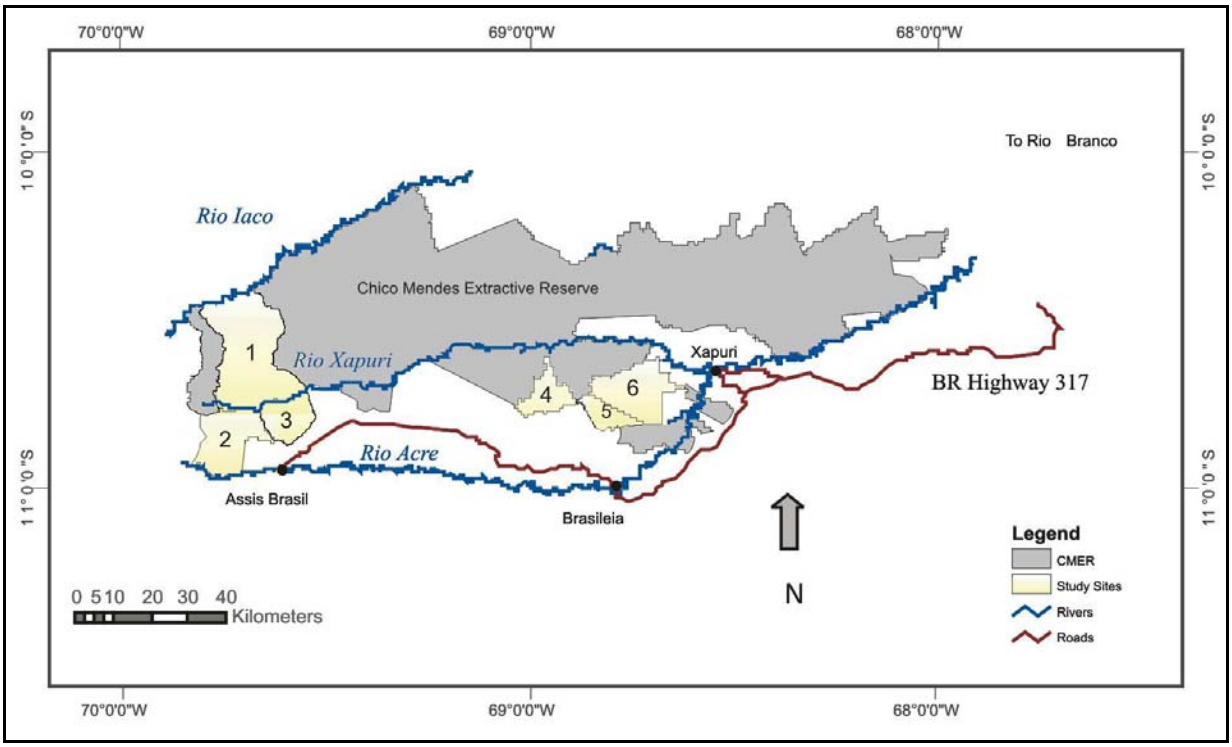

Figure 4-2. Location of the study communities within the CMER: (1) Icuriã, (2) São Francisco, (3) Paraguaçu, (4) Humaitá, (5) Porongaba, (6) Filipinas

Communities were chosen with the help of the municipal level reserve associations based on the following criteria:

(i) Rubber estates were open and inviting to outside research. This was an important factor as the reserve is considered Federal property and outside research requires an invitation from the

communities and a research license from the National Centre for the Sustainable Development of Traditional Populations (CNPT).

(ii) Among those rubber estates chosen by the associations, estates were stratified based on perceptions of the reserve leaders on traditional extractive orientation versus non-traditional market orientations.

Table 4-1. Characteristics of the study sites

	Brasiléia			***Assis Brasil***		
	Filipinas (6)	**Porongaba (5)**	**Humaitá (4)**	**Paraguaçu (3)**	**São Francisco (2)**	**Icuriã (1)**
Estimated No. households	72	26	32	40	73	72
No. households surveyed	26	17	19	20	19	29
Ave. family size	6.96	4.82	5.56	8.15	5.15	4.61
Av. holding size (ha)	608.00	429.00	432.00	560.00	416.00	300.00
Total Area *Seringal* (ha)	29.908	8,937	14,487	19,511	29,933	64,405
Forest canopy type	Dense	Dense	Dense	Dense/Open	Open	Open
Impact by division of watershed?	No	No	No	No	No	Yes
Main form of transport	Road	Road	Road	Road	Road	Water/ Road
Distance from community base to nearest urban center	36 km	23 km	30 km	10 km	22 km	75 km
Livelihood Emphasis	NTFP	Cattle/NTFP	Cattle/NTFP	Cattle/Ag	NTFP/Ag	Cattle/Ag

Remote Sensing Analysis

Our remote sensing analysis follows from a collaboration between researchers with different research objectives and, in one case, study sites. Therefore, satellite image analysis was carried out on the footprint level for the Alto Acre region (10 scenes). LANDSAT TM and ETM+ images were obtained for 1986, 1992, 1996, 1999, and 2003 for Path/Row 02/67 and 03/67 (Image Source: Tropical Rain Forest Information Center of Michigan State University). Chronic cloud and haze problems common to the region required that the image synchronization match the short dry season, between mid-June and early September, rather than more narrowly

circumscribed dates. We started our time series in 1986 in order to get a glimpse of land-use and land-cover before the reserve was created, and used subsequent years to see patterns in change, but limited our timeframe to 2003 in order to match our remote sensing data to our survey data, thus capturing more specific explanations of land-use and land-cover change at a particular point in time.

Ground data were collected between October 2003 and August 2005 for image georeferencing, as well as over two hundred additional training samples of various land-cover types. A training-sample protocol was developed based on the specific ecology and land-uses/covers of the region and a training-sample data base was created, including information on the geographic coordinates of the sample using a Global Positioning System (GPS), the land-use/land-cover type, sketch maps, and digital photos. We also collected brief land-use histories given by the land-owners to aid in the development of training sample data over various time frames (other than 2003). Given the spatial resolution of our imagery (i.e. 30m), samples were limited to areas one hectare or greater.

Geometric rectification with a linear first-order polynomial fit was carried out on the 2003 images based on ground control points collected in the region using a GPS, using roads and intersections, and when a good geographic distribution was necessary and roads were lacking, both rivers and waterways. All resampling was done using a nearest neighbor resampling algorithm. The 2003 images were then used as a base to which the remaining scenes were resampled. On average, 12 ground control points (GCPs) were used for each image, with at least one point in each quadrant of the image, resulting in a root mean square error less than 0.5 pixels (or < 15 m) in each case.

Radiometric calibration (RADCAL) and dark subtraction (ATCORR) model developed by Green et al. (2002) was used to correct images for comparation. Although this method helped to clean up the images in general, it did not clear up all atmospheric problems, particularly scattering effects on the 1992 02/67 image. We adopted a hybrid unsupervised/supervised approach, which allowed us to create a more ample classification schema, even in years where training sample data were lacking.

An unsupervised classification was carried out on each image using a clustering algorithm to define land-cover classes based on spectral statistics with a standard number of 100 classes, 12 maximum iterations, and a convergence threshold of 0.95. Our 100 classes were gradually collapsed into 12 classes: dense forest, open/bamboo forest, initial secondary succession, intermediate secondary succession, pasture with trees, managed "clean" pasture, unmanaged "dirty" or "scrubby" pasture, agriculture/bare soil, high density urban, water, cloud, and cloud shadow (see Table 4-2 for description of classes). Class assignment involved three assessments: (i) Visual interpretation of the image sequence (geographically linked) using expert knowledge and vectorized ground data and land-use histories collected in the field to guide our decisions regarding class ownership, and analysis of the spectral behavior of individual pixels belonging to known classes using a spectral profile tool; (ii) comparative analysis of the spectral behavior of the signatures for each of the 100 classes as well as groups of similar classes using the signature mean plot module; and (iii) the interpretation of unsupervised classes based on their spectral seperability statistics generated using a transformed divergence module.

Based on these criteria, the initial 100 classes were individually analyzed and assigned, with the help of the vectorized ground data and land-use histories we collected in the field, to a final classification schema, spectrally similar classes were merged with like classes, while others,

such as those representing noise, were eliminated altogether from the classification. Due to the large number of initial classes, this was done in several stages producing a series of intermediary signature files for each year: thus, a 100 class signature file might be reduced to 60 classes, then 30, and once again until the final desired 12 classes had been reached. In order to ensure maximum spectral seperability of our classes, Steps 1-3 were completed and evaluated various times throughout the intermediary stages.

Table 4-2. Land-use classification schema

ID	***Class***	***Description***
1	Dense Tropical Forest	Dense, closed tropical forest common to the region
2	Mixed Open/Bamboo Forest	Open semi-deciduous forest intermingled with patches of bamboo and/or palm species
3	Secondary Succession 1	Herbaceous, seedling and sapling vegetation up to 5 meters high, typical of agricultural land left to fallow or non-managed pastures
4	Secondary Succession 2	Intermediate secondary stage with woody vegetation up to 15 meters high, closed canopy
5	Pasture with Trees	Managed pasture intermingled with trees
6	Managed Clean Pasture	Managed clean pasture, open grasslands with substantial green cover
7	Tall grass/Wetlands	Tall grass/wetlands, lush green vegetation typical of areas with poor drainage or grassy wetlands
8	Agriculture/Bare Soil/Overgrazed Pasture	At peak of dry season, areas lacking green vegetation cover, and/or showing patches of bare soil
9	High Density Urban	Presence of asphalt and human-made surfaces with high reflectance (found outside of reserve only)
10	Water	Rivers, creeks, ponds and other water bodies
11	Clouds	Cloud
12	Cloud Shadow	Cloud Shadow

The final signature files representing 12 land-use/land-cover classes for each image constituted the input for a supervised classification using a probability-based Maximum Likelihood algorithm. After classification and evaluation, the classes were further reduced to a more simple and realistic classification schema given the constraints with such a long image sequence: Forest, Secondary Succession, a combined Agricultural class (i.e., pasture, agriculture, bare-soil), Water, and Cloud/Shadow. Aggregation helped eliminate sources of error among our

anthropogenic classes, in particular, given that all images correspond to the dry season, when vegetation is commonly under hydrological stress.

To deal with common problems caused by atmospheric scattering due to cloud cover problems in our 1992 image specifically and misclassifications and confusion caused by other anomalies (e.g., tree shadow and natural bamboo "die-off" in one instance), post-classification techniques, such as a 3 x 3 kernel filer, and to a lesser extent, polygon filling, were used in some instances and in specific area of interests (AOIs), followed by careful inspection and the visual comparison of problem areas with the original bands geographically linked to the filtered image.

An independent hold-out sample of roughly 150 ground reference points were digitized into polygons and used in an accuracy assessment for both the 02/67 and 03/67 footprints for our 2003 images (representing both 895 and 1,264 pixels respectively). In both instances, we achieved an accuracy level of 85 % (p-value of 0.05).

Land-cover transition matrices were generated using a matrix or cross-tabulation module. Starting with the 1986 and 1992 images for each footprint, the matrix module was run successively adding each year in the sequence until a final transition matrix representing all years between 1986 and 2003 was complete. These transition images follow the state of any given pixel and its change from year to year. Separate transition matrices were produced to track deforestation, secondary regrowth, and a final matrix that attempted to capture the swidden/fallow cycle within each rubber estate, resulting in 6 final images, 3 for each footprint. Given uncertainties due to the spectral similarities between anthropogenic land uses as well as the problematic nature of having such a long (18 yr) timeframe, pasture and cultivation classes were aggregated together to minimize classification error. Our transition matrices, therefore, used a simple forest-nonforest-secondary forest classification, thus minimizing the chances of

error common between anthropogenic classes. As a result, it is impossible to distinguish through imagery analysis if any of these rubber estates have greater than five percent of their allowable area in pasture, focusing instead on the efficacy of the 10% rule. Lastly, digital boundaries of the six *seringais* were then used to create masks producing 18 final images (capturing deforestation, regrowth, the swidden/fallow cycle) for each community, allowing the calculation of the rates and amounts for each transition type between any given time period.

Household Surveys

A total of 130 household interviews were completed within the six rubber estates between March 2004 and December 2004 by two of the authors (Vadjunec and Gomes) and two field assistants in conjunction with a local non-governmental organization (NGO), the Group for Research and Extension in Agroforestry Systems in Acre (PESACRE). As often as possible, the interviews were completed with both the male and female head of the household. Each interview was conducted in Portuguese, took about three hours to complete, and contained structured and open ended questions regarding specific land-use, production and sale of agricultural and extractive products, small animal and cattle production regarding production and yields for the year previous (2003), as well as household characteristics and history, and questions regarding the rules (both formal and informal) and management of the reserve, the history of the household's involvement in the rubber tapper's movement, and the social organization within each *seringal*, or rubber estate. Additionally, since many households operate on a mainly subsistence or recently transitioning mixed-subsistence and market livelihood system, we constructed a livelihood index to show what we feel is a more realistic picture of overall economic development and well being. The index totals the presence or absence of 30 social, economic, and health-related development indicators (e.g., overall house construction, possession of important household appliances, agricultural equipment, access to an electric

generator or other power source, water pump or well, access to safe drinking water or water treatment, trash and sewage disposal, accessible healthcare and education, mode of transportation, overall satisfaction with the reserve etc.).

Although the original intent was to choose households at random, difficult access and incomplete residency lists caused us to adopt a more opportunistic sampling strategy. Few roads exist in the reserve and some communities required a three day walk to reach. The only residency list available to use was outdated, and furthermore, was compromised by lack of information on households that are not officially members of the associations. Sometimes outsiders and non-members of the movement have purchased land, often illegally; they therefore may not be registered residents, but they no-doubt bring different land-use practices and economic orientations to the reserve.

Of the 130 households selected, 65 are involved in the government sponsored environmental program *ProAmbiente,* which, although still in initial phases, proposes to pay small producers for environmental services. These households are officially recognized by and participate in the municipal-level extractive associations. These households were selected through a series of open public meetings held by the Rubber Tapper's Union to generate interest in *ProAmbiente*. The remaining 65 households participating in this study were chosen based on both maximizing the geographical distribution of households selected within each community to the greatest extent possible, and with the help of key informants, emphasis was placed on representing the range of households involved in the various extractive/non-extractive activities that were brought to light in our initial community meetings (i.e., cattle, extractivism, agriculture, or a mix of activities). After two years of field experience, we estimate that 40% of the total households were interviewed in each of the study sites.

Results

Remote Sensing Results

Figure 4-3 and 4-4 illustrates patterns and spatial/temporal trajectories of land-use/land-cover change in studied Seringais from 1986 to 2003. Seringal Humaitá had the largest percentage of total area deforested by 2003, totaling 9.20 % of the *seringais* (Table 4-3). Porongaba and Paraguaçu fell between (7.84 % and 6.20 % respectively). Filipinas and São Francisco had the next lowest amounts of deforestation (3.80 % and 4.93 % respectively). Lastly, Icuriã, had the lowest total percent deforestation (3.58 %) among all of the six rubber estates.

Deforestation rates were on average highest during the initial 1986-1992 time period, accounting for between 17-39 % of the total area deforested by 2003, averaging ≈ 24 % of the total area deforested per *seringal*. This period was marked by extreme changes in the lifestyles of rubber tappers, including part of the initial violent conflicts between rubber tappers and cattle ranchers and the subsequent creation of the reserve in 1990, followed by the discontinuation of rubber subsidies that occurred in the 1990s. The periods between 1992-1996 and 1996-1999 indicate a general overall drop in deforestation rates within each of these six estates. An overall drop in deforestation rates during this time frame was also observed elsewhere in the region (Ludewigs 2006). This overall drop in deforestation rates is perhaps attributable to the initial optimism of the rubber tappers in securing the reserve, initial international funding and support, as well as the end of violent land conflicts throughout the region. Between 1999 and 2003 this trend changed toward more deforestation, for the most part, with the exception of São Francisco, which continues to see a drop in deforestation rates. Contrary to prediction, however, none of the study areas have surpassed the allowable limits of deforestation as set by the 10 % rule in the Utilization Plan.

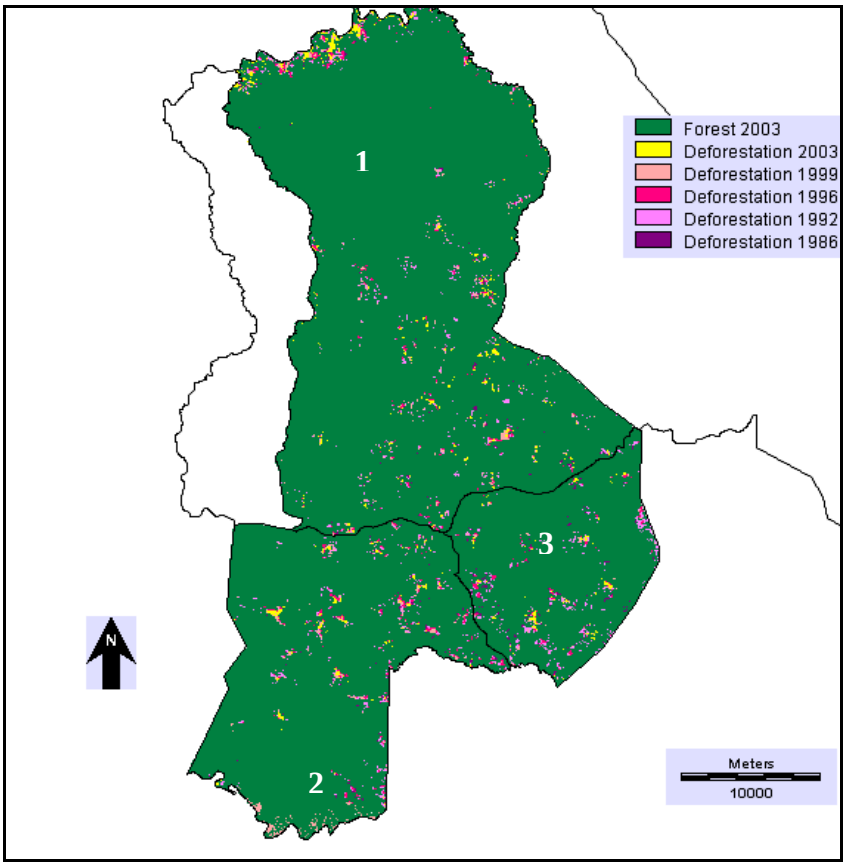

Figure 4-3. Trajectories of LUCC in the seringais in Assis Brasil within the CMER: (1) Icuriã, (2) São Francisco, (3) Paraguaçu

