Collective Action and Assurance of Property Rights to Natural Resources: A Case Study from the Lower Amazon Region, Santarém, Brazil

Célia Regina Tomiko Futemma

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Emilio F. Moran, Ph.D.

Elinor Ostrom, Ph.D.

Doctoral Committee

Richard Wilk, Ph.D.

Daniel Willard, Ph.D.

September 19, 2000

Para...

Minha mãe Ume Futemma, minhas irmãs e meus irmãos
Meu pai Kyuzo Futemma, em memória
Os ribeirinhos da Gleba Ituqui e da comunidade de Patos do Ituqui

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ABSTRACT

COLLECTIVE ACTION AND ASSURANCE OF PROPERTY RIGHTS TO NATURAL RESOURCES: A CASE STUDY FROM THE LOWER AMAZON REGION, SANTARÉM, BRAZIL

The present study aims to analyze human cooperative behavior in a rural setting in regard to assurance of property rights to natural resources, and to understand the reasons why some people cooperate and some do not. To pursue this goal, I analyzed communities of native peasant people from the Ituqui settlement in the Brazilian Lower Amazon region. Their livelihood relies heavily upon resources from surrounding ecosystems—floodplain and upland. The floodplain is composed of two main ecological zones: natural grassland and flooded forest. The upland ecosystem is also composed of two main zones: bottomland and upland dense forest (tropical moist). This case focuses on two collective actions in which they have been involved. The first collective effort involved seven communities from the Ituqui settlement and dealt with assurance of property rights of the upland ecosystem. After approximately 15 years of land movement, the upland ecosystem was privatized through agrarian reform by the end of the 1980s. In the mid-1990s, the second collective action took place in one community whose residents had participated in the first collective endeavor. The second group effort involved only one-third of the households and its main purpose was to guarantee property rights to the floodplain ecosystem. Household analysis uncovers heterogeneity in terms of household structure and economy, which creates different incentives for people to cooperate or not. Historical accounts reveal that social capital facilitated involvement in the collective action. Finally, in places where individuals explore more than one system in an integrated production economy, the actions taken in one ecosystem may affect other related

ecosystems. Analysis of structure and composition of the upland forest and remote-sensing analysis of patterns of land use indicate that although the target of the collective action is the floodplain, the upland is indirectly affected. In this case, opening a pasture and removing wood species to subsidize cattle activity in the floodplain creates a consequential effect on the upland. To conclude, this study shows the importance of considering multi-scale analysis in studies of collective action and conservation.

TABLE OF CONTENTS

Chapter 3: The *Caboclo Ribeirinho* Household and the Community Organization

Chapter 4: Land Conflict, Collective Action, Land Reform, and Land-Use Changes

Chapter 5: Motivation for Collective Action and Its Ecological Effects on the Upland Forest

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

ACACI	Rural Producers Association of the Gleba Ituqui (*Associação Comunitária dos Agricultores e Criadores do Ituqui*)
BASA	Amazon Bank (*Banco da Amazônia*)
BB	Bank of Brazil (*Banco do Brasil*)
CEPLAC	National Cacao Research and Extension Program (*Comissão Executiva do Plano da Lavoura Cacauaeira National*)
CPT	Land Pastoral Commission (*Commissão Pastoral da Terra*)
DPU	Department of National Patrimony (*Departamento do Patrimônio Nacional*)
EMATER	State Rural Extension Agency (*Empresa de Assistência Técnica Rural*)
EMBRAPA	Brazilian Agricultural Research Institute (*Empresa Brasileira de Pesquisa Agropecuária*)
FASE	Federation of Agencies for Social Work and Education (*Federação das Associações de Assistência Social e Extensão*)
IBAMA	Brazilian Institute for Renewable Natural Resources and the Environment (*Instituto Brasileiro dos Recursos Naturais Renováveis e do Meio Ambiente*)
IBDF	Brazilian Institute for Forestry Development (*Instituto Brasileiro de Desenvolvimento Florestal*)
IBGE	Brazilian Census Bureau of Statistics (*Instituto Brasileiro de Geografia e Estatística*)
INCRA	National Institute for Colonization and Agrarian Reform (*Instituto Nacional de Colonização e Reforma Agrária*)
FNS	National Foundation for Health (*Fundação Nacional de Saúde*)
MEB	Movement for Brazilian National Education (*Movimento de Educação no Brasil*)
PROCERA	Special Program of Credit Line for Agrarian Refom (*Programa de Crédito Especial para Reforma Agrária*)