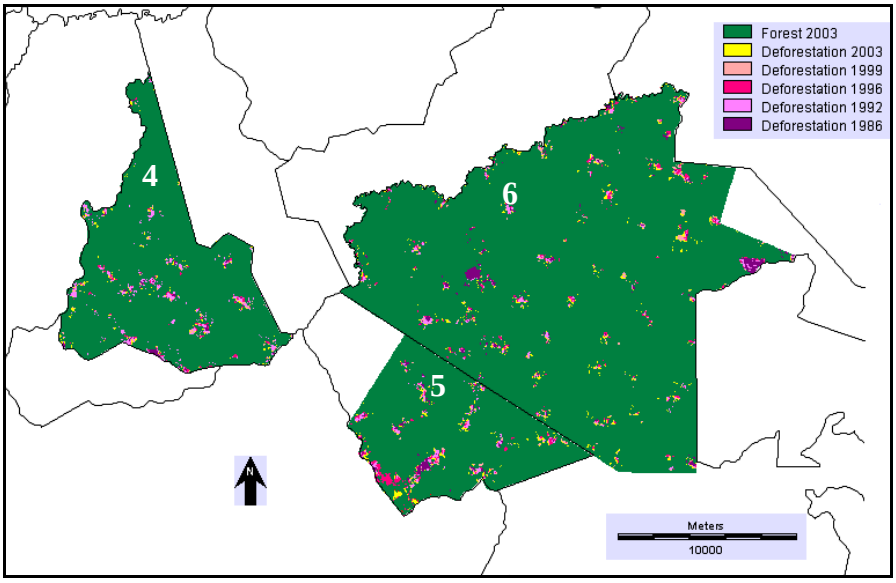

Figure 4-4. Trajectories of LUCC in the seringais in Brasiléia within the CMER: (4) Humaitá, (5) Porongaba, (6) Filipinas

Table 4-3. Percent deforestation in six seringais from 1986-2003

	Brasiléia			Assis Brasil		
	Filipinas (6) (ha/%)	Porongaba (5) (ha/%)	Humaitá (4) (ha/%)	Paraguaçu (3) (ha/%)	S. Francisco (2) (ha/%)	Icuriã (1) (ha/%)
Forest 2003	28,777 (96.20)	8,413 (92.18)	12,480 (90.79)	15,838 (93.80)	29,264 (95.07)	63,368 (96.42)
Deforestation 1999-2003	289 (0.97)	167 (1.83)	248 (1.80)	132 (0.78)	196 (0.64)	646 (0.98)
Deforestation 1996-1999	171 (0.57)	63 (0.69)	147 (1.07)	113 (0.67)	438 (1.42)	443 (0.67)
Deforestation 1992-1996	233 (0.78)	188 (2.06)	282 (2.05)	162 (0.96)	318 (1.03)	397 (0.60)
Deforestation 1986-1992	201 (0.67)	188 (2.06)	494 (3.59)	506 (3.00)	477 (1.55)	724 (1.10)
Area deforested (1986)	242 (0.81)	107 (1.18)	94 (0.69)	134 (0.79)	88 (0.29)	144 (0.22)
Total Deforested	**1,136 (3.80)**	**714 (7.84)**	**1,265 (9.20)**	**1,047 (6.20)**	**1,517 (4.93)**	**2,354 (3.58)**

Transition matrices following secondary succession between the 1986-2003 period further reveal variations in land-use trajectories and schemas between households within each of the six communities (Table 4-4). Porongaba and Filipinas had among the highest total percentage of area in secondary succession by 2003, with 4.65 % and 4.62 % respectively. Seringal Humaitá, with the highest percentage of total area deforested, also had one of the higher percentages in secondary succession by 2003 (3.59 %). In general, the seringais located in the municipality of Brasiléia have considerably higher rates of secondary succession than their counterparts in Assis Brasil (Paraguaçu 1.22 %, São Francisco 1.87 %, and Icuriã 1.47 %). Filipinas, with the second lowest amount of deforestation, also had the second highest rate in secondary succession (4.62 %), while São Francisco had both a low rate of deforestation and a much lower rate of secondary succession (1.87 %), suggesting different land-use decisions and intensification among all rubber estates.

Table 4-4. Percent secondary succession in six *seringais* from 1986-2003

	Filipinas (6) (ha / %)	Porongaba (5) (ha / %)	Humaitá (4) (ha / %)	Paraguaçu (3) (ha / %)	S. Francisco (2) (ha / %)	Icuriã (1) (ha / %)
Secondary Succession 1999-2003	141 (1.03)	66 (0.72)	134 (0.97)	111 (0.36)	183 (0.59)	362 (0.55)
Secondary Succession 1996-1999	195 (1.42)	234 (2.57)	214 (1.56)	41 (0.13)	80 (0.26)	72 (0.11)
Secondary Succession 1992-1996	89 (0.65)	45 (0.49)	67 (0.49)	46 (0.15)	64 (0.21)	178 (0.27)
Secondary Succession 1986-1992	58 (0.42)	27 (0.30)	34 (0.24)	41 (0.13)	66 (0.21)	215 (0.32)
Area in secondary succession (1986)	152 (1.10)	52 (0.57)	46 (0.33)	139 (0.45)	184 (0.60)	145 (0.22)
Total Secondary	**635 (4.62)**	**425 (4.65)**	**495 (3.59)**	**379 (1.22)**	**577 (1.87)**	**972 (1.47)**

Lastly, a final transition matrix was made for each of the six communities to capture the swidden/fallow cycle used among small-scale agriculturalists in Amazonia (Moran 2000, Ludewigs 2006). The final matrix quantified areas that shifted from deforested to secondary succession and remained in secondary succession throughout the transitions between the 1986-1992, 1992-1996, 1996-1999, and 1999-2003 images. The result is an estimate of the percent of areas in secondary succession that remain in secondary succession by 2003 versus the percent that are re-used and deforested again throughout the 18 year transition (see Table 4-5).

Table 4-5. Area and percent remaining in secondary succession and later reused (swidden/fallow cycle) between 1986-2003

	Filipinas (6)	Porongaba (5)	Humaitá (4)	Paraguaçu (3)	S. Francisco (2)	Icuriã (1)
Total area secondary succession b/t 1986-2003 (ha)	635.45	428.07	495.23	378.81	576.63	972.00
Area remaining in secondary succession by 2003 (ha)	269.92	175.58	214.55	57.15	109.27	195.93
Percent remaining in succession by 2003	42.48	41.02	43.32	15.09	18.78	20.16
Percent reused-swidden/fallow cycle by 2003	57.52	58.98	56.69	84.91	81.12	79.84

More than half of the area in secondary succession has been re-used within each of the seringais by 2003. These numbers suggest a high amount of intensification among rubber tapper households within each seringal. The rubber estates in the municipality of Assis Brasil, on average, have lower rates of deforestation, along with lower rates of long-term secondary succession, as well as a higher percentage of areas appearing to capture the swidden/fallow cycle. As a result, Paraguaçu, São Francisco, and Icuriã appear to be areas undergoing less extensification, with greater preservation of primary forests. The seringais in Brasiléia, on the other hand, can be classified as areas with generally higher levels of deforestation along with higher rates of secondary succession, apparently emphasizing extensification and other options over more traditional swidden techniques. In the next section, we use the household data to explain the driving forces of such land change currently underway in the CMER, as well as to explore its relationship to resident well-being.

Household Survey

The results of our household surveys show a wide range of both subsistence and market activities among rubber tappers within the various rubber estates surveyed. The main extractive market activities are the collection of Brazil-nuts and continued rubber tapping for latex production (despite the overall decline of rubber production in the region). Increasingly, small-scale agriculture (beans, rice, manioc, coffee and corn), animal husbandry (mainly chickens, swine, ducks, sheep and goats), and cattle ranching are seen by rubber tapper households as necessary income-generating alternatives, given the market instabilities associated with traditional NTFPs. As a result, households are becoming more involved in some sort of market activity beyond traditional extractivism (Table 4-6).

Multivariate Analysis of the Variance (ANOVA) reveals marked between group difference regarding the percent of households involved in extractivism and agriculture per rubber estate (p

≤ 0.05) (Table 4-6). The most dramatic difference is regarding extractive activities. All households surveyed within Brasiléia are involved in some sort of extractivism. The households within the municipality of Assis Brasil are involved to a much lesser extent. Conversely, the majority of households in Assis Brasil are involved in market agriculture, compared to less than half of those surveyed in Brasiléia. There are no between group differences regarding the number of households involved in small animal production and cattle ranching for market sale, although the extent and intensity varies.

Table 4-6. Percent of households involved in market activitis in 2003 (n=households)

	Brasiléia			Assis Brasil		
	Filipinas (6)	Porongaba (5)	Humaitá (4)	Paraguaçu (3)	S. Francisco (2)	Icuriã (1)
Extractivism*	100.00	100.00	100.00	65.00	47.37	10.00
	(26)	(17)	(19)	(13)	(9)	(3)
Agriculture*	38.46	58.88	47.37	90.00	73.68	72.41
	(10)	(10)	(9)	(18)	(14)	(21)
Small Animal Production	84.62	70.59	73.68	85.00	57.89	68.97
	(22)	(12)	(14)	(17)	(11)	(20)
Cattle	53.85	41.18	68.42	55.00	52.63	79.31
	(14)	(7)	(13)	(11)	(10)	(23)

*Statistically significant at 0.05 level, ** 0.10 level (ANOVA test of significance)

A closer look at the means and standard deviations between *seringais* reveal marked differences and emphases in land-use and land-cover strategies among the households surveyed (Table 4-7). ANOVAs indicate statistically significant between group differences regarding extractive activities between rubber estates ($p \leq 0.05$). There are important differences in Brazil-nut production with the households in Brasiléia producing upwards of 10 times the amount of Brazil-nuts produced in the *seringais* found in Assis Brasil. Brazil-nut prices are consistent and regulated by the larger market, so the distinction in question is not the result of market differences between the two municipalities. Rather, it may be the result of ecological differences

in terms of forest types between rubber estates. The dense closed canopy forest in the region of Brasiléia is richer in Brazil-nut trees than are the forests of the other *seringais*.

Likewise, the number of rubber trails on each property and the amount of rubber production are significantly different between rubber estates ($p \leq 0.05$). Porongaba and Icuriã (23.59 and 33.93 kg/household, respectively) produce the least latex, while Filipinas and São Francisco produce the most (223.85 and 258.95 kg/household, respectively), thus being the most "traditional" of the six seringais in our study. Note, however, the figures for the two high-latex seringais are well below the 1995 reserve-wide average reported as 714 kg of rubber produced per household (Feitosa 1995: 72). Although the percent of total income from extractivism remains significantly high, at least in Brasiléia, the percent of the total household income derived from rubber has plummeted from the 44.7 % reported by Feitosa (1995: 71) to 8.55 % in the six rubber estates reported here, making it one of the least important economic activities within our six seringais.

Not only does rubber production remain highest in our "traditional" *seringais*, they remain fairly dependent on it, deriving 11.44 percent of the total household income from the activity in Filipinas and 20.80 % in São Francisco. In general, these differences can be attributed to various responses by rubber tappers to the last rubber bust, where some households responded by diversifying their production base, creating new economic opportunities, while others, due to either a strong sense of tradition or insufficient resources or other opportunities, continue to invest in rubber production.

In one instance, however, low levels of rubber production may be attributed to local species abundances and economic inertia. *Seringal* Icuriã occupies portions of two watersheds

Table 4-7. Summary statistics from household surveys: land-use and livelihood statistics (Mean and S. D.)

		Brasiléia			*Assis Brasil*	
	Porongaba (n=17)	**Filipinas (n=26)**	**Humaitá (n=19)**	**Paraguaçu (n=20)**	**S. Francisco (n=19)**	**Icuriã (n=29)**
Land Holding						
Rubber Trails on Property (n)*	4.29 *(2.71)*	6.08 *(3.32)*	4.32 *(1.83)*	5.60 *(3.27)*	4.16 *(2.27)*	1.69 *(2.80)*
Brazil-nut Trees on Property (n)*	213.00 *(245.82)*	319.42 *(345.31)*	358.75 *(315.19)*	92.25 *(91.96)*	36.95 *(113.94)*	2.24 *(5.50)*
Pasture (ha)**	9.44 *(4.13)*	7.00 *(6.38)*	12.03 *(12.47)*	7.70 *(7.95)*	7.29 *(5.37)*	11.72 *(7.22)*
Swidden Agriculture (ha)*	2.94 *(2.34)*	2.16 *(1.49)*	1.61 *(0.76)*	2.25 *(1.01)*	2.34 *(1.83)*	3.16 *(1.60)*
Extractivism						
Brazil Nut (latas)* [a]	318.71 *(224.00)*	367.54 *(375.97)*	254.63 *(166.92)*	22.80 *(46.84)*	0.00 *(0.00)*	0.14 *(0.52)*
Rubber (kg)*	23.59 (75.23)	223.85 *(256.55)*	125.26 *(176.40)*	174.00 *(349.88)*	258.95 *(432.14)*	33.93 *(124.76)*
Agricultural Production						
Rice (kg)	1030.59 *(617.62)*	1156.15 *(834.40)*	738.95 *(534.64)*	916.00 *(647.80)*	934.21 *(481.33)*	916.07 *(652.64)*
Beans (kg)*	382.94 *(344.72)*	268.85 *(599.58)*	228.95 *(213.77)*	750.00 *(580.06)*	457.89 *(391.67)*	395.71 *(284.01)*
Corn (kg)*	537.94 *(546.33)*	666.92 *(745.57)*	557.89 *(393.09)*	995.00 *(945.61)*	1121.05 *(1258.56)*	1239.29 *(1010.44)*
Manioc flour (kg) *	574.12 *(532.81)*	599.42 *(735.51)*	273.63 *(418.85)*	628.00 *(795.18)*	331.58 *(381.59)*	253.93 *(195.57)*
Café (kg)**	20.88 *(52.63)*	1.00 *(4.05)*	37.11 *(126.00)*	173.80 *(386.70)*	76.00 *(320.70)*	25.21 *(67.92)*
Animal Production (n)						
Chicken	87.35 *(136.29)*	38.65 *(22.29)*	39.68 *(31.72)*	53.10 *(27.15)*	61.58 *(60.09)*	63.43 *(32.33)*
Swine	7.58 *(11.04)*	9.44 *(17.03)*	6.16 *(9.25)*	9.95 *(8.25)*	12.89 *(15.96)*	8.64 *(9.06)*
Ducks	0.94 *(2.14)*	3.42 *(5.81)*	1.05 *(2.86)*	1.10 *(2.55)*	2.95 *(3.92)*	3.54 *(6.00)*
Sheep/Goats*	3.00 *(4.87)*	3.41 *(5.23)*	7.16 *(12.81)*	5.55 *(9.72)*	2.63 *(5.59)*	9.35 *(10.00)*
Cattle**	14.18 *(13.39)*	8.19 *(8.31)*	19.47 *(29.78)*	16.55 *(20.17)*	7.74 *(7.36)*	17.45 *(13.31)*
Dependency on Activity (% of total income)						
Extractivism (%)*	63.06 *(29.10)*	74.31 *(19.55)*	62.84 *(24.31)*	22.95 *(27.96)*	20.80 *(29.09)*	2.95 *(11.89)*
% of total rubber	0.69	11.44	5.68	10.41	20.80	2.95
Agriculture (%)*	13.60 *(17.59)*	8.11 *(16.00)*	7.60 *(14.43)*	30.64 *(30.00)*	27.69 *(24.23)*	35.15 *(30.56)*
Small Animal Production (%)*	6.61 *(6.89)*	9.64 *(10.02)*	11.26 *(14.68)*	24.76 *(26.13)*	11.92 *(18.27)*	9.38 *(12.77)*
Cattle (%)*	16.73 *(25.70)*	7.90 *(8.52)*	18.46 *(22.32)*	21.60 *(24.29)*	18.54 *(24.17)*	45.30 *(31.42)*
Livelihood Index* [b]	10.71 *(3.29)*	9.04 *(2.63)*	11.42 *(3.83)*	7.90 *(3.16)*	9.63 *(4.57)*	11.71 *(4.22)*

Statistically significant at *.05 level, **0.10 level (ANOVA test of between group difference)
a) A *"lata,"* or can, is the traditional system of measuring Brazil Nuts in their brute form for sale (i.e., with shells on). 1 *lata* is equivalent to a 20 liter bucket, and normally yields about 11 kgs of Brazil Nuts.
b) Based on 30 individual indicators (e.g., overall house construction, appliances, agricultural equipment, access to an electric generator, water pump, safe drinking water, trash and sewage disposal, accessible healthcare, mode of transportation, etc.).

and that located closest to the main community is not rich in rubber trees. Historically, this community served as a hub for the sale of regional latex and, given the proximity to the Iaco River, the transport of latex to urban centers. Many of the residents in this *seringal* did not tap

rubber but instead worked in the counting houses, supply good stores, and with transportation logistics regarding the rubber trade. Since both the paving of the BR-317 and changing market conditions, traditional water transport routes for rubber have been either eliminated or have changed, leaving the residents of Icuriã with less of a role to play in the rubber trade, and fewer livelihood options, mainly agriculture and cattle ranching.

While the local and regional markets have affected rubber tappers' land-use choices, the density of Brazil-nut and rubber trees appear to do so as well. Pearson's correlation coefficients (Table 4-8) reveal a significant positive correlation between the percent of total income derived from extractivism and the number of Brazil-nut trees in the *colocação* ($r = 0.467$, p-value ≤ 0.01). Similarly, there is a significant positive correlation between the percent of total income derived from extractivism and the number of rubber trails controlled ($r = 0.454$, p-value ≤ 0.01).

Similarly, there is a significant positive correlation between the percent of total income derived from extractivism and the number of rubber trails controlled ($r = 0.454$, p-value ≤ 0.01). In contrast, there is a significant negative correlation between both the number of Brazil-nut trees and rubber trails controlled by a household and the percent of total income derived from both cultivation and cattle, suggesting that land-users may be choosing livelihood strategies based on ecological constraints due to differences in NTFP potential among forest types.

There are marked differences in agricultural practices among rubber estates that appear to be more subtle than other activities, with different *seringais* emphasizing different products. Outside of manioc flour production, the three rubber estates in Assis Brasil produce greater amounts of beans, corn, and coffee (p-value ≤ 0.10), and other than Porongaba, have among the highest amount of land under agricultural production. Furthermore, the *seringais* in Assis Brasil

Table 4-8. Livelihood index, deforestation, and land-use correlations (n=130)

	Livelihood Index	**% Income Agriculture**	**% Income Small Animals**	**% Income Cattle**	**% Income NTFPs**	**Total Deforestation (ha)**	**Area Pasture (ha)**	**Agricultural Plot (ha)**	**Brazil-nut Trees (n)**	**Rubber Trails (n)**
Livelihood Index	1	-0.047	0.073	0.348*	-0.183**	0.519*	0.491*	0.227*	-0.045	-0.216**
% Income Agriculture	-0.047	1	-0.079	-0.030	-0.548*	-0.023	-0.060	0.101	-0.252*	-0.225**
% Income Small Animals	0.073	-0.079	1	-0.170	-0.178**	-0.124	-0.149	-0.006	-0.107	-0.003
% Income Cattle	0.348*	-0.030	-0.170	1	-0.527*	0.384*	0.370*	0.192*	-0.202**	-0.255*
% Income NTFPs	-0.183**	-0.548*	-0.178**	-0.527*	1	-0.152***	-0.120	-0.218*	0.467**	0.454*
Total Deforestation (ha)	0.519*	-0.023	-0.124	0.384*	-0.152	1	0.981*	0.329*	0.080	0.100
Area in Pasture (ha)	0.491*	-0.060	-0.149	0.370*	-0.120	0.981*	1	0.235*	0.111	0.120
Agricultural Plot (ha)	0.227*	0.101	-0.006	0.192**	-0.218**	0.329*	0.235*	1	-0.184**	-0.068
Total Brazil-nut Trees (n)	-0.045	-0.252*	-0.107	-0.202*	0.467*	0.080	0.111	-0.184**	1	0.394*
Rubber Trails (n)	-0.216**	-0.225**	-0.003	-0.255*	0.454*	0.100	0.120	-0.068	0.394*	1

*Correlation is significant at the 0.01 level, **0.05 level, ***0.10 level

derive at least twice as much of their income from market agriculture than in Brasiléia. A Pearson's correlation coefficient shows a slight positive relationship between the size of an individual household's agricultural plot and pasture size ($r = 0.235$, p-value ≤ 0.01). Rules that allow a landholder to deforest two hectares a year (1 hectare mature, 1 hectare secondary forest) for their agricultural plots may be inadvertently encouraging pasture formation, as it is easier to transform an old agricultural plot into pasture, than to go from mature forest to pasture.

In a traditional swidden system, each year a household deforests a small area for agriculture, which, in the past would be left to fallow for an average of three to four years. Increasingly that fallow is being replaced by pasture and new forest is cut for cultivation. In fact, 56.6 % of the households surveyed leave an abandoned agricultural plot to fallow, 13.1 % turn that plot immediately to pasture, 19.7 % plant "*Pueraria phaseoloides,*" or tropical kudzu, and 10.6 % follow some combination of these options. Tropical kudzu, a legume (nitrogen fixing) and weed suppressant species, is often planted for forage for cattle and is used in pasture development. The majority of households surveyed in the rubber estates in Assis Brasil leave their abandoned agricultural plots for fallow. The majority of households surveyed in Brasiléia, on the other hand, plant either tropical kudzu or pasture following agriculture, suggesting various land management strategies between the two municipalities.

Pasture and agricultural development have a positive relationship with deforestation, while extractivism a negative one. Interestingly, there appears to be no correlation between either the total area deforested or the total area in pasture, and the number of Brazil-nut trees and rubber trails on household property (see Table 4-8). These results lead us to believe that the influence on land-use decisions of changing markets and ecological conditions notwithstanding, pushing land-holders in one direction or another, decisions regarding the number of cattle to possess and the amount of land

to deforest may be based on other social, institutional, or political factors, such as access to capital funds, rubber tapper culture, or participation in the movement. It is important to note that cattle are seen by many rubber tappers as a savings account, an asset to be used in times of distress (Feitosa 1995). This follows a similar rationale amongst colonist smallholders elsewhere in Acre (Ludewigs 2006) and can be found throughout Amazonia (Faminow 1998, Mertens *et al.* 2002). For other households, cattle are becoming a major market activity (Gomes 2001). Regardless, the investment in cattle pays off as there is a significant positive correlation between the percent of total household income derived from cattle and livelihood welfare ($r = 0.384$, p-value ≤ 0.01), while there is a negative correlation between the percent of total income derived from extractivism and quality of life (livelihood index) ($r = -0.183$, p-value ≤ 0.05). Agriculture and small animal production appears to have no significant relationship to livelihood, but a significant positive relationship exists between deforestation and a household's livelihood index ($r = 0.519$ p-value ≤ 0.01).

Overall the *seringal* -level household results suggest that Seringal Filipinas and São Francisco are the most "traditional" rubber estates with the highest latex production and lowest amounts of both cattle (8.19 and 7.74) and pasture (7.00 and 7.29 ha) per household. Households in Humaitá have the greatest amounts of both pasture (12.03 ha) and cattle (19.47), but also remain involved to some extent in a variety of extractive activities. Icuriã has the second highest reported amounts of both pasture (11.72 ha) and cattle (17.45). While Humaitá and Icuriã appear to be the least 'traditional' of the rubber estates, the communities of Porongaba and Paraguaçu reside somewhere in between these two nodes in terms of both pasture (9.44 ha and 7.70 ha) and cattle (14.18 and 16.55). With the exception of Icuriã, these results are consistent in explaining the deforestation trends outlined previously in the remote sensing analysis.

Discussion

The results suggest that the label "rubber tappers" for the occupants of the CMER may be a misnomer. In fact, among the *seringais* surveyed here, households pursue diverse livelihood practices including extractivism, small-scale market cultivation, small animal rearing, and increasingly, cattle production. Rubber tapping plays increasingly less an important role in livelihood strategies. Still, the majority of households surveyed identify themselves, for historical, cultural, and political reasons, as rubber tappers first and foremost, rather than colonists, small-scale ranchers, or agriculturalists. Indeed, some evidence suggests that rubber tappers' involvement in agriculture and small-scale cattle rearing is not just a recent development, but always existed, although to a much lesser extent, since the rubber barons abandoned their rubber estates in the 1960s and 1970s (Murrieta and Rueda 1995). The main change is not the adoption of such activities; it is the extent of their use and relative proportion of household income. Rubber tappers are no doubt being influenced by development forces operating outside the CMER. In Acre, rubber has descended from the most important economic activity to one of the least, while cattle and cultivation have become increasingly important. Thus cattle have a ready market outside of the reserve, while many rubber and extractive products simply do not. Understanding the land dynamics in the reserve requires the expansive interpretation of the rubber-tapper label that is held by the occupants and central to their land-use decisions.

According to the remote sensing analysis, none of the six *seringais* surveyed here have surpassed the 10 % limit set on the amount of allowable deforestation by 2003, although at least one trend projection indicated that this limit would be exceeded by that date. Humaitá and Porongaba are, however, close to reaching this limit. It is also noteworthy that some *seringais*

may have passed the 5 % allowable for pasture (roughly 15 hectares per household).[3] Compared to other land-users in Amazonia, deforestation rates remain low, however. Evidence of high amounts of land in secondary succession in Brasiléia and increasing intensification among land-users in Assis Brasil suggests that rubber tappers may be undergoing a process of adaptation that may alleviate deforestation pressures with proper management. The reserve provides other important environmental services that must also be considered. The CMER currently serves as a firewall, buffering the rain forest (located between highly deforested cattle ranches and largely forested indigenous communities), and offering biodiversity protection (Vadjunec 2007).

Pasture for cattle and crop development are the greatest drivers of deforestation within our study areas, and appear to be negatively correlated with extractive activities. The rubber estates with the highest amount of cattle also have the highest amount of deforestation. The only exception to this trend was Seringal Icuriã, but this may be due to inconsistencies with both population dynamics and boundary issues. Cropping plays more of an important role in the rubber estates of Assis Brasil where natural forest differences resulting from the division of the watershed limit NTFP extractive potential. Furthermore, cultivation is linked to deforestation because increasingly households convert their abandoned agricultural plots to pasture instead of leaving them to fallow.

As expected, Filipinas and São Francisco, the two most traditional extractive *seringais* (in terms of sustained emphasis on latex production), had fewer cattle, maintaining among the lowest rates of deforestation. This result suggests that investments in non-timber forest projects might be beneficial to forests. As currently practiced, however, emphasis on NTFP production

[3] Due to the common property aspects of the reserve, the difficulty mapping at the household level, and the fact that many households actually create pasture together, while other households rent their pasture out, we rely on the remote sensing results to test the efficacy of the deforestation rules, and use the household level data to explore relationships between land-use, deforestation, and well-being.

does not appear to better livelihood conditions. For extractivism to be a serious contender, these traditional *seringais* press for the return of long-term and realistic subsidies, supporting rubber collection as well as heavy investments in other "green" products such as *açai* fruit, honey, vegetal leather products and handicrafts. The pro-forest government of Acre has already started to invest in these areas, with the creation of a condom factory in Xapuri , for example, but it remains to be seen whether it will get residents back to rubber tapping, let alone working in other NTFP activities.

Most of the debate surrounding cattle in the CMER focuses on deforestation for pasture, but such arguments need to be expanded to include considerations of both secondary regrowth and the swidden/fallow cycle. The remote sensing analysis shows that much of the deforestation in the six *seringais* surveyed here is permitted to move into secondary succession, and over half of the area in secondary succession is re-used at a later time period. Thus a significant proportion of the disturbed land cover in the study area remains in some disturbed condition and is not permitted to reach mature stages of forest regrowth. Rubber tapper households appear to be changing their production systems. Although most rubber tapper households are not expanding their agricultural plots per se, they may be using the "2-hectare per year" rule to augment their pasture size on a yearly basis Overall, the results suggest that land-use and land-cover change, and even the responses to such change, is dynamic in the CMER. Aside from changing market and land-use emphases and the resulting variable rates of deforestation, there are also increasing differences in production systems and technologies adopted by rubber tappers as their main source of livelihood begin to change, suggesting not only extensification but also intensification.

Lastly, it is obvious from this exercise that new property boundaries of some *seringais* are needed. Icuriã is a case in point, a community in which the official digital rubber estate boundaries appear to be inconsistent with both the community's and local officials' definition of the actual *seringal*, with some officially recognized residents appearing to live outside of both the reserve itself, as well as the community. In addition, various boundaries exist for a few of the *seringais* in the CMER that have size differences of as much as 15 %. Such variances no doubt affect the results of the deforestation amounts and rates reported here at the *seringal* level. When the question of which boundary to use arose, we opted for the boundaries that most incorporated the households surveyed within the specific community, relying on both GPS points and field experience in the region. If remote sensing is to be considered a serious tool for monitoring the sustainability of the CMER, it is crucial that these issues be resolved.

The discrepancy with Icuriã between the high amount of land reported by households to be in pasture and the low levels of actual deforestation found in the remote sensing analysis points to yet another issue; mainly, extenuating ecological circumstances caused by the division of the watershed, making much of the *seringal* uninhabitable. Unlike the five other rubber estates in this study, where all land is claimed by some household or another, much of Icuriã is without water (or Brazil-nut trees), and consequently without households. These vast tracks of barren land create an unfair advantage for the residents of Icuriã when monitoring the 10 % rule at the community level. Exceptions like Icuriã reveal the limits to a remote sensing approach when monitoring the adherence of households to the rules outlined in the PU, and show why it is important to monitor the reserve's efficacy on the ground. Given these new boundary issues in an historically common property system where property is defined by access to trees and trails, rather than geometric space per se, we argue that in order for monitoring to be effective with the

adoption of new land-use practices, authorities really need to invest in mapping properties at the household (*colocação*) level. This will ensure that effective and timely monitoring can, indeed, take place.

Conclusions

The search for a "win-win" scenario in the CMER and other Extractive Reserves in Brazil appears to be far more complicated than the simplified notion that rubber tapping and other NTFP activities can provide improved material well being while preserving tropical forest. Furthermore, the majority of rubber tappers themselves, at least in this study and most likely for the CMER, define their "rubber tapper" label as including a wide-range of activities that require the forest to be cut, perhaps increasingly so. Overall, when compared to outside colonization projects and ranching operations, the deforestation occurring within the CMER can be considered quite low, but when looked at as a conservation unit, the six *seringais* examined are undergoing surprisingly rapid land-use and land-cover changes with cattle and agriculture as the main drivers of such change. Such changes are inextricably linked to current outside market influences, which privilege cattle to NTFP extractivism. As of yet, however, none of these six *seringais* have surpassed the 10 % limit set on the amount of allowable deforestation. While some communities may surpass allowable deforestation limits in the near future, evidence of intensification among land-users suggests that rubber tappers may be undergoing a process of adaptation that alleviates deforestation pressures while providing improved incomes. After all Holt (2005: 209) argues: "conservation develops as a result of experience and learning, sparked by negative changes in resource characteristics." The environmental changes now underway may be capturing this learning and adjustment process, rather than a long-term trend suggesting system unsustainability.

Much of the current criticism questioning the sustainability of the CMER, and the entire ER model, may reflect biases or misconceptions regarding the character of "rubber tapping" livelihoods as well as the "pristineness" of Amazonian forests. The murder of Chico Mendes has been enlarged to equate cattle with "evil" livelihoods. As a result of such caricaturizing, the mere idea that the rubber tappers championed by Mendes are now raising cattle themselves is met with little enthusiasm by some proponents of the extractive reserve concept. It must be remembered that Chico Mendes and the rubber tappers may have been fighting for the forest, but also, and more importantly, for a right to both a better livelihood and land security.

Cattle and market agriculture are and will likely remain part of a rubber tapper's land-use system, and consequently need to be addressed realistically in terms of appropriate policy development for the rubber tapper populations in the region. Rubber tappers want technical support regarding agricultural development, particularly pasture formation and its sustained use. Cattle, however, remains a "dirty" word in the CMER, and rubber tappers continue to find little support, information, or new policy and regulations regarding such matters. The results of this study show that cattle are positively linked to both livelihood welfare and deforestation, while dependence on extractivism (at least as currently practiced) is linked to a decrease in welfare, as well as a decrease in deforestation. Our suggestion, therefore, is two-fold. Policy directions for both the CMER and the ER model need to focus on cattle regulation and sustainable pasture management, as well as a serious re-investment in NTFP marketing and development in order to make extractivism more viable.

CHAPTER 5
WHAT MAKES A RUBBER TAPPER IN THE BRAZILIAN AMAZON?: CULTURAL, LIVELIHOODS AND INSTITUTIONAL-ORGANIZATIONAL FACTORS UNDERLYING SELF-DEFINITION

Introduction

The Amazon Rubber Boom, which spanned the late nineteenth and early twentieth centuries, introduced a new social actor to Amazonia - the rubber tapper - a forest extractivist at the bottom of a mercantile network linking local, regional and global economies. Over the course of a century, rubber tapper identities originated and centered on their cultural heritage as impoverished migrant peasants with roots in the semi-arid Brazilian northeast (Santos 1980), laborers coerced by rubber estate owners in Amazonia under the dept peonage systems (Cunha 1946, Weinstein 1983, Bunker 1985), and more recently evolved to emphasize successful natural resource managers living at peace with the forest (Anderson 1990, 1992 and 1994, Fearnside 1992, Nepstad and Schwartzman 1992, Allegretti 1995) and as articulators of a victorious social and environmental justice movement in defense of the forest that have directly influenced policy in the Amazon through the Extractive Reserve system (Allegretti 1989, 1990 and 1994, Schwartzman 1989, Fearnside 1989).

With a recent history of notable accomplishments, rubber tappers' perceptions of livelihood options have become broader and are starting to show contrasting trajectories (Gomes 2001, Vadjunec 2007). Official recognition of rubber tapper land claims led many observers to expect forest extractivism to continue, indeed to flourish. Forest extractivism, however, has increasingly faced economic difficulties that have prompted changes in livelihood strategies, even to the point of the growing adoption of cattle ranching, an activity long associated with rancher adversaries of rubber tappers (Gomes 2001 and 2005, Ehringhaus 2006, Vadjunec 2007, Toni 2007).

Since their historic achievements in the 1980s, there has been little attention to the cultural definition rubber tappers (Wallace 2004, Vadjunec 2008). Given rapid socio-economic, institutional and political transformations in the Amazon, it is important to examine rubber tappers individuals' self-definition, after almost three decades of their historical struggle. Given the circumstances in which they are now situated, we explore the idea of what it means to be a rubber tapper in Amazonia today. To answer this question, it is important to understand the evolution of rubber tapper livelihood trajectories to comprehend how rubber tapper definition was historically constructed and how individuals currently define themselves.

Rubber Tappers' Historical Trajectories and Definition Construction

During the rubber boom, the definition of a rubber tapper was straightforward: a "migrant worker tapping rubber in the Amazon." The collapse of the Amazonian rubber industry prompted by the appearance of plantation-grown rubber in Southeast Asia (Weinstein 1983), however, forever altered this definition. The Amazonian rubber economy was briefly revitalized by the Brazilian and United States governments during the Second World War when Southeast Asian rubber supplies areas were controlled by the Japanese, blocking the U.S and its allies' access to rubber (Martinello 1988). Although the state assumed economic and social control of the rubber industry during this period, long-time rubber tappers and new migrants continued to be subjected to a highly exploitative relationship under the same historic debt peonage systems (called *aviamento*), despite the fact that a grassroots reaction to these systems became increasingly more evident (Bakx 1988, Oliveira 1985, Martinello 1988). After the second short-lived rubber boom, the Amazonian rubber economy once again collapsed, causing many rubber barons to abandon their rubber estates, leaving the rubber tappers to fend themselves. Despite the failure of rubber to establish long-term economic development of the region (Coomes and Barnham 1994), the

rubber tapping industry indelibly impacted its culture (Tocantins 1979, Santos 1980, Bakx 1988, Rancy 1992).

In the state of Acre in the southwestern Brazilian Amazon, rubber tapping was once at the core of the state economy, bringing thousands of people to the region and shaping local culture. After the rubber economy crash, while many rubber tappers in the state fled to urban centers, others stayed in the abandoned rubber estates supplying local and regional markets with latex (otherwise banned for importing into Brazil). The establishment of strong ties with the forest along with a new found freedom from the *aviamento* system, led to livelihood diversification among rubber tapper communities. Other forest products such as Brazil nuts became more important, and rubber tappers began to engage in small-scale subsistence agriculture (e.g., Campbell 1996). Such extractive activities, however, only held a peripheral importance in regional politics - extractivism was generally viewed as a backward, economically-stagnant, and peripheral activity, and forest dwellers were considered as obstacles to development in Amazonia (Barbosa 2000). After the final rubber bust, the largely forgotten rubber tappers were virtually invisible on the national scene (Almeida 2004).

In the 1960s, Brazil's then-military government prioritized regional development policies aimed at opening up the Amazon frontier as a way to integrate the region with the rest of the country, including major infrastructure programs, colonization projects, and stimulation of economic growth via fiscal incentives for capital investment (Mahar 1978, Hecht and Cockburn 1989, Moran 1981, Oliveira 1991, Schmink and Wood 1992). By the 1970s, migration by farm families into colonization areas proceeded alongside the establishment of large ranches by investors. As a result, ranching activities began to be consolidated, while forest extractivism was forgotten by the national government.

In Acre, where extractivism was still the basis of the state economy, the 1970s were marked by a major federal campaign to attract investors from the south of Brazil. The "isolated lands" targeted for settlement were historic rubber estates, which at the time were still occupied by rubber tappers unable to prove land rights under Brazilian law. Nonetheless, their land was rapidly transferred by rubber estate owners to "*Paulistas*" - ranchers originating from São Paulo and other states in southern Brazil. Widespread land speculation occurred rapidly, and in few years around of one third of the land in Acre was sold to *Paulistas* and former rubber estates were cleared by cattle ranchers (Bakx 1988, Silva 1990, Calaça 1993).

The arrival of roads and investors alongside with a rapid shift in landownership, led to violent conflicts along the development frontier (Nunes 1991, Sobrinho 1992, Silva, 2003, Paula, 2005, Paula and Silva 2006). The clash of legacy of the rubber boom, with its history of a strong forest-based culture, and heavily influenced by the Rural Worker's Union and the Catholic Church, rubber tappers mobilized as a social movement in Acre in the late 1970's. Chico Mendes was a major force behind the movement. Through non-violent collective action, Mendes and the rubber tappers fought for recognition of their historic land claims, in light of abandonment of rubber estates by their owners. The rubber tapper's movement gradually evolved, receiving increasing political clout for their agrarian reform via recognition of their traditional land claims.

During the rubber tappers' fight against cattle ranchers, the traditional notion of rubber tapper definition was actively portrayed and vocalized. Grassroots mobilization in defense of forests and their inhabitants won admirers among international environmental organizations who emphasized the ecological benefits of forest-based extractivism, propelling rubber tappers onto the world stage through a discourse that linked human rights abuses and environmental destruction. Rubber tappers articulated an environmental image of extractivism to support their

agrarian reform agenda. The success of the rubber tappers' movement in protecting their land and livelihoods in addition to their evolving strategy of political negotiation and agenda-building, drastically changed the conceptualization that rubber tappers might have previously elaborated, requiring a more complex definition. As a result, being a rubber tapper came to be associated with social movement for agrarian reform to recognize traditional land rights based on long-term use of forest for sustainable livelihoods practices. It was under these circumstances, as has been well-documented (see Revkin 2004, Hecht and Cockburn 1990), that the traditional definition of rubber tapper evolved to be associated with greenness, emphasizing the environmental dimension of forest extractivism.

Growing recognition of the social and ecological consequences of deforestation and the murder of Chico Mendes in a year of record forest burning in the Amazon prompted the creation of federal extractive reserves system (Allegretti 1990; Schwartzman 1992). Extractive reserves are forest areas inhabited by extractive populations granted long-term usufruct rights to resources which they collectively manage (Allegretti 1989). The creation of the first extractive reserves in early 1990s marked an unprecedented success of environmental policy-making in the Brazilian Amazon (Allegretti 1989; Schwartzman 1989), and has been promoted as a focal policy tool for promoting forest conservation while simultaneously increasing the economic value of forests and rural income.

Despite this potential and promotion as a model for extractivism development in Amazonia, historically only two non-timber forest products (NTFPs), rubber and brazil nut, have been extensively managed. Ironically, at the onset of ER implementation in the 1990s, federal rubber subside for rubber was cut, and the already low rubber prices plummeted. Almost two decades after the establishment of the federal Extractive Reserves in Amazonia, however, the

model still faces challenges of putting these objectives into practice as economic, social, and ecological constraints have emerged (e.g. Anderson 1992, Browder 1990 and 1992, Homma 1992, Hall 1997). Extractivist communities are still faced with a current pattern of low-income generation based solely on forest activities, and the goal of economic growth is a major driver forcing livelihood change in Extractive Reserves. As the pressure to diversify production and to increase income grows, rubber tappers are increasingly moving toward cash-crop agriculture, and small-scale cattle ranching as important components of their livelihoods strategies to maintain and/or increase household income (e.g. Gomes 2001, Wallace 2004, Ehringhaus 2006, Vadjunec 2007). Nevertheless, despite the widespread decline of rubber tapping, the category of rubber tapper (*seringueiro*) has become and continues to be culturally and politically powerful within the social movement and regional politics.

In 1998, allies of the rubber tappers movement came to power in the state of Acre and launched new experiments in regional development policies (Kainer et al. 2003). Jorge Viana, an environmentalist, an academically trained forester, and a close associate of Chico Mendes, was elected governor for the state in 1998 and re-elected in 2002. In the 2006 election, Arnóbio Marques ("Binho"), Viana's vice-governor, was elected governor and continues the development policies initiated by his predecessor. The "Forest Government" as it is locally called, operates under broadly defined concepts of forest development. The driving principal of diversified extractivist development emphasizes the social aspect of local and regional development and is evidenced in the government's latest forest conservation and development concept "Florestania," or forest citizenship. Florestania is built on respect for the environment and recognition and appreciation of local knowledge and cultural traditions of forest dwellers, honoring the legacy of Chico Mendes and the rubber tappers' movement (Government of Acre 2005).

The Forest Government has gained growing support in Brazil and abroad and has been successful in rallying financial support for its ground-breaking development approach. This legacy and the platform the government gave to alternative development ideas helped them to advance major programs funded by the Brazilian national government, the National Bank for Social and Economic Development (BNDES), and multilateral cooperation agencies, such as the Inter-American Development Bank (IDB).

Forest dwellers are encouraged to increase production of the twin pillars of the traditional Acrean extractivist economy: rubber tapping and Brazil nut harvesting. An important fiscal incentive was the creation of the Chico Mendes Law in 1999 - a rubber subsidies program to encourage a return to rubber tapping (Kainer et al. 2003). To offer value-added income for rubber tappers families, the state government has created a series of incentives for forest-based entrepreneurs, which include access to green markets and processing of forest-based production. Xapuri, where the rubber tapper movement arose, has become an industrial complex for diverse forest-based development initiatives, which include community-based logging, an eco-friendly furniture industry, a Brazil nut processing plant, and a condom factory that uses local latex to supply the Brazilian Health Ministry's program with distribution of condoms in medical centers throughout the country.

In this context, rubber tapper definition has become strongly embedded in *Acreano* State history and pride, becoming part of a larger, more complex regional concept over time. Yet, their traditional definition and knowledge remain alive, complex, and extremely dynamic. Little research has been done in Amazonia regarding peasant self-definition. Nugent (1993) argues that traditional Amazonian peasantry is historically wrongly defined by the "other" and remains relatively "invisible," yet quite complex. Harris (2007: 7) concludes that Amazonian river

dwellers define themselves based on shared skills and experiences, adapted around survival to changing market and environmental conditions. Becker (2004: 9) criticizes the seemingly uniform category of Latin American "peasantry," and instead argues that many social groups have "hybrid identities" based on a complex combination of their own culture, the prevailing dominant culture, land struggles, and political and economic forces. Here, we explore this complex definition of peasant as it refers to rubber tappers.

While local discourse sometimes points in this direction, there is no golden age of rubber tapping to return to and regardless of these many changes in support of forest extractivism, cattle ranching is continuous expanding in Acre (Valentim et al. 2002; Toni 2007). What is more, this land use activity is not confined to larger-scale landowners but is growing among other groups and erstwhile rubber tappers (Gomes 2001). Although cattle ranching runs counter to the ecologically sustainable precepts of the extractive reserve concept, rubber tapper communities in the Chico Mendes Extractive Reserve (CMER), the symbolic site of the early struggles are increasingly pursuing small-scale cattle ranching as a sound income-generating activity. This trend toward cattle ranching occurred despite profound historical and cultural differences with rubber tappers livelihoods trajectories, but it respond to regional market demand operating in the region, and dominate economy outside extractive reserve areas. We therefore argue that traditional definition of rubber tapper need to be revisited, and a more dynamic view that recognizes the wider range of economic possibilities within extractive reserves discussed. The image of 'forest guardian' with inherently environmental practices is dangerous in the context of changing pressures and practices and the idealized guardian can be recast as the "forest villain," fueling agendas of hardcore protectionists and developers.

Chico Mendes has himself become a legend of almost mythic proportions, being described as an "ecologist," a "rain-forest Gandhi," an "eco-martyr," and one of the "50 most important environmental thinkers in history" (Gale 1998, Palmer 2002, Maxwell 2003, Revkin 2004). On the 20th anniversary of his murder (dec/2008), his memory was celebrated in many ways. In Acre, the state government officially dedicated 2008 as the Year of Chico Mendes; the Brazilian Congress dedicated a solemn special session to remember his name and struggle; his story was retold throughout major newspapers and television networks (e.g., BBC, Discovery Channel, Globo); and the Brazilian President, Luiz Ignacio "Lula" da Silva, led tributes to Chico Mendes in his weekly radio address. Diverse political coalitions have coalesced around Chico Mendes' legacy, developing a dialectic around the importance of the "forest-dwellers" that Mendes represented; however, in many cases the coalition member groups have each tried to set a different agenda for rubber tappers, each claiming to be a direct philosophical descendent of Chico Mendes' legacy of forest conservation.

For all this celebration and attention, when rubber tappers do not behave as expected, they are criticized. Ironically, while everyone was celebrating Chico Mendes' memory, the Brazilian Environmental Agency (IBAMA) began an operation to expel "illegal" occupants from the extractive reserve that carries Chico Mendes' name. IBAMA took the stance that those raising cattle were acting illegally by not obeying the reserve's rules against increasing cattle raising activities, and 350 families were commanded to leave the reserve. The president of the Rural Workers Union of Xapuri, the same Union Chico Mendes was president when assassinated, however, challenged IBAMA's action against these reserve families, arguing that small-scale cattle ranching has become an important economic activity for rubber tappers and the lack of

government investment in extractive reserves is to blame for such livelihoods transformations and its environmental impacts in the Reserve.

The problem described here represents an opportunity for broader debates on forest resource co-management pacts by government institutions and grassroots organizations for economic options and administration of extractive reserves in the very place where Chico Mendes argued for this right twenty years ago. It is time to ask questions about how these new contradictions might shape rubber tapper definition today.

The past one hundred years or so have constituted rubber tapper as a distinct social category. During this time, rubber tapper definition has evolved. That is of course based on neo-colonial comparative advantages of the region, tied to rubber, albeit under highly exploitative labor relations. That changed via the autonomy and the agrarian reform movements, which evidence attachment to the rubber estates, which were adamantly defended by rubber tappers, which also helped constitute regional identity in Acre as opposed to the *Paulistas* from southern Brazil, and originated a strong environmental movement in the region.

Campaign all call on invocation of "seringueiro" in specific ways that were not always consonant. Rubber tapper definition have changed over time and often been imposed by outsiders, whether critics or supporters. And now, all of this is back in play, because the historical trappings of exploitative labor relations has been swept away, the economic importance of rubber is in question, and the quality of life in towns looks in many ways better than that in Extractive Reserve. There are currently divergent pressures on people in the CMER as regards their productive activities, via supports for extractivism alongside market incentive for cattle ranching, and consequently this pulls various directions at how rubber tappers define themselves. If all these are shorn from rubber tappers as a basis for their definition, we are left

with regionalism, which is somewhat diffuse since it does not just apply to the CMER but to Acre more generally.

This study seeks to shed light on rubber tappers' definition reflecting on their historical livelihood trajectories while considering their current evolving socioeconomic and development circumstances as residents of Extractive Reserve. This paper uses quantitative data collected from a household survey, and qualitative data collected from key-informant interviews from the Chico Mendes Extractive Reserve to explore the following questions: (1) Does everyone self-identify as a rubber tapper today? (2) If not, which cultural, institutional organizational and livelihoods characteristics help explain who does?, and (3) What additional qualitative evidence can help us interpret what it now means to identify as a rubber tapper?

Data and Methods

Selection of the Study Sites

This study was carried out with rubber tapper communities of the Chico Mendes Extractive Reserve (CMER) in southwestern Brazilian Amazonian state of Acre (Figure 5-1). The eastern part of Acre lies at the westernmost limit of the Amazonian development frontier that experienced massive changes in land use since the 1970s, constituting part of the complex land use mosaic. The CMER lies just at this limit of the frontier. Forest dwelling communities in this region live at the threshold of forest based economies and competing large-scale types of land-use in which the CMER is nested within and along the limits of the deforestation front and within different land tenure types and thus, different land uses. In many ways, the study region and its unique political ecology are particularly appropriate for the study of the changing perception of what it means to be a rubber tapper today.

The CMER is the second largest extractive reserve in Amazonia with an area of approximately 970,570 ha (9,705 square kilometers). It is divided into the historically important

rubber tapper estates (*seringais),* stretching across seven municipalities and bordering the Brazilian highway leading to the Pacific. Research was carried out in eight rubber estates within three municipalities of the CMER: Assis Brasil (São Francisco, Icuria, Paraguaçu), Brasiléia (Humaita, Porongaba, Filipinas) and Xapuri (São João do Iracema, Indêpendencia). Seringais were chosen with the assistance of reserve leaders, and were stratified on the basis of their location and orientation towards perceived traditional extractive and non-traditional rapidly changing communities.

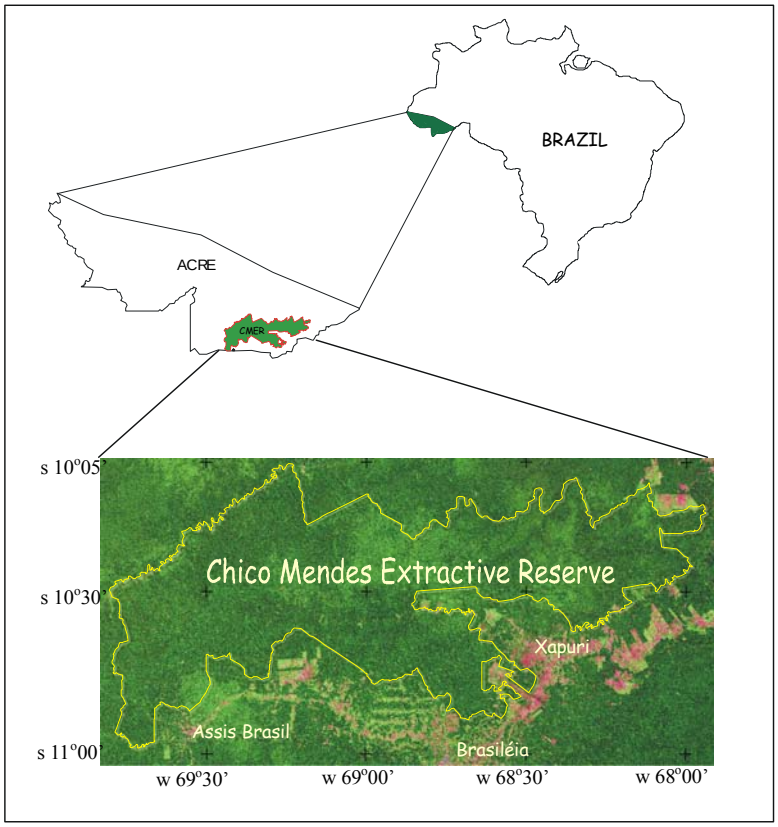

Figure 5-1 – Location of the Chico Mendes Extractive Reserve

Household Surveys

A total of 149 household interviews were completed within the eight communities between March 2004 and January 2005. Each interview took about three hours to complete, and contained

open and closed ended questions regarding general land-use and household characteristics and history, as well as specific questions regarding individuals self-definition issues. Randomization, in this case, was not possible. Difficult access in the rainy season and incomplete residency lists caused the research team to adopt a more opportunistic approach. Few roads exist in the reserve, and some communities are 50-75 km from the nearest urban center. As a result, attention focused on ensuring adequate geographic coverage while stratifying for different livelihood orientations and emphases (i.e., extractivist, agriculture, small animal production and cattle). Data from the surveys are used in descriptive statistics and in the multivariate regression model. Results of the data are enriched by open-ended interviews with key-informants.

Operational Definitions, Measurement and Hypothesized Effect of Explanatory Variables

This section presents operational definitions for a respondent's self-definition outcome variable as well as a set of explanatory variables that may influence a respondent's self-definition as a rubber tapper. These variables consider both indicators related to rubber tapper's historical trajectories as well as explore the contradictory nature of changing land use observed in the Chico Mendes Reserve.

Table 5-1 contains definitions and the operationalization for all explanatory variables used in the analysis, in addition to their expected effects on a household head's self-definition as a rubber tapper. We focus on a single outcome binomial variable: a respondent's self-definition as a rubber tapper. To account for variation in this outcome variable, the analysis includes five groups of explanatory variables: socioeconomic characteristics of the households head's, institutional and organizational contexts, land-use practices, location, and knowledge about land use rules in the reserve. These indicators provide a measure of the diverse factors that may lead to a household head's self-definition as a rubber tapper, given the transformations currently occurring in the extractivist economy throughout the region.

Table 5-1. Operational definitions and hypothesized relationships of explanatory and outcome variables

Variables	Operational definition/Unit	Expected effects on individual definition as rubber tapper
Outcome variable:		
Household head's self-definition	rubber tapper (0=no, 1 = yes)	
Independent Variables:		
1 - Socioeconomic Indicators		
A - Household Head's Background		
First occupant of the homestead	(0=no, 1 = yes)	+
Years of residence	years in the homestead	+
Age of household head	years	+
Schooling of household head	years	-
Previous residence	0 = in the reserve; 1=outside	+
Relatives living in this seringal	0=no, 1 = yes	+
B - Assets		
Household owns a tv	0=no, 1 = yes	-
Household owns gas	0=no, 1 = yes	-
Household owns a refrigerator	0=no, 1 = yes	-
Manioc processor house	0=no, 1 = yes	-
Household owns a solar panel	0=no, 1 = yes	-
Household owns a chainsaw	0=no, 1 = yes	-
Household has a wood house	0=no, 1 = yes	+
Household owns a phone	0=no, 1 = yes	-
2 - Institutional Context indicators		
Assoc. at municipal level	Membership (0=no, 1 = yes)	+
Assoc. at community level	Membership (0=no, 1 = yes)	+
Assoc. w/ producers cooperative	Membership (0=no, 1 = yes)	+
Assoc. w/ rural workers syndicate	Membership (0=no, 1 = yes)	+
Participated in *empate*	(0=no, 1 = yes)	+
Participates in *multirão*	(0=no, 1 = yes)	+
Household head received gov. credit	(0=no, 1 = yes)	-
3 – Land-Use Indicators		
C – Forest Extractivism		
Rubber tapping	(0=no, 1 = yes)	+
Total area	hac	+
Rubber production	measured in kilos	+
Total number of brazil nut trees	number	+
Total brazil nut production	measured in kilos	+
D – Annual Crops sold		
Rice production sold	kilos sold	-
Corn production sold	kilos sold	-

Table 5-1 Continued.

Variables	Operational definition/Unit	Expected effects on individual definition as rubber tapper
Bean production sold	kilos sold	-
Manioc production sold	kilos sold	-
E – Cattle ranching and pasture		
Raise cattle	(0=no, 1 = yes)	-
Household started to raise cattle	measured in years	-
Total number of head of cattle	number	-
Total number of cattle head sold	number	-
Household started to make pasture	measured in years	-
Total size of pasture area	measured in ha	-
Plan for # of cattle in 10 years	number	-
4 – Location		
Household at municipalities	1=Xapuri	+
	2=Brasileia	+
	3=Assis Brasil	-
5 – Land use rules indicators		
Knows the utilization plan	(0=no, 1 = yes)	+
Know the 10% deforestation rule	(0=no, 1 = yes)	+
Know the 5% pasture rule	(0=no, 1 = yes)	+

Socio-economic indicators

Household head's socio-economic indicators have been used elsewhere in modeling smallholder deforestation in Amazonia, in relation to wealth, and productive practices, among other characteristics (Brondizio & Siqueira 1997; Godoy 1997; Godoy *et al.* 1997; Brondizio 1999; Brondizio & al. 2001; Perz 2001b, 2001a), but assumptions regarding the classification (e.g., small farmer, colonists, caboclos) are taken for granted and little effort is made to understand how these rural people in fact see themselves. The first group of variables presents socioeconomic indicators divided by household head's background and assets. By background (table 5-1a), we refer to household head's first occupancy of the homestead, previous and length of residence in the homestead, as well as age and kinship ties.

Many homesteads in the CMER are very old, dating from the rubber boom period, while more recent new settlements are being opened through sub-division of those old settlements (Gomes 2001). We have noted that there are recent changes in migration dynamics within the CMER, as many families constantly seeking out a home with better road access and closer to cities. Being a first occupant and years of residence in a homestead may give an indication of household head's origin and/or identification with the history of the region. As the rubber market has drastically decreased in the region, we have observed that rubber tapping is often practiced to a greater extent by older household head's that have a vast knowledge regarding extraction and processing techniques, often preferring to tap rubber over some other activity despite market constraints, while younger household head's tend to be engaged in other activities, due to a lack of historical commitment to extractivism (Gomes 2001; Vadjunec *et al.* nd). We, therefore, expect that household heads who are first occupant of a homestead with a longer residence in the reserve, and older household heads should be more prone to define themselves as rubber tappers.

By assets (table 5-1b), we consider a householder access to larger, more expensive secondary material goods. As individuals in the region are increasingly integrated into regional and, even global markets, we have also seen important transformations in their lifestyles, having more access to material goods that until recently were seldom seen in the reserve (e.g. refrigerator, TV, solar panels, cell phones, electric generators). These changes may directly influence diet, lifestyle and means of communication in the CMER. For example, until recently, communication was more based on a collective level, with news being spread via the local association either through word of mouth or two-way radio. Increasingly, individuals in some areas now have their own cell phone, thus eliminating the need for collective means of communication. Changes are also observed in terms of living condition as respondents

increasingly buy chainsaws or pay others an hourly rate for the use of it, and we have noted changes in their housing quality (finished wood houses vs. traditional rubber tapper construction). With those transformations, rubber tappers may reject the rubber tapper lifestyle for its perceived backwardness, desiring instead, a seemingly more modern counterpart. We expect that this increased access to material good will also impact social status, and therefore may have a negative affect on a respondent's self-definition as a rubber tapper.

Institutional context indicators

The second group of variables represents institutional context and social organization indicators. Institutional variables include membership association at the municipal and community level, participation in the worker's union, cooperativism, *empates*, *multirão*, and access to credit. Rubber tapper communities in the CMER have several forms of nested institutional-organizational affiliation structures, operating within and outside their communities. (Cardoso 1992; Vadjunec 2007). Individuals first institutional affiliation occurs at the community level as families living close to each other create association, in which important collective decisions are made related to shared concerns about the community (e.g., maintenance of *varadouros* or feeder roads, marketing transportation, health care, and education). A second level of association affiliation operates at the municipalities compassing the reserve's territory, as a strategy to coordinate the reserve management in different municipalities, making the link between rubber tapper community associations, the Brazilian government and other agencies in the region.

Other institutional measurements are related to affiliation with institutions not restrict to the CMER's residents but direct linked to the extractive reserve roots. Cooperative affiliation, a more direct market oriented institution, plays an important role for the reserve's residents, such as the marketing of extractive goods and helping ease transportation costs. Moreover, the rural

workers' syndicates were historically key entities articulating the initial needs of the rubber tapper's movement (Hecht & Cockburn 1989; Paula 1991; Sobrinho 1992), and thus, we, consider the reserve residents' affiliation to those institutions.

A major characteristic of the rubber tapper movement in the 1980s was its organizational capacities and strong sense of community. Living isolated and geographically dispersed in the forest, they slowly began to organize against the major causes of deforestation that occurred in the area, and developed a resistance movement by the means of "*empates*" or stand-offs, blocking people and machinery with their bodies as a strategy to protect the forest against cattle ranchers (Paula 1991; Calaça 1993; Almeida 2002). Householders in the CMER are in the core area where such strategies developed. Indeed, several of the individuals in our sample reported that they participated in *empates*, while others, especially younger household heads, have older family members who were directly involved in or knowledgeable of those historical processes, which are still referred to in the current day. Another means of mutual collaboration was known as the *mutirão* - a still frequent way to help each other at the homestead level, such as clearing trails, building bridges to facilitate transportation, taking care of a neighbor's agricultural field in case of sickness, among other collective tasks.

Participation in such institutions and traditional forms of mutual collaboration is indelibly related to shared concerns in the CMER that arise due to co-residence in forested areas traditionally associated with extractivism. Overall, we expect that individual affiliation with these institutions together with participation on traditional practices of mutual collaboration that are very important on rubber tapper culture, given their collective nature, should strengthen traditional livelihoods systems and thus, we expect, will portray a positive influence on an individual respondent's self-definition as rubber tapper.

Land-use indicators

The third set of indicators is related to resource management, grouped into three main components of livelihoods systems in the CMER: forest extractivism, annual crops and cattle ranching. This set of indicators provides a means of measuring the effects of livelihoods changes, and are expected to have mixed results on an individual self-definition. Extractivist production (table 5-1c) have been historically important to rubber tappers livelihoods, and is in the core of the extractive reserve concept (Allegretti 1989; Schwartzman 1989), and thus is expected to be significant in defining individual's self-definition as rubber tappers. Recent studies, have identified livelihood changes in the CMER (e.g., Sassagawa 1999; Gomes 2001; Ehringhaus 2005; Vadjunec 2007). Given that subsistence agriculture has long seen mostly as a subsistence land use practice among rubber tapper, we measured agriculture in term of actual agricultural products sold (table 5-1d). Among those changes, small-scale cattle raising represents the most questionable for what was initially envisioned as a sustainable livelihood system for extractivist populations. Cattle ranching and pasture-related indicators (table 5-1e) are considered due to its recent importance as a short-term income source for families as well its contradictory nature of changing livelihoods with the historical struggle and political discourse of the rubber tapper's movement. Given the history of the movement as anti-ranching, today, cattle and pasture development, in addition to increased commercial agriculture, is likely to constrain and reduce individual self-definition as rubber tappers.

Location indicators

We also attempt to capture differences through location of households across municipalities. The reserve is spread out into three municipalities with different histories in the articulation of the rubber tapper's movement and current different levels of support for extractive reserve development initiatives. There are also different ecological zones in the reserve

potentially affecting access to forest resources (i.e. some areas do not have access to rubber and/or Brazil nut). Given these differences, we measured a respondent's self-definition across three municipalities, in a attempt explore if they may differentiate across location despite being within the same extractive reserve. We expect that in the municipality of Assis Brasil, which has little forest extractive resources, location will have a negative impact on individual's self-definition as rubber tappers.

Reserve wide land-use rules

A final group of indicators is about land-use rules in the reserve. The reserve was created as the main result of the rubber tapper's movement, forging a new land tenure system with co-management responsibilities divided between the Brazilian government and the rubber tapper organizations. As the CMER was created, the Brazilian government along with rubber tappers created a series of rules combining traditional practices with Brazilian environmental laws which all the reserve residents have to obey, referred to as the "Utilization Plan." We collected individuals knowledge about the utilization plan extensively (see Vadjunec 2007), but for the purpose of this analysis we measure, only three aspects. First, if the respondent was aware of the existence of the utilization plan regulating land use in the reserve. Then, we used two more specific questions related to the most evident transformations we have observed, that is, increased deforestation for pasture land for cattle raising. We asked if the respondents recognize the rule that states that they can deforest only 10% of their property. Lastly, if they are aware of this rule, we asked them if they were aware that out of that 10% permitted, only 5% can be allocated for pasture creation. This gives evidence if they were in compliance with the rules created and, in general terms, their commitment to the extractive reserve model as a means of sustainable development. Despite a household head's potential knowledge of those rules, we cannot necessarily assume that they always obey the rules. Evidence, however, exists that even

mere knowledge of the rules positively impacts a community, creating social cohesion and decreasing environmental impacts (Ostrom 1990; Moran & Ostrom 2005). We expect that respondent's knowledge about the rules in the reserve should have a positive impact on a respondent's self-definition as a rubber tapper.

Logistic Multiple Regression Model

The variable that we used to represent rubber tapper individuals self-definition is a binary variable. The most appropriate model, in this case, is therefore a binary logistic regression. Such a model is used in instances of binary variables when the desire is to estimate the probability of the occurrence of an event (Agresti 1990), or in our case, the probability of household head's self-identifying as rubber tapper or not. In our model, Y_i is defined so that: 1= self-identification as being a rubber tapper, and 0=no self-identification as rubber tapper. Logistic regression model allows estimation of the likelihood of the occurrence of an event expressed as the probability of the event occurring relative to the probability of the event not occurring, where p_i is the likelihood of the occurrence of the event i for each individual. Logistic regression allows estimation of coefficients b for explanatory variables X (1…n). The coefficients can be exponentiated to yield odds ratios which indicate the change in the likelihood of Y=1. Results from logistic regression thus indicate effects of the independent variables on the likelihood of self-identifying as a rubber tapper, including the variables which make such self-identification more likely.

In order to define the final model and minimize the number of variables used that maximizes the precision of the model, we tested one by one variable until the final model was found. This allowed us to start with a high number of inter-related variables (explained above) and systematically eliminate all variables that proved to be insignificant, to give us the best

possible regression model for our study. For more detail on the operationalization details of the dependent and independent variables, see table 5-1.

Results

Analysis of Descriptive Findings

A respondent's self-definition as a rubber tapper may reflect, among other things, one's background as a traditional forest-dweller of a specific socioeconomic class, one's degree of participation in the rubber tapper's institutions and social movement, one's main livelihood practices, the degree of integration into market for both extractivist and non-extractivist production, in addition to one's recognition of the current land tenure regulation. Table 5-2 presents descriptive statistics for those characteristics among household head's in the CMER. We find it surprising that 78 percent of respondents still identify as rubber tappers. Among the block of variables that assess socio-economic aspects for household head's background, only 27% of them were the first residents on the property, while the average duration of residence was over 13 years and the mean age of household heads was 40 years old. These averages suggest generally older household heads and a relatively long duration of residence; however, the standard deviations reveal considerable variation among respondents in the sample.

It also shows that some assets related to improved livelihood needs and production activities are become more common, as over 50% of the individuals surveyed own a finished wood house and have access to gas for cooking, while over 30% own a chainsaw and a house to process manioc. Other assets more related to communication that usually depend on surplus cash, such as the possession of a TV or a phone, are still limited (possessed by less than 15% of the individuals in the sample). These findings, we argue are important, because they are relatively new material goods, implying a recent and differentiated socio-economic status for some rubber tapper families in the reserve.

Table 5-2. Descriptive statistics for socioeconomic aspects, institutional context, land-use practices, location and land-use rules, among households in the Chico Mendes Reserve

Variables	Mean	Standard deviation	N
Outcome variable:			
Self-definition as rubber tapper (0=no, 1 = yes)	0.78	0.41	147
Independent Variables:			
1 – Socioeconomic indicators			
A – Household head's Background			
First occupant (0=no, 1 = yes)	0.27	0.45	143
Years of residence	13.17	10.28	148
Age of household head	40.69	13.46	149
Years of schooling of household head	2.5	1.71	149
Previous residence	0.29	0.45	147
Relatives living in this seringal	0.87	0.32	147
B - Assets (0=no, 1 = yes)			
Household owns a tv	0.11	0.31	148
Household owns gas	0.52	0.5	148
Household owns a refrigerator	0.02	0.16	148
Manioc processor house	0.38	0.48	148
Household owns a solar panel	0.15	0.36	148
Household owns a chainsaw	0.33	0.47	148
Household has a wood house	0.75	0.43	149
Household owns a phone	0.08	0.27	148
2 - Institutional indicators (0=no, 1 = yes)			
Association at municipal level	0.92	0.26	148
Association at community level	0.62	0.49	148
Association producers cooperative	0.14	0.35	148
Association w/ rural workers syndicate	0.69	0.46	147
Household head participated in *empate*	0.25	0.43	143
Household participates in *multirão*	0.76	0.42	143
Household head received gov. credit	0.48	0.5	147
3 - Land-Use Indicators			
C - Forest extractivism (kg)			
Rubber tapping (0=no, 1 = yes)	0.41	0.49	146
Total area (hectares)	426.17	303.67	149
Rubber production	142.68	269.91	149
Total number of brazil nut trees *	186.24	286.58	149
Total brazil nut production (kg)	1686.25	2680.94	149
D - Annual crops sold (kg)			
Rice production sold	248.04	387.83	149
Corn production sold	81	339.43	149

Table 5-2 Continued.

Bean production sold	162.1	268.04	149
Manioc production sold	173.55	799.35	149
E - Cattle ranching and pasture			
Raise cattle (0=no, 1 = yes)	0.86	0.34	149
Total number of head of cattle	14.04	17.46	149
Year household started to raise cattle	8.52	7.77	135
Total number of cattle head sold	3.48	9.19	149
Total size of pasture area	8.79	7.62	149
Year household started to make pasture	8.57	7.14	131
Plan for # of cattle in 10 years	84.55	172.09	138
4 - Location			
Household at Municipalities			
1=Xapuri	0.19	0.39	149
2=Brasiléia	0.35	0.48	149
3=Assis Brasil	0.46	0.49	149
5 - Land use rules (0=no, 1 = yes)			
Knows the utilization plan	0.79	0.4	147
Know the 10% deforestation rule	0.81	0.38	146
Know the 5% pasture rule	0.72	0.44	146

1. Values shown are either proportions (binomial variable) or arithmetic means (continuous variable)

Regarding institutional-organizational context indicators, overall, 60% of household head's were affiliated with a grass-roots institutions, excluding cooperatives; 92% were affiliated with the reserve-wide association, demonstrating the importance of the association in recognizing individuals as official reserve residents, divvying up land and resources. Individual affiliation with a cooperative was much lower, only 14%, implying that they access other mechanisms in marketing products. Nearly 50% of the household head's had received government access to credit in some form. This strikes us as somehow surprising, as only recently have rubber tappers even begun to receive formal government credits. These results imply an increased governmental recognition for rubber tappers, a result of their continued political coalition and broader development agenda in the region. In addition, participation in traditional forms of cooperation were high with 76% of household head's having participated in a *mutirão* and 25% having

participated in an *empate*, implying that such households were directly engaged in the movement for some time, twenty years ago when the last *empate* took place.

Forest extractivist practices and the intensity of extractivism depend mostly on the size of land traditionally measured by the number of rubber trails (01 rubber trail = 100 hectares), as well as resource (rubber and Brazil nut) dispersion in different ecological zones of the reserve (Vadjunec 2007). Thus, total area of a household showed an average of 400 hectares, or about four rubber trails per households. Despite this land availability for tapping rubber, only about 40% actually tap rubber, and the average production is about 142 kilos per year, an insignificant outcome for people that traditionally had their main livelihood economy based on rubber production. Obviously, a clear sign of the stagnation of the rubber economy in the region. The number of brazil-nut is the next most important measurement of forest extractivist production, and individuals are very aware of how many brazil nuts trees they hold as a means of projecting annual brazil nut production and income, as well as calculating the value of their land. The average number of brazil nut trees per property was close to 200 trees, while annual production was over 1600 kilos per household. Overall, forest extractivism indicators showed substantial standard deviations, indicating differential production, likely to be a result of substantial variation regarding extractivist resources across different areas of the reserve.

The descriptive statistics also show low means of agricultural production sold, with rice representing the most important cash crop--with less than 300 kilos sold per household. This suggests mainly subsistence agriculture, and demonstrates an overall low market link among respondents based on agricultural production, but standard deviations are also high, implying that for some individuals agricultural production might represent an important income generator. Cattle ranching appear as a widespread activity, as 86% of the respondents raise cattle, with an

average of 14 heads of cattle and a mean of about 9 hectares of land under pasture per household. The high percentage of cattle raising combined with the fact that both the number of years since a individual started to raise cattle, and number of years started to create pasture area average less than 9 years, indicates that ranching a relatively young activity, having increased substantially only recently. This is supported by the average household heads plan for cattle in the next ten-year period, averaging over 80 heads.

Analysis of the Multivariate Regression Model

For a better understanding of the complex interaction between variables, this section presents the multivariate model in which the variables ultimately were found to be significant in the model tested. Table 5-3 presents the results of the logistical regression model regarding respondents self-definition regressed against indicators of household head's background and assets, institutional-organizational context, livelihood practices and land-use regulation indicators.

The first determinant of self-definition involves a household head's background. In contrast to our expectation, the odds ratio indicates that individuals that were first occupants of the homestead were 0.3 times more likely to declare themselves a rubber tapper than those that are not first occupants. In other words, the first occupant have less chances of self-define as rubber tapper, as indicated by a odds ratio less than 1. We suspect, homestead turnover is not due to outsiders coming in, but rather reflects increasing sub-division among family members for more secure usufruct rights to their land and recognition as a new CMER resident. Even so, most such young household head's tends to neglect traditional forms of extractive livelihoods, but may be linked to extractive cultural identities through their parents' history and experiences. None of the other household head's background variables show significant net effects on individual self-

definition, which suggests that the way they define themselves is complex, regardless most of the background variables measured.

Table 5-3. Multivariable model of household self-definition as rubber tapper regressed on household background, institutional context, land-use practices and regulations in the Chico Mendes Extractive Reserve

Variable		B	Odds Ratios	Wald Chi-Square	df	Sig.
Intercept		-1.884		4.194	1	.041
Household head's background						
First occupancy of the homestead	No	-1.182	0.3	4.647	1	.031
	Yes	0.000		.	.	.
Institutional context						
Affiliation w/ community association	No	-1.347	0.3	5.001	1	.025
	Yes	0.000		.	.	.
Participation in mutirão	No	1.390	4.0	4.901	1	.027
	Yes	0.000		.	.	.
Land use						
Total area household landholding (ha)	None (ref.)	2.788	4.9	8.019	1	.005
	100 < 300	1.189	9.5	1.911	1	.167
	300 < 600	0.538	16.2	0.318	1	.573
	> 600	0.000		.	.	.
Reserve regulation						
Knows the utilization plan	No	1.000	2.7	3.112	1	.078
	Yes	0.000		.	.	.

Two institutional context variables exert strong effects on a household head's self-definition. Individuals affiliated with a community level association, diverging from our expectation, tend to abandon the traditional notion of rubber tapper, as the odds ratios indicate that individuals affiliated with community level association were 0.3 times more likely to define themselves as rubber tappers than those not affiliated. That is, individuals affiliation with the association tend to decrease the chance of self-definition as rubber tapper. In addition, household head's participation in a *mutirão* shows a significant positive effect: respondents that participated in a *mutirão* are 4 times more likely to declare themselves a rubber tapper than those that did not participate.

Land use variables reveal a limited array of significant factors. We expected that land use practices related to extractivist activities would positively influence individual self-definition as a rubber tapper, while other predicators related to cattle ranching and pasture would have a negative effect. Our expectation was not met. The only predictor that exhibits the anticipated effects was the total land area of the household, a finding that supports arguments that self-definition is not dependent on land-use practices, but on the size of the land hold. Traditional land area definition is based on the number of rubber trails in a household's land holding, but in a few parts of the reserve (especially in the municipality of Assis Brasil), rubber trees are not present, and thus this traditional definition is problematic. Individual with areas with 300 hectares or three rubber trail (01 rubber trail = 100 ha) are 4.9 times more likely to declare themselves as rubber tappers than those where rubber trail is not an appropriate definition of land measurement. This chance increase according to the size of land holding as individuals with 300-600 hectares and individuals holding over 600 hectares (or 06 rubber trail) are respectively 9.5 and 16.2 times likely to declare themselves as rubber tappers than those with land not formally defined based on the number of rubber trails. Although we expected that size of landholding would be important because it implies more potential extractivist resources available to the land-user, this effect was not observed when looking at actual land use variables, suggesting that size of the area – a key factor for extractivist production – is key for household head's self-definition as a rubber tapper but does not contribute to support land use practices as a significant predictor for self-definition.

Household head's general knowledge about the utilization plan also presents important significance in their self-definition as rubber tapper. Those individuals that responded that they knew about the reserve utilization plan were 2.7 times more likely to define themselves as rubber

tapper than those who did not know the utilization plan. More detailed knowledge about two specific rules regarding land use did not show significant net effects on a respondent's self-definition

Discussion

These findings bear important implications for (i) understanding of the factors that differentiate among who self-identifies as rubber tappers and who does not, (ii) the recent history of the rubber tapper struggle for forest conservation, (iii) the role of institutions and land use practices on household head livelihoods improvement and (iv) policies for extractive reserves as an important environmentally sound strategy in the region.

The multivariate model provides empirical support that reveals only a few factors exert significant effects on a household head's self-definition, showing some support for what is commonly expected, but more importantly not supporting general expectations of what a rubber tapper is expected to be in the region, according to their historical social movement and traditional livelihoods trajectories. With the exception of being the first occupant, socioeconomic factors did not exert significant effects on respondent self-definition, contrary to our expectation. Yet, first occupancy, as observed in table 5-3 reveals a significance contrary to what we expected as being the first occupant increases the likelihood of those households heads not considering themselves a rubber tapper.

Homesteads are traditionally older-aged settlements (Gomes 2001). But we have observed since the reserve's establishment, especially on those areas close to cities, that old homesteads have been increasingly sub-divided for the formation of new homesteads by family members. This might represent a shift suggesting that new occupants may have the tendency to reject traditional notions of rubber tapper definition. New families may be opting for a "modern"

lifestyle following general trends of the region, refusing the idea of a 'traditional lifestyle' imposed on them by the traditional and narrow historic definition of a rubber tapper.

Only two out of seven institutional variables showed significance in individual respondent self-definition as presented on table 5-3, with one (affiliation with the community level association) working against traditional rubber tapper definition, as the likelihood of household heads declaring themselves as rubber tapper was higher for those not affiliated. This finding seems to represent a rupture to traditional rubber tapper definition in the core of the smallest social organization structure that was very important to the coalition of the well-known tapper's movement for land and social justice merely twenty years ago. It is easy to see the early success of these organizational processes and expect that this is maintained in the core of their social structure. But, with the creation of the reserve their main goal (right for land) was finally reached, and their agenda as a social group, residents of the reserve, appears to have shifted, becoming more about development and less about the history, unity and success of the social movement (Ehringhaus 2005). In many instances the real or historic leaders of the movement have left the reserve, participating instead in political discussions outside of the reserve. Vadjunec (2007) cites increasing dissatisfaction of residents with the community level associations, suggesting that these associations are no longer articulating the needs of traditional rubber tappers. The rubber tapper movement is very alive on the development agenda in Acre with supporters from NGOs and government institutions. But residents of the reserve, by refusing a self-definition as a rubber tapper in the bottom of the diverse social structures, seem to challenge those institutions that historically supported and capitalized on the image of the traditional rubber tapper – an definition that seemed more appropriate to win over policy makers by emphasizing the reserve and the movement in terms of a conservation initiative, rather than a

economic development initiative. As expected, participation in a *multirão* has a positive impact on respondent self-definition as rubber tapper, suggesting that rubber tapper definition is more tied to sources of social community building for mutual practical collaboration than for their current formal institutions at the community level.

Livelihoods changes seem to be the obvious indicators revealing the loss of traditional lifestyles among the reserve residents. Yet, not one land-use indicator measured exerted significance in a household head's self-definition. In contrast to our expectations, neither traditional land use practices (rubber and brazil nut extractivism), nor commercial agriculture, nor cattle ranching were important in a household head's self-definition as a rubber tapper. That is to say, individual self-definition cannot be predicted by current land-use activities. Despite the widespread decline of rubber tapping or recently increased small-scale cattle ranching practices, the category of rubber tapper continues to be culturally important, as descriptive analyses show that over 70% of the individuals interviewed consider themselves as rubber tapper. That is to say, despite livelihood transformations underway, most respondents still refer to themselves as rubber tappers, illustrating the cultural importance of the title, and perhaps the perceived political benefits that go along with it. If rubber tapping can arguably be linked to rubber tapper historical definition, is seems to be problematic to consider individuals that do not tap rubber as rubber tappers, today. In fact, one important challenge for the rubber tappers today is the recasting of their traditional definition during a time practically devoid of rubber, followed by increasing cattle ranching practices.

Cattle ranching among rubber tapper are neither a fabricated argument nor outsiders' speculation against traditional perception of rubber tapper. Thus, it appears as the main factor in this contrasting transformation and one that easily finds opponents. In fact, much of the initial

success of the rubber tapper's movement came from *not* being a cattle rancher, or being exactly the opposite of a cattle rancher. Rubber tappers were the foil to cattle ranchers - it was a powerful way to create political allies with environmentalists and among the international community. The inspirations behind the rubber tapper movement against encroaching cattle ranching in Acre are well expressed in their cultural manifestation involving music, religion, and art, as can be seen in the rubber tapper anthem.[1] Cattle ranching expansion among the CMER residents has not been formally addressed by governmental institutions either to discuss potentially better ways to enforce current regulation or to sustainably manage inside the CMER. Leaders of the reserve's resident associations are open to discussing the issue, and possess a strong sense of reality about the situation; as a leader from Brasiléia says:

> "Today, people have different visions. It is not that same vision of the trade unionists from 20 years ago. The vision of some officials in our association is different. They are sons of the native or historic rubber tappers, but have different vision of their father. So, this is a contradiction. Even more, today almost everybody is in favor of the raising of livestock. We can no longer be against cattle - this time is over. All of us have cattle. What we can say now is that we need to create new rules for cattle raising and pasture creation inside the reserve, we intend to do this; or better yet, we need to do this. We need proper technology in order to modify the kind of cattle we raise, not only with the idea of raising cattle for sale. Beyond this, we need these animals for pulling cargo and for milk for our children. Our leaders stayed very quiet during this entire time, and extractivists tried to conceal what is going on, what they were doing, creating pasture behind their secondary parcels. Some directors of the associations still avoid the question when someone asks them, how is deforestation being controlled inside the reserve. I am against deforesting large clearings, but in those areas that are already cleared, let's raise cattle. The situation will only change if a plan provides strong economic alternatives for extractivists, only this will decrease deforestation for pasture on the CMER.

The results in cattle ranching and pasture areas indicators lead us to believe that it is not seen by individual respondents as problematic for their self-definition as rubber tappers. However, the analyses show that the likelihoods of residents to consider themselves as rubber

[1] The rubber tapper anthem (hino do seringueiro): Let's give value to the rubber tappers/ let's give value to this nation/ for it is through their work/ that cars and airplanes tires are made/ Bicycle tires are not made of cheese/ It is not cattle leather that truck tires are made of/ it is not cattle horns that erase letters, no/ these are all products of rubber, made by our hands. (By J.S. Araújo - First president of the Rubber Tapper National council).

tappers is higher when they know the existence of the utilization plan, although variables measuring specific rules about cattle ranching and pasture regulation (e.g. size of land allowed for deforestation and for pasture) did not show significance in shaping individuals self-definition.

Cattle ranching remains a dirty word in the CMER, being politically sensitive and can be a source of conflict among neighboring, and regulation of cattle raising and pasture area has been part of a debate among individuals with different development perspectives. During fieldwork, we experienced some household head's engaged on cattle raising not willing to talk about cattle ranching related questions, while few others, not engaged in such activity, demonstrated strong opposition for their neighbors involvement with it. In this context, pasture lands often do not surround the house, and can be distributed in very different parts of one's landholding. Those respondents with a greater tendency to expand ranching, knowing the rules limiting the expansion of pasture areas, tend to distribute pasture land in different parts of the *colocação* with no continuing pasture areas. This makes it more unlikely for a landholder to be penalized. In fact, this corroborates the argument that individuals respondents are indeed conscientious about ranching and land-use regulations within the reserve and the political issues that cattle ranching carry, contrasting with the lack of significance observed in the model. Some household head's defend more strict enforcement of the current regulation measured by overall size allowed for deforestation, while others defend a more direct regulation about cattle, for instance controlling the number of heads a householder may be allowed to hold. Land use regulations directly related to cattle raising (5% of the overall 10% allowed) are increasing rejected by individual respondents more engaged in cattle ranching activities, showing a trend that cattle herds will continue to grow if dependent on a individual's will.

There are current contrasting perspectives among individuals. We interviewed an older household head's that has lived in the same rubber estate all his life and is becoming part of a minority still linked to rubber tapping. His connection is expressed not only by his significant rubber production, but also by a profound tie to this activity in a much more symbolic than material relation. His tie to extractivism may explain the absence of cattle ranching in his settlement, and his expressed lack of a plan in regards to raising cattle. It is notorious that new generations of household head's are well aware of the laborious hard work of rubber tapping practices and, more importantly, its seemingly poor economic return, experienced by their fathers or other family members. As one younger household head's (and son of a rubber tapper) explained, "Who wants to get up at four in the morning to tap rubber, in the dark, with all of the wild animals and the snakes? I would rather be outside in the sun in my pasture." Cattle herds appear as an attractive option that provides liquefiable assets and perhaps status among community members.

Local development approach, as evidenced on the "forest government" concept of "Florestania" or forest citizenship, assume that cultural values have priorities over material factors in determining livelihood options for the future, and that the traditional perception of rubber tappers, traditionally conservationist, guarantees the viability of the extractivist economy. Nevertheless, the traditional values shaping rubber tapper definition are at first rooted in their historical material conditions and not the opposite as is enforced in local development agenda which builds on traditional rubber tapper definition serving to legitimate the political movement and current governmental agenda as 'being green'. In this sense, cultural values alone cannot be used as a guarantee for conservation in the Extractive Reserve. Even though rubber tappers today still have a generally pro-conservation mindset, it is idealist to believe that their traditional

culture per se can be translated into conservationist practices. Their pro-conservation culture and values can and do change with changes in material condition for subsistence. As this analysis shows, most of their social organization values that were very important for rubber tappers definition twenty years ago are not influencing their perception as a rubber tapper today, because values are not static and individuals are changing their values to adapt to new socioeconomic conditions, as well as new wants and needs. It is not to say that their definition is shaped in term of solely their economic condition.

The apparent tension between a pro-forest government and the maintenance of cattle as big business, we argue produces a sort of local schizophrenia, where cattle culture and forest culture can exist side by side, as evidenced by this year's Expo Acre (a regional cattle and agricultural exhibition) that featured an exhibition of genetically superior cattle next to a replica of the house where Chico Mendes was murdered, in an exhibition celebrating the history of the rubber tapper's movement on the 20th anniversary of Chico Mendes murder. If government and policy makers can envision these land-uses side-by-side, it is no wonder that rubber tapper themselves find it easy to justify such radical land-use changes while still incorporating them into an extractivist culture. Yet, cowboy culture dominates rural Acre today, and thus has a direct influence on the reserve residents. The music on the radio is dominated by country music, the night clubs in the cities portray the cowboy life-style as a much wanted and well-respected social status. Small businesses in rural Acre focus on the demands of agropastoral activities. And the mere trip to the city from the forest reveals the extent to which cattle dominates the landscape. In the imagination and within the media messages bombarding the rural population in Acre, the country lifestyle is bigger and better than the forest lifestyle.

Conclusions

Despite an attempt to explain individuals self-definition as rubber tappers based on a wide set of land-use, institutional and livelihood variables, results show that only a few were significant as seen in table 5-3. Our attempt to measure individual self-definition is the result of prolonged reflection about rapidly transforming landscapes and livelihoods witnessed by the authors while fieldwork was being conducted. Perhaps, issues such as self-definition cannot be measured quantitatively, as our qualitative data shows the complexity the livelihood issues facing rubber tappers today. Yet, we still find this exercise valuable in understanding the sheer complexity of a historically marginalized and misunderstood group. What it means to be a rubber tapper today is a complex question with a mix of rationality and subjectivity, involving affirmation with historically constructed trajectories and challenged with contrasting development circumstances as livelihood issues continue to emerge. Cattle raising, for example, as a historically contrasting practices, should not be seen as a rupture from or within traditional rubber tapper definition, as this option generally has a positive impact on a household's socioeconomic status. Instead of traditional value abandonment, it reflects a rational decision based on the current best available option for their economic improvement.

Socio-economic conditions and social services have improved substantially since the establishment of the CMER. Some indicators not measured in the analyses could also affect a respondent self-definition. Transportation, family education, and road opening facilitating market links for the residents are part of these improvements. Today, kids and teens almost all have access to basic schooling and are, for the most part, literate. This is in stark contrast to their parents, the majority of whom are illiterate. Such changes will no doubt continue to reshape rubber tapper definition in the future.

Most research on land-use change takes issues of individual self-definition for granted. To our knowledge, the majority of research in the CMER starts with the assumption that the reserve's residents are indeed rubber tappers. In order for future conservation and development initiatives to be successful, we need a better understanding of what ties residents of the CMER together. We argue that development policy needs to be designed with flexible definitions of rubber tapper in mind. NGO's and government policy that focuses solely on extractivism development, though important, may be out of touch with the complexity of current land-uses and livelihood preferences of today's rubber tapper.

The rubber tapper seems to have a stereotype that is still very much labeled by 'other,' and there has been little attention to how their current livelihood systems and socio-economic conditions challenge this traditional view. In the 1980s, the rubber tapper movement and allies mobilized the global community committed to preserving the environment, in order to ensure their own land and livelihood rights. While we are not arguing that their social movement is or was in any way 'false,' by fighting a global fight for the forest, rubber tappers may have unwittingly created for themselves a very limited definition based on land-use. Such activities as tapping rubber and collecting brazil nuts, admittedly sustainable or green, are inserted in their values as well as in their basic identification: the rubber tapper. Thus, the environmental definition was imposed on or inserted within the definition of a rubber tapper, without denying, confirming a mutual influence between the local and the global.

The Extractive Reserve system was an expression of a multifaceted mosaic of social players of great diversity whose rationale can be reconstructed by recognizing that they share similar problems, despite their differences and overall goals. But the problems faced by rubber tappers in the past (land security) are not the same as today. Their needs have changed, yet many

of their historical external supporters remain centered on the same historical issue, environmental protection. We argue that rubber tappers are and remain concerned with environmental issues, but their major problem today is centered on the socioeconomic development that has been lacking within the Extractive Reserves. Thus, a lot of assumptions we make regarding what defines a rubber tapper reflects a historical moment that does not necessarily reflect reserve residents and their development perspectives today. The notion of rubber tapper strengthened in the 1980s is still very alive and in several aspects legitimate, but has continued to evolve and today may be unrealistic, transcending local realities. As rubber tappers agenda in these twenty years since Chico Mendes has evolved from one centered on the struggle for land and social justice to sustained socioeconomic improvement, their past image may be called into question and potentially criticized by their historical allies. It is therefore important to understand how rubber tappers define themselves today if we are to ensure the success of the Extractive Reserve tomorrow.

CHAPTER 6
CONCLUSIONS:

The overarching goal of this dissertation has been to address critical questions, concerns, and criticisms regarding the experience of ERs as a conservation and development tool in the Brazilian Amazon, and in so doing to integrate core themes: the evolution of the ER as a people-based conservation policy; changing livelihood conditions and natural resource management practices; deforestation and land-use patterns; and the impact of historical-cultural livelihood practices on rubber tappers' self-definition today. These research issues were addressed in the four research papers comprising this dissertation.

The first paper of this dissertation (Chapter 2) provided a region-wide analysis of the evolution of ERs over the past two decades, exploring how the ER model has expanded and how political and regional development dynamics have affected ER policy – either favoring or restricting the establishment of ERs. In the first wave states, both Rondônia and Acre have placed a significant percentage of their territory under ERs. The status of ERs in Acre appears to be solid, in terms of territory and political support while in Rondônia, it is stagnated in growth and there is a profound lack of government support for ER. Rondônia's state reserves may be the most paradigmatic in their application of the model after twelve years; a typical case of struggle between the economic development and environmental protection camps, in which the winner is usually determined by the group that has more political weight. The situation in the second wave states looks promising if recent advances continue in coming years; it is very likely they will. Pará and Amazonas, are far from reaching some of the first wave states in percentage of land under ERs, but have demonstrated a consistent process of establishing ERs since the early 2000s, representing the trend for continuing growth of ERs areas.

ERs as a public policy is widely considered one of the options to simultaneously decrease deforestation rates in the region while responding to social group demands, especially in development frontier areas. The creation of ERs should not be seen as static or synonymous of forest protection per se. The success of creating a new ER cannot be seen by both social movement and government as an end of an end in itself, as have been the case with several ER implemented. Three elements should be essential to all ER efforts: 1) alternatives for improvement of economic and social well-being of ER residents; 2) a strong monitoring process; and 3) an active and continuous social movement coalition. The general focus of both social movement and government institutions has been to create new ERs areas, and pay less attention to socio-economic conditions within ERs. The adoption of cattle ranching among residents of the Chico Mendes reserve addressed in the following chapters is an example of the lack of public policy supporting sustainable economic practices for ER residents. This perspective need to be reviewed in order to guarantee sustainable future for ERs in Amazonia.

The second paper (Chapter 3) provided a comparative analysis of cattle ranching adoption among colonist smallholders and forest extractivists in the Amazon, exploring why livelihood strategies among a variety of social actors in a highly heterogeneous socioeconomic region are converging on a single activity: cattle ranching. Showing similar trends regarding the growth of cattle husbandry in Xapuri (Acre) and Uruará (Pará), the results suggest a regional push toward cattle ranching expansion among colonist smallholders and forest extractivists in the Brazilian Amazon. Cattle ranching among colonist and forest extractivists are driven by market forces, but also have distinct political development contexts. Smallholder colonists present a more diversified economy with greater market links in which cattle ranching is consolidated as a economic practice, while forest extractivists, regardless of the potential of forest products to

improve local livelihoods, have more limited economies in which cattle represent a option under an uncertain economy, and they have not yet confronted the political and development controversies of cattle raising in Extractive Reserves. Cattle ranching among forest extractivists in Xapuri are a challenge and may represent an opportunity to promote a broader debate to review forest resources co-management pacts by government institutions and grass-root organizations for Extractive Reserve administration in the very place where it was negotiated twenty years ago.

The third paper (Chapter 4) expanded the discussion beyond issues of cattle ranching adoption, to consider deforestation issues by remote sensing analysis to household surveys addressing the question of what are the dominant land-use and livelihoods practices of extractivists in the CMER and how are they changing. The six *seringais* examined are undergoing rapid land-use and land-cover changes with cattle and agriculture as the main drivers of such change. As of yet, however, none of these six *seringais* have surpassed the 10 % limit set on the amount of allowable deforestation. Although some communities may surpass allowable deforestation limits in the near future, the rate as compared to outside ER areas should still be seen as a measure of environmental success for the ER system. At the time of the creation of the CMER in 1990, residents depended more heavily on traditional non-timber forest product extraction including Brazil-nut collection and latex production. Traditional land-use activities are currently undergoing rapid changes in the CMER. Rubber tapping has gone from being historically one of the most important land-use activities, to the least important making up less than nine percent of a household's total income on average. Cattle and market agriculture are and will likely remain part of a rubber tapper's land-use system in the CMER, and consequently need to be addressed realistically by local institutions and decision-makers. Cattle, however, remains a

"dirty" word in the CMER. Policy directions for the CMER need to address sustainable pasture management, as well as a serious re-investment in NTFP marketing and development. The debate over rubber tappers and cattle husbandry has seeped into the press, motivating pointed criticism and questions about the sustainability of the CMER. These critics have shown clear bias against rubber tappers that break with their traditional identity, presenting the case of cattle ranching in the CMER as if it is a phenomenon exclusive to ERs rather than a generalized economic and environmental problem in the Brazilian Amazon.

Some critics have even used this debate to question the viability overall of the ER model in Amazonia. The murder of Chico Mendes has been enlarged to equate cattle with "evil" livelihoods. As a result of such caricaturizing, the mere idea that the rubber tappers championed by Mendes are now raising cattle themselves is met with little enthusiasm by some proponents and supporters of ER concept.[1] It must be remembered that Chico Mendes and the rubber tappers may have been fighting for the forest, but also, and more importantly, for a right to both land security and improved rubber tappers' well-being.

The fourth and final paper (Chapter 5) provided an analysis of rubber tapper identity, exploring which institutional, cultural, and land-use factors currently shape rubber tapper self-identification in the face of their historical-cultural trajectories and current livelihood practices. Results show that only a few variables were significant in explaining household self-identity. Larger size of land-holding, more knowledge of management rules, and participation in community activities make it more likely to identify as a rubber tapper, while more recent

[1]For example, while doing fieldwork in Acre, I was a bit concerned about "where" and "with whom" I would start to discuss my research topic due to it politically sensitive nature. I gave presentations for both local and international NGOs branch offices as well as at various seminars at the Federal University of Acre (UFAC). An international NGO, with a local branch in Rio Branco (Acre), saw a need and opportunity to develop a proposal regarding cattle ranching expansion in the CMER. I was contracted as a consultant to address cattle ranching within the Reserve as part of a project to review regulations regarding cattle raising and pasture management initiatives in the reserve. My final report, despite being well received at the local branch, was excluded from the annual report at the international office in Washington, DC, and no funding was allocated to the proposal presented.

occupancy in the CMER and involvement in the official movement have a negative impact on identifying as a rubber tapper. Cattle raising should not be seen as a rupture from or within traditional rubber tapper definition, as this option generally has a positive impact on a household's socioeconomic status. Instead of identity abandonment, it reflects a rational decision based on the current best available option for their economic improvement.

Most research on livelihoods change takes issues of identity for granted. To our knowledge, the majority of research in the CMER starts with the assumption that the reserve's residents are indeed rubber tappers. In order for future conservation and development initiatives to be successful, we need a better understanding of what ties residents of the CMER together. Otherwise, development policy may be out of touch with the complexity of current land-uses and livelihood preferences of today's ER residents.

The stereotype of the traditional rubber tapper is still very much labeled by "other," and there has been little attention to how their current livelihood systems and socio-economic conditions challenge the traditional perceptions of rubber tappers. In the 1980s, the rubber tapper movement was seeking new allies and fostered the construction of new images; as a result, they were able to mobilize a global community committed to preserving the environment, and ensure the protection of their own land and livelihood rights. Although we are not arguing that this definition is or was in anyway false, it now seems that rubber tappers, by making their struggles a global fight for the forest, may have unwittingly frozen their definition in time. This "environmental" image was inserted in the definition of a rubber tapper, revealing the cross-influence between the local and the global. Rubber tapper definition is a complex and ever-changing idea, participatively created over time. Although the definition was formed publicly at

the height of the rubber tappers' movement in the 1980s, it is continuously evolving as new land-use and livelihood issues emerge.

The Extractive Reserve concept was an expression of a diverse mosaic of social players recognizing that they share similar problems, despite their political differences and varied goals. Yet, many of the rubber tappers historical external supporters remain centered on the same historical issue: environmental protection. We argue that rubber tappers are and remain concerned with environmental issues, but their major problem today is centered on the socioeconomic development that has been lacking within the Extractive Reserves. Thus, many assumptions we make regarding what defines a rubber tapper reflects a historical moment in time that does not necessarily concord with the development perspectives of CMER residents today. The definition which strengthened in the 1980s is still very alive and in several aspects legitimate, but has continued to evolve in the past twenty years, bringing up new issues that may be called into question and potentially criticized by rubber tappers historical allies. It is therefore important to understand how rubber tappers define themselves today if we are to ensure the success of the Extractive Reserve tomorrow.

APPENDIX A
CORRELATION ANALYSIS

Table A-1. Analysis of relations between outcome and explanatory variables for socioeconomic aspects of households in the Chico Mendes Extractive Reserve

1 - Socioeconomic Indicators:		**Household self-definition (%)**		
A - Household background variables		No Rubber Tapper	Rubber Tapper	Total
First occupant of the homestead **	No	14.6	85.4	100
	Yes	38.5	61.5	100
Years of residence	< 10	20.9	79.1	100
	10 < 20	21.3	78.7	100
	> 20	21.2	78.8	100
Age household head (year)	< 30	17.9	82.1	100
	30 < 50	21.3	78.7	100
	> 50	24.2	75.8	100
Schooling of households head	None	16.7	83.3	100
	1 < 4	22.0	78.0	100
	4 < 8	25.0	75.0	100
Previous residence	In the reserve	18.6	81.4	100
	Out the reserve	25.0	75.0	100
Relatives living in this seringal	No	11.1	88.9	100
	Yes	21.9	78.1	100
B - Assets variables				
Household own a tv	No	20.6	79.4	100
	Yes	20.0	80.0	100
Household own gas	No	18.3	81.7	100
	Yes	22.7	77.3	100
Household own a refrigerator	No	19.7	80.3	100
	Yes	50.0	50.0	100
Manioc processor house	No	18.9	81.1	100
	Yes	23.2	76.8	100
Household own a solar panel	No	21.0	79.0	100
	Yes	18.2	81.8	100
Household own a chainsaw	No	20.6	79.4	100
	Yes	20.4	79.6	100
Household has a wood house	No	13.	86.5	100
	Yes	23.6	76.4	100
Household own a phone +	No	22.2	77.8	100
	Yes	0.0	100.0	100

+ p < .10; * p< .05; ** p < .01

Table A-2. Analysis of relations between outcome and explanatory variables for institutional context aspects of households in the Chico Mendes Extractive Reserve

2 - Institutional context indicators		**Household self-definition (%)**		
Variables:		No Rubber Tapper	Rubber Tapper	Total
Assoc. at municipal level	No	20.0	80.0	100
	Yes	21.3	78.7	100
Assoc. at community level +	No	13.0	87.0	100
	Yes	26.1	73.9	100
Assoc. w/ producers cooperative*	No	24.0	76.0	100
	Yes	4.8	95.2	100
Rural workers syndicate	No	18.2	81.8	100
	Yes	22.8	77.2	100
Participation in *empate*	No	21.9	78.1	100
	Yes	22.2	77.8	100
Participation in *multirão*	No	28.1	71.9	100
	Yes	20.2	79.8	100
Household received gov. credit	No	20.5	79.5	100
	Yes	20.8	79.2	100

+ p < .10; * p< .05; ** p < .01

Table A-3. Analysis of relations between outcome and explanatory variables for land-use aspects of households in the Chico Mendes Extractive Reserve

3 - Land-use indicators		**Household self-definition (%)**		
A - Forest extractivism variables		No Rubber Tapper	Rubber Tapper	Total
Rubber tapping **	Yes	10.0	90.0	100
	No	28.6	71.4	100
Total area **	none	58.8	41.2	100
	100 < 300	22.0	78.0	100
	300 < 600	12.5	87.5	100
	> 600	9.7	90.3	100
Total rubber production *	none	27.7	72.3	100
	< 300	14.3	85.7	100
	> 300	4.0	96.0	100
Total number of brazil nut trees *	None	40.0	60.0	100
	< 100	19.3	80.7	100
	100 < 300	9.7	90.3	100
	> 300	12.5	87.5	100
Total brazil nut production +	none	29.3	70.7	100
	< 1000	23.1	76.9	100
	> 1000	12.7	87.3	100
B - Annual crops sold variables				
Rice production sold	none	19.0	81.0	100
	< 1000	23.6	76.4	100
	> 1000	25.0	75.0	100
Corn production sold	none	19.8	80.2	100
	< 1000	33.3	66.7	100
	> 1000	0.0	100.0	100
Bean production sold	none	18.6	81.4	100
	< 1000	24.1	75.9	100
	> 1000	33.3	66.7	100
Manioc production sold	none	23.9	76.1	100
	< 1000	12.5	87.5	100
	> 1000	0.0	100.0	100
C - Cattle and pasture variables				
Raise cattle	No	15.8	84.2	100
	Yes	21.9	78.1	100
Year household started to raise cattle	None	15.8	84.2	100
	< 10	16.0	84.0	100
	10 < 20	28.2	71.8	100
	> 20	33.3	66.7	100

Table A-3. Continued

3 - Land-use indicators		**Household self-definition (%)**		
C - Cattle and pasture variables				
Total number of head of cattle	None	15.8	84.2	100
	< 20	19.6	80.4	100
	> 20	29.0	71.0	100
Total number of cattle head sold	None	21.3	78.7	100
	< 10	19.2	80.8	100
	> 10	37.5	62.5	100
Year household started to make pasture	none	20.0	80.0	100
	< 10	19.3	80.7	100
	10 < 20	24.4	75.6	100
	> 20	23.1	76.9	100
Total size of pasture area (ha)	none	20.0	80.0	100
	< 10	19.2	80.8	100
	10 < 20	23.7	76.3	100
	> 20	40.0	60.0	100
Plan for # of cattle in 10 years	none	0.0	100.0	100
	< 50	21.6	78.4	100
	50 < 100	18.2	81.8	100
	> 100	20.6	79.4	100

+ p < .10; * p< .05; ** p < .01

Table A-4. Analysis of relations between outcome and explanatory variables for location of households in the Chico Mendes Extractive Reserve

4 - Location indicator		**Household self-definition (%)**		
Variable:		No Rubber Tapper	Rubber Tapper	Total
Household at municipalities *	Xapuri	3.8	96.2	100
	Brasiléia	17.0	83.0	100
	Assis Brasil	30.9	69.1	100

+ p < .10; * p< .05; ** p < .01

Table A-5. Analysis of relations between outcome and explanatory variables for households' knowledge about land-use regulation in the Chico Mendes Extractive Reserve

5 - Land use rules indicators		**Household self-definition (%)**		
Variables:		No Rubber Tapper	Rubber Tapper	Total
Knows the utilization plan +	Yes	17.9	82.1	100
	No	33.3	66.7	100
Know the 10% deforestation rule	Yes	21.0	79.0	100
	No	22.2	77.8	100
Know the 5% pasture rule *	Yes	17.0	83.0	100
	No	32.5	67.5	100

+ p < .10; * p< .05; ** p < .01

…

APPENDIX B
QUESTIONNAIRE USED IN THE CHICO MENDES EXTRACTIVE RESERVE

Pesquisadores: Valério Gomes (University of Florida) Jacqueline Vadjunec (Clark University)

Questionário familiar n° _____ Equipe nº: _____ Responsável pelo preenchimento:_____ Data:_____

Coordenadas Geográficas (UTM) X:_____ Y:_____

Nome da seringal:_____ Colocação:_____Ramal _____ Km (BR)_____

Município:_____ Estado do Acre

1 - INFORMAÇÃO GERAIS:

Nome dos entrevistado: _____ Apelido _____

Identificação dos membros da Unidade Familiar

Nº	Nome	Parentesco*	Local de nascimento**	Sexo M/F	Idade (anos)	Ocupação***	Escolaridade Estuda ( ) Sim ( ) Não	
							Ensino****	Série
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								

* 1 – Esposa, 2 – Esposo; 3 – Filho/a; 3 – Neto; 4 – Avó; 5 – Outros.

** 1 – outro estado (indicar qual); 2 – nasceu e cresceu no seringal na resex ou outros; 3 – nasceu na cidade (acre); 4 – nasceu na colônia; 5 - outros

*** 1 – Produtor; 2 – Meeiro; 3 – Arrendatário; 4 – Aposentado; 5 – Professor; 6 – Agente de Saúde; 7 – Outros

**** 1 – Ensino fundamental completo; 2 – Ensino fundamental incompleto; 3 – Ensino médio completo; 4 – Ensino médio incompleto; 5 – Ensino Superior completo 6 – Ensino superior incompleto

Não residentes na colocação (familiares que deixaram a colocação)

Nome	Sexo M/F	Parentesco*	Idade	#Onde mora?	**Porque mudou?	Tempo que saiu (anos)

* 1 – Esposa, 2 – Esposo; 3 – Filho/a; 3 – Neto/a; 4 – Avó; 5 – Outros.
# 1 – Cidade mais próxima; 2 – Capital; 3 – outro seringal; 4 – mesmo seringal; 5 – colônia perto da reserva; 6 - outros
**1 – Para estudar; 2 – casou; 3 – para trabalhar; 4 - conflito com uso da colocação; 5 outros

Residentes não permanentes na colocação (trabalhadores temporários/membros da famílias passando tempo etc...)

Nome	Sexo M/F	Parentesco*	Idade	Para que?**	Tempo

* 1 – Esposa, 2 – Esposo; 3 – Filho/a; 3 – Neto/a; 4 – Avó; 5 – diarista, 6 - Outros.
** 1 - para coletar castanha; 2- cortar borracha; 3- trabalhar na derrubada de roçado; 4 - para colheita de roçado; 5 – limpar pasto; 6 – outros_____

Onde morava antes de vir para esta colocaçao?
☐ outra colocação no mesmo seringal ☐ outro seringal dentro da reserva ☐ colonia proximo da reserva
☐ na cidade ☐ na bolivia ☐ sempre viveu neste seringal ☐ outros:_____

Quais os dois últimos lugares que morou?

Local	**Ano**	**Motivo da saída**

Por que motivos se mudou ?

☐ ficar perto de parentes ☐ casamento ☐ briga de vizinho
☐ pouca castanha e borracha ☐ acesso/distancia para cidade ☐ não tinha escola/posto saúde
☐ pouca caca ☐ outros _____

Mora aqui o ano todo? ☐sim ☐ não. Neste caso, indique onde/quando:_____

Quanto tempo mora nesta colocação? _____ Por que veio morar aqui? _____

_____

Você é o primeiro ocupante desta colocação ☐ Sim Não ☐

Você sabe quando esta colocação foi aberta ☐ Sim ☐ Não Quando?_____

Esta colocação e parte da divisão de outra colocação mais velha Sim ☐ Não ☐

Esta colocação já foi dividida alguma vez? Sim ☐ Não ☐ Quantas vezes?_____

Caso resposta positiva, quando? (anos/os anos em caso de mais de uma vez)_____

_____

Quais os motivos para divisão?

☐ Casamento do filho (a) ☐ Arrendamento ☐ Para ter mais área para

2

desmatar ☐ para filho ser cadastrado na associação como morador ☐ Outros.

Quais?_____

Sua família pretende continuar morando neste lugar? ☐ Sim ☐ Não

Por quê? _____

Tem parente morando na comunidade? ☐ Sim ☐ Não

Grau de parentesco: _____

O Sr. tem casa na cidade? ☐ Sim ☐ Não Faz quanto tempo?_____

Vale a pena relatar a historia da família e os principais acontecimentos.

_____

_____

_____

2 - PROPRIEDADE DA TERRA

Como o Sr/a adquiriu esta colocação?

☐ comprou ☐ trocou ☐ herdou ☐ posse ☐ foi assentado ☐ concessão de uso ☐ divisão da colocação ☐ outros: Especificar _____ Quando? _____

Tipo de documento:

☐ LO – Licença de Ocupação; ☐ RC – Recibo de Compra e Venda; ☐ - Direito de Posse; ☐ - Direitos Tradicionais Adquiridos; ☐ - Contratos de Arrendamento; ☐ SD – Sem Documento; ☐ título de concessão de uso; ☐ - Outros tipos de documento: Especificar:_____.

Tem problemas com a documentação da propriedade _____

_____

3 - INFRAESTRUTURA INTERNA

Casa e outras estruturas

Estrutura	Quando construiu?	Piso*	Paredes**	Cobertura***	Tamanho
Casa					
Paiol/tulha					
Casa de farinha					
Defumador					
Chiqueiro					
Viveiro					
Açude					
Curral					
Cerca					
Galinheiro					

3

* 1 – Paxiuba; 2 – Madeira; 3 – Cerâmica; 4 – Chão batido; 5 – Outros. ** 1 – Paxiuba; 2 – Madeira; 3 – Alvenaria; 4 – barro; 5 – Outros. *** 1 – Palha; 2 – Cavaco; 3 – Brasilit; 4 – Alumínio; 5 – Outros

Utensílios domésticos na casas

Itens	Unidades	Estado	Itens	Unidades	Estado
Radio simples			Panela de pressão		
Radio Amador			Espingarda		
Relógio			Guarda roupa		
Placa Solar			Mesa		
Bateria			Sofá		
Telefone			Filtro		
Televisão			Antena Parabólica		
Fogão a lenha					
Fogão a gás					
Botija de gás					
Lampião a gás					
Geladeira					
Bomba dágua					

Meio de transporte próprio ☐ Bicicleta ☐ Moto ☐ Carro ☐ Carroça ☐ animal ☐ Outros _____

Equipamentos ☐ motosserra ☐ motor de barco ☐ roçadeira, ☐ gerador ☐ Outros _____

4 - HABITOS

Saneamento

De onde utiliza água? ☐ do rio/igarapé ☐ da cacimba ☐ de poço, ☐ encanada, ☐ outros. _____

Tratamento de água ☐ não trata ☐ coa ☐ filtro ☐ hipoclorito ☐ outros. _____

Distancia da água da casa. _____. Falta água no período seco. _____

Existe Banheiro/Privada ☐ Sim ☐ Não Tem caixa d"água instalada ☐ Sim ☐ Não

5 - ORGANIZAÇÃO COMUNITÁRIA

Organização	Ano de associado?	Frequência das reuniões?*	No ultimo ano, já participou nas reuniões com? (S/N)	Alguém desta colocação teve cargo? (S/N)	Qual função ?	Quando teve cargo? (Ano/tempo)	Você esta satisfeito com essa organização? **
AMOREB							
Ass. da comunidade							
Cooperativa							
Sindicato							
CNS							
Other:							

* (1) 01 por mês, (2) 01 cada 03 meses (3) 01 cada 06 meses (4) 01 cada ano

**(1) Sim, muito (2) Sim, em geral (3) Não, em geral tem problemas (4) Não, muito desastifeito

Alguém deste colocação participou em:

☐ Empates -- Quando?_____

☐ Multirões-- Quando?_____ Para que?

_____

_____

Assuntos discutidos: _____

Para que serve uma associação?_____

4

6 - PRINCIPAIS FORMAS DE COMUNICAÇÃO

☐radio ☐pessoas/recados ☐ televisão ☐ telefone, radio amador (radio fonia)

Tem rádio funcionando? ☐ sim ☐não

Qual(is) programa(s) de rádio e de que emissora ouve?_____

7 - MOBILIDADE

Freqüência que vai a cidade?_____ Como vai? ☐ a pé ☐ ônibus ☐ animal ☐ lotação ☐ Outros. _____

Motivo_____

8 - RELIGIÃO

Tipo de religião

☐ Evangélico ☐ Católico ☐ não participa ☐ Outras_____

9 - ALIMENTAÇÃO

Itens	Quantidade comprada por mês	Valor total gasto por mês	Onde compra*
Açúcar			
Óleo			
Sal			
Arroz			
Macarrão			
Feijão			
Café			
Farinha de mandioca			
Milho			
Sabão em pó			
Sabão em barra			
Verduras			

* 1 – na comunidade; 2 - na cidade; 3 - marreteiro

10 - CREDITO

Já teve acesso a Crédito Rural? ☐ Sim ☐ Não
Caso sim, qual linha de crédito? Especificar:_____.

Qual a situação atual da linha de crédito?
( ) Crédito quitado
( ) Crédito em vigência / Carência em vigência
( ) Crédito em vigência / Parcelas em adimplência
( ) Crédito em vigência / Parcelas em inadimplência

Qual a situação atual dos itens financiados?
( ) Implantadas/intalados/adquiridos

( ) Implantadas mas abandonadas. Porque?_____
( ) Não implantadas/adquiridos? Porque?_____
( ) Danificadas. Como: Fogo acidental ( ), ataque de pragas ( ), Invasão de animais ( ), outros ( )_____

11 - USO DA TERRA

Como era a propriedade quanto chegou?

☐ floresta_____ha ☐ capoeira____ha ☐ pasto ____ha ☐ área cultivada _____ha ☐ outros _____

Quantas castanheiras existem na propriedade? _____
Número total de estradas de seringa na colocação?_____

O sr. corta borracha ☐ Sim ☐ Nao
Caso nao, quando foi o ultimo ano que o Sr. Cortou borracha?_____
Caso sim, quantas estradas o Sr. Cortou ano passado (2003)_____

Distribuição de uso da terra hoje

Tipos	**Tarefas ou**	**Hectares**
Área de capoeira (total)		
Área de pasto (total)		
Área de roçado/lavoura branca:		
Arroz		
Feijao		
Milho		
Macaxeira		
Area de culturas perene:		
Café		
Pupunha		
Citrus		

Pretende derrubar este ano? ☐ sim ☐não. Tamanho da área (ha):_____ ☐ Floresta ☐Capoeira alta ☐ Capoeira baixa ☐ Pasto degradado ☐ outros

O que costuma fazer quando a área não produz mais? ☐ Semeia puerari a para recuperacao ☐ Deixa na capoeira ☐ Pasto ☐ Outros

12 - PRODUÇÃO ATUAL (extrativismo, agricultura, e animal)

A – Dados gerais da Produção extrativista

Produtos 2003	Produção (qde)	Consumo (qde)	Venda (qde.)	Preço de venda (R$)
Castanha (latas)				
Borracha (kg)				
Mel de abelha (litros)				
Copaíba (litros)				
Semestes				
Outros:				

B – Dados gerais da produção agrícola/lavoura branca

Produtos 2003	Produção	Consumo (qde.)	Venda (qde.)	Preço de venda (R$)
Arroz Kg				
Milho Kg				
Feijão Kg				
Mandioca Kg				
Outros:				

C – Dados gerais da produção agrícola/culturas perenes

Produtos 2003	Produção	Consumo (qde.)	Venda (qde.)	Preço de venda (R$)
Café				
Pupunha				
Citrus				
Banana				

D – Dados gerais da produção anual de animais

Animais 2003	Total producao	Consumo (qde.)	Venda (qde.)	Preço de venda/animal
Galinha				
Porco				
Pato				
Ovelha				
cabrito				
cavalo				

13- Transporte e comercialização

Para quem você vende a produção?

Produtos	Local de venda			
	Núcleo da Associação	Cooperativa	Comercio na cidade	Marreteiro
Extrativista				
Borracha				
Castanha				
Agricola:				
Arroz				
Milho				
Feijão				
Mandioca				
Animal:				

Pequenos animais				
Gado				
Cabrito/ovelha				

Como é feito o transporte da produção?

Trechos	Produtos	Tipo de acesso				Meio de transporte			Tempo
		Rio	varadouro	ramal	rodagem	barco	animal	carro	

Exemplo quanto ao trecho: se vem de casa ate a BR na carroça, da BR ate a cidade de ônibus, ou vem direto de barco ate a cidade e assim por diante.

De quem é o transporte?

☐ Próprio ☐ Núcleo da Associação ☐ Cooperativa ☐ Prefeitura ☐ Fretado ☐ Comunidade ☐ Outros

Como é feita a comercialização? ( ) Individualmente ( ) Comunitária. Porque? _____

_____

14 - MATA CILIAR OU APP

Tem rio ou igarapé na propriedade? ☐ sim ☐ não. Quantos? _____

Para produzir, utiliza fogo na area? Sim ( ) Não ( )

Faz aceiro para queimar? Sim ( ) Não ( ) Que outra prática usam? _____

Comunica o vizinho? Sim ( ) Não ( ) Convida os vizinhos para ajudar? Sim ( ) Não ( )

Retira autorização junto aos órgão competentes? _____. Quais órgãos? _____

Como a família trabalha na manutenção das culturas?
( ) adubação orgânica
( ) adubação química Quanto? Valor gasto
( ) usa sementes selecionada
( ) Existe assistência técnica ☐ sim ☐ não. Como é:_____

Como faz a limpa das culturas?
( ) capina manual
( ) capina mecânica (roçadeira)
( ) capina e controle de pragas e doencas (química)

Quais os principais impactos ambientais notados na colocação (desmate na margem do igarapé etc...):_____

_____

_____

15 - INFORMAÇÃO SOBRE A ATIVIDADE DE PECUARIA

Cria gado? ☐ sim ☐ não.

Ano que começou a fazer pasto: _____Em que ano comecou a criar gado? _____

☐ tem gado e pasto ☐ tem pasto, não tem gado

8

Caso tenha pasto e nao tenha gado, porque tem pastagem na colocacao?

☐ pasto foi criado pelo morador anterior ☐ pretende comprar gado

☐ aumentar o valor da colocao para venda ☐ outros_____

A pastagem da colocacao é utilizada para:
( ) gado próprio ( ) gado de fora/meia ( ) arrendado/alugado ( ) doa para o visinho ( ) outro:_____

Quantos animais comprou nos últimos 3 anos? 2003: _____ 2002: _____ 2001 _____

Quantos animais vendeu nos últimos 3 anos? 2003: _____ 2002: _____ 2001 _____

44. Rebanho atual (composição)	touros + 3 anos	vacas		novilhas 1 - 3 anos	garrotes 1 - 3 anos	Bezerros (1 ano)		total
		dando leite	outras			macho	fêmea	
número de animais								
Gado comprado em 2003								
De quem comprou+								
valor pago R$								
Gado vendido em 2003								
valor recebido R$								
Para quem vendeu #								
Onde vendeu *								

+ 1 – fazendeiro, 2 – visinho, 3 – colono de fora de reserva, 4 – outros_____
# 1 – visinho, 2 – marreteiro vindo da cidade, 3 - fazendeiro, 4 – colonheiro de fora da reserva
* 1 – no próprio seringal; 2 – cidade; 3 – visinho, 4 – marreteiro; 5 – outros

Como é feito o calculo para definir o preço do animal para venda?
☐ Peso vivo do total do animal ☐ kilos de carne ☐ Idade ☐ outros_____
Qual o preço pago pelo kilo da carne aqui na colocação?_____kilos
Quem estima o peso do animal? ☐ comprador ☐ dono do animal

Alem da compra, qual é a outra origem de seu rebanho?
☐ recebeu dos pais ☐ recebeu de meia de outro produtor
☐ contrato de meia com fazendeiro ☐ negociado com intermediário
☐ troca por produtos (castanha/borracha) ☐ outro: _____

O Sr, tem alguma cabeça de gado fora desta colocação? Sim ☐ não ☐ Caso sim,

Quantas?_____Onde?_____ Porque?_____

O sr. Tem alguma cabeça de gado de outra pessoa na sua colocação? Sim ☐ não ☐ Caso sim,

Quantas cabeças?_____ Porque?_____

De quem é este gado?

☐ De outro seringueiro ☐ colono de fora da reserva ☐ fazendeiro ☐ outro _____

Do seu rebanho, quantos bezerros nasceram no ano passado (2003)? _____

De onde os recursos para compra gado esta vindo?

☐ venda de castanha ☐ venda de borracha ☐ venda de produtos agrícolas ☐ aposentadoria ☐ credito do banco

☐ outros_____

O Sr. Poderia me dar uma estimativa do valor total do seu rebanho bovino?_____Reais

Quando Sr. decide vender o gado?

☐ compra de equipamentos ☐ doença na família ☐ pagamento de financiamento ☐outros_____

16 - MANEJO DE PASTAGEM

O sr. Queima a pastagem?

☐ sim → com que freqüência? _____
☐ Não

Tipos de capim presentes:

☐ jaraguá (lageado) ☐ colonião ☐ canarana
☐ braquiária ☐ quicuio ☐ outro: _____
☐ braquiarão ☐ andropogon ☐ pasto natural

O que o Sr. Faz para plantar? ☐ utiliza sementes ☐ utiliza mudas ☐ outros_____

O Sr. utiliza algum adubo para formação ou manutenção da pastagem? ☐ sim ☐ nao Qual?_____

Quais as principais pragas que ocorrem na pastagem? ☐ cigarrinha ☐ gafanhoto ☐ outros_____

Qual a idade de sua área de pastagem?

Idade	hectares	Cobertura anterior*
10 anos ou +		
9 a 5 anos		
4 a 1 anos		
Total		

* 1 – mata, 2 – capoeira, 3 – área agrícola (roçado), 4 – outros_____

Qual a extensão de cercas na colocação? _____ (metros)

Qual a extensão de cercas na colocação? _____ (metros)

De quantos em quantos tempo costuma roçar o pasto?

☐ uma vez por ano ☐ a cada dois anos ☐ outros _____

Tipo de mão-de-obra utilizada para roço dos pastos:

☐ familiar ☐ empreita ☐ diarista ☐ empregado permanente ☐ outro:_____ _____

Quantas diárias de serviço foram utilizadas na ultima rocagem? _____ Quantas diárias de serviço foram pagas? _____

Qual foi o valor total gasto com roço de pasto no ultimo ano? R$ _____

O que o Sr. acha que seriam as alternativas para que as famílias diminuíssem as áreas de pastagens na reserva?
☐ manejo de madeira ☐ melhorar o preço da borracha/castanha ☐ fiscalização mais intensa na reserva ☐ outros:_____

Qual é a f onte de água para o rebanho?
☐ rio ☐ igarapé ☐ nascente ☐ açude ☐ outros_____

A fonte de água e duradoura durante o ano inteiro ☐ sim ☐ não
(obs: Depois da entrevista, retirar coordenada geografica da fonte de água utilizada pelo gado)

Coordenadas (UTM): X: _____ _____ Y:_____

17 – MANEJO DE REBANHO BOVINO:

Você vacina o gado? Quais vacinas ja aplicou?

Doença	Sim/Nao
Aftosa	
Carbúnculo	
Brucelose	
Raiva	
Paratifo	
Outras (quais?)	

Quais as melhorias que você tem para cuidar do gado?

Melhoria	Sim/não
curral sem cobertura	
curral com cobertura (barracão)	
piquete para bezerros	
divisões da pastagem	

Quais tipos de alimentos você da para os animais?

Tipos de sal	Sim/Nao	Frequência/mes	Quant. utilizada por mes (kg)
sal comum			
mineral			
capineira na época seca			
ração ( )			
Vermífugo			
outros (especifique)			

Perguntas abertas:
Porque o senhor acha que muitos seringueiros estão investindo em criação de gado?
_____
_____
_____

Há problemas em criar gado na reserva hoje? Se sim, quais são?
_____
_____
_____

Qual o principal beneficio da criação de gado?

_____
_____
_____

O sr. Acha que a criação de gado na reserva esta prejudicando a floresta (natureza) (percepção do seringueiro)?

_____
_____
_____

Quantas cabeças de gado o Sr. Gostaria de ter daqui a dez anos?

_____
_____

Qual o tamanho da area de pasto necessario para esta criacao?

_____

O seu visinho cria gado? (próxima colocação onde o entrevistado irá) ☐ sim ☐ nao
Qual o tamanho da área de pastagem dele? _____(hectares)
Quantas cabecas de gado ele tem? _____(quantidade)
Nome da colocação:_____Nome do visinho:_____

18 – NORMAS DE UTILIZAÇAO DA TERRA, MONITORAMENTO E ORGANIZAÇAO COMUNITARIA:

Você conhece o Plano de Utilização (PU) de regras pra na reserva? ☐sim ☐não
Você acha que o PU é importante? Porque? ☐sim ☐não

_____
_____
_____

Quem criou o PU? (marque todas) ☐ IBAMA/CNPT ☐ AMOREB
☐ As associações dentro dos seringais
☐ os moradores ☐ Outro:_____

O sr. participou das discussões de elaboração do PU? ☐ sim ☐não

12

Regras	Voce conhece? (S/N)	Voce concorda?*	Voce acha que essa regra em geral esta sendo monitorada? (S/N)	No ultimo ano, voce conhece um exemplo quando algum morador não seguiu essa regra? (S/N)
Pode desmatar até 10% da colocação				
Pode ter até 5% em área de pasto				
Pode derrubar só 1 ha de mata e 1 ha de capoeira por ano				
Tem que pedir liçença para derrubar				
Tem que proteger os rios, lagos, e igarapés				
Tem que proteger as praias e as beiras de varadouro				
Não pode derrubar seringueira				
Não pode derrubar castanheira				
Não pode vender madeira				
Não pode levar madeira para a cidade (vender)				
Não pode caçar com cachorro				
Não pode levar caça para a cidade (vender)				
Não pode pescar com, venenos, ou redes				
Não pode levar pesca para a cidade (vender)				
Não pode vender a terra, so na direita de uso				
Novo morador só pode entrar com autorização da comunidade e da associação				
Outra regra:				
Outra regra:				

* (1) Sim, concorda sempre (2) Sim, concorda as vezes (em geral) (3) Não, discocorda as vezes (4) Não, nunca concorda
OBS: Explicar diferencas entre as opcoes sempre e as vezes—examplo: durante dificuldade financeiro ou a doença na familia

Monitoramento

Quem é mais responsável pela monitoramento na reserva? (marque apenas um)

☐ IBAMA/CNPT ☐ AMOREB
☐ As associações dentro do seringais nas seringuais
☐ Os moradores ☐ A policia
☐ Outro:_____

Porque?
_____
_____
_____

No ultimo ano, já veio alguma pessoa do IBAMA/CNPT para fiscalizar a sua colocação?
☐ sim ☐não O seu seringal? ☐ sim ☐não

No ultimo ano, o Sr. teve uma penalidade por uma infração do PU? ☐ sim ☐não

13

Explica (Regra quebrada, penalidade).

_____

_____

No ultimo ano, já conhece uma pessoa quem recebou uma penalidade por uma infração do PU?
☐ sim ☐ não

Explica (Regra quebrada, penalidade).

_____

_____

Qual regra é mais desrespeitada no seu seringal ?_____

Porque?

_____

_____

O Plano de utilização mudou a forma de viver no seringal? ☐ sim ☐ não

Mudou para melhor ou pior? ☐ melhor ☐ pior

Você acha que as moradores precisam novas regras (a novo PU)? ☐ sim ☐ não

Porque?

_____

_____

Plano de Manejo

O Sr. sabe das modificações que estão sendo discutidas sobre as normas na reserva? ☐ sim ☐ não

Se a resposta for sim, quais as normas são diferentes do PU? (TIRAR)

_____

_____

_____

Já atendou na reunião sobre mudanças nas normas em Brasiléia (22/10/03)? ☐ sim ☐ não

Se, fosse necessário criar uma nova regra para a reserva, qual seria esta nova regra?

_____

☐ Criação de gado TIRAR ☐ Exploração comercial de madeira ☐ Outro:_____

Problemas e Conflitos

Qual o maior problema na reserva?

_____

_____

_____

Quais os três maiores problemas ambientais no seringal?

1._____

2._____

3._____

Qual os três maiores fontes de conflitos e brigas no seringal? (Pode ser com pessoas fora também.)

1._____

2._____

3._____

Quais os três maiores problemas/necessidades no AMOREB?

1._____
2._____
3._____

Qual os três maiores problemas/necessidades no IBAMA/CNPT?

1._____
2._____
3._____

No ultimo ano, alguém invadiu sua colocação? ☐ sim ☐ não ☐ não sabe

Porque foi invadida? ☐terra ☐caça ☐retirada de madeira
☐pesca ☐retirada de outros produtos extrativistas (plantas, sementes, castanha, borracha)

Quem foi o invasor? ☐ morador ☐ moradores da áreas de entorno (fora) da reserve
☐ pessoas da cidade ☐ não sabe

Onde? Explica na historia:

_____
_____
_____

No ultimo ano, alguém invadiu esse seringal? ☐ sim ☐ não ☐ não sabe

Porque foi invadida? ☐terra ☐caça ☐ retirada de madeira
☐pesca ☐retirada de outros produtos extrativistas (plantas, sementes, castanha, borracha)

Quem foi o invasor? ☐ morador ☐ moradores da áreas de entorno (fora) da reserve ☐ pessoas da cidade

Onde? Explica na historia:

_____
_____
_____

Nos últimos 5 anos teve problemas/conflitos no seringal com:

		AMOREB	☐ sim ☐ não
Conflito de terra	☐ sim ☐ não	Prefeitura	☐ sim ☐ não
Venda de colocação	☐ sim ☐ não	Associação (local)	☐ sim ☐ não
Pesca clandestina	☐ sim ☐ não	Cooperativa	☐ sim ☐ não
Caça clandestina	☐ sim ☐ não	Vizinhos/comunidade	☐ sim ☐ não
Venda de madeira clandestina	☐ sim ☐ não	Outro seringal	☐ sim ☐ não
IBAMA/CNPT	☐ sim ☐ não	Vizinhos (fora da reserva)	☐ sim ☐ não

Você esta satisfeito de morar em uma Reserva? ☐ sim, muito ☐ sim, em geral
☐ não, em geral tem problemas ☐ não, muito desastifeito ☐ não sabe

Porque? Explica.

_____
_____
_____
_____

15

O Sr se considera um seringueiros? ☐ sim ☐ não
(explorar a percepção do entrevistado nesta pergunta)

16

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BIOGRAPHICAL SKETCH

Carlos Valério A. Gomes was born in Ourém, State of Pará, Brazil. As the son of an eastern Amazonian farmer, he did what most teenagers in this region did growing up: worked in the fields planting and harvesting crops, and rode horses and herded cattle while attending high school. In 1989, he moved to Rio Branco, State of Acre in the southwestern Amazon. He received his undergraduate degree in Geography in 1995 from the Federal University of Acre (UFAC). Post-graduation, he worked as an associate researcher with the Zoobotanical Park of UFAC and as a consultant to the Extractive Reserves Project/Pilot Program for the Protection of the Brazilian Rainforests (PPG-7), contracted by the United Nations Development Program (UNDP). A Fulbright Fellowship (Amazon Basin Program) brought him to the University of Florida (UF) where he received a master's degree in Latin American studies with a concentration in tropical conservation and development in 2001. His graduate research with forest dwellers in the southwestern Brazilian Amazon focuses on Extractive Reserves as a people-based conservation model. His work broadly addresses changing livelihood strategies among extractivist people, land-use/land-cover change, socioeconomic drivers of deforestation, and development policy for sustainable livelihoods in the region. In 2007, he worked as a researcher-trainer with one of UF's partner NGO (Pesacre) in Rio Branco-Acre to analyze a payment for environmental services program for smallholders in the Brazilian Amazon, as part of the ALFA (Alliance for Amazon and Atlantic Forest) Consortium program, financed by the USAID-Brazil Environment Program. Upon completion of his doctoral program in Geography at UF, Valério intends to return to the Brazilian Amazon to continue his career working at the interface of applied research, sustainable development strategies for forest dwellers, and regional environmental/development policy formation.