SESMA — Santarém Municipal Secretariat for Health Service (*Secretaria Municipal de Saúde de Santarém*)

SESPA — Pará State Secretariat for Health Service (*Secretaria Estadual de Saúde do Estado do Pará*)

SPU — Secretariat of Union Patrimony (*Secretaria do Patrimônio da União*)

STR — Union of Rural Workers (*Sindicato dos Trabalhadores Rurais*)

SUDAM — Superintendency for Development of the Amazon (*Superintendência de Desenvolvimento da Amazônia*)

Chapter 1

INTRODUCTION

Goals and Scope of This Dissertation

Appropriation of natural resources has been a key issue in conservation of the environment as well as a key issue in how to guarantee rural small producers a proper livelihood. On the one hand, attributes of the environment affect the problems people face in crafting diverse types of property rights regimes. On the other hand, types of property rights influence patterns of land use and, thus, conservation of natural resources.

The political economy context of the Amazon region has directly or indirectly affected small producers' decision making regarding forms of use of natural resources. Based upon large-scale utilization of natural resources and export-led products, development projects in the Amazon have created unequal distribution of natural resources, restricting access of small rural producers to these resources in many places. Limited access, in turn, has led small producers to organize and mobilize themselves in order to claim their rights to natural resources. As pointed out by political ecologists, unequal distribution of land and incentives created by development programs has increased environmental problems such as deforestation.

While political ecology focuses on the effects of social systems on natural systems, cultural ecology allows one to address how environment affects individuals' decisions, such as assignment of property rights to resources. Empirical evidence shows the existence of customary rules in which local resource users define property rights to natural resources using their attributes as one of the important factors affecting the design of a regime. Resources that are diffuse with high costs of delimiting their boundaries and fluctuate in time and/or space tend to be controlled on a collective basis such as grazing areas for livestock. In contrast, for resources that are more easily delimited with more stable temporal and spatial distribution as well as whose frequency and productivity per area are high, a private rights system is found. Thus, in rural field settings—community or settlement—a combination of property rights systems (collective, private, and/or state ownership) can be observed due to the different characteristics of each natural resource.

In order to understand individuals' decision making in regard to use and appropriation of natural resources, local organization, and their implications to patterns of natural resource use, the present study aims to answer three main questions: (1) In a small rural village, does a change in property rights regime of a natural system affect patterns of resource use and distribution among its residents? (2) In regard to collective appropriation of a natural resource, how important are historical accounts, household attributes, and physical characteristics of a land to explain individuals' decisions about initiating and maintaining a collective action? (3) What are the ecological and land-use outcomes resulting from a change in property rights?

A case from the Santarém region in the Lower Amazon will be analyzed to address these questions. The Patos do Ituqui community—hereafter called simply Patos or the Patos community—is the center of this case study, selected after intensive exploratory fieldwork and previous work in the region. During this preliminary field period, I visited approximately 25 local communities and talked with leaders and family members of each community. I also visited relevant local grassroot and governmental organizations to collect more information about each of those visited communities. As described below, the Patos community appeared to be a unique case of two collective actions that took place in a relatively short time period (20 years) with involvement of several other communities in the first case and only part of the Patos community in the second. The second collective action involved a collective purchase of a particular natural resource system and shows a situation in which human action taking place in one natural system affected another one.

The Patos community was founded approximately 80 years ago. Residents share strong social ties and rely heavily on surrounding natural resources for their subsistence. This community extends across two different ecosystems: floodplain and upland. Both ecosystems have undergone recent institutional changes with regard to property rights. The upland changed from "open access" to private ownership, while the floodplain has been experiencing an ongoing shift from "open access" to communally owned land. The community is comprised of 33 households of which one-third participated in a recent collective action to guarantee rights to resources and two-thirds did not. Despite the importance of community-level organization, the social unit of analysis in the present study is the household, assuming that this is the basic social unit or productive unit in which many of the relevant decisions related to these collective actions took place.

A history of change in upland forest ownership reveals the occurrence of a social mobilization in which a group of local small producers from Patos and five other communities was involved as one of four main actors. The other three major actors (in the first major collective action undertaking) were ranchers, agents from non-governmental organizations (NGOs), and officials from governmental agencies. While the NGOs' agents were important actors for providing support for local empowerment and claiming rights to land, ranchers were competing with local residents for rights to the same natural resources. The government's role was multifaceted, and the next section focuses on how various governmental development projects in the Amazon region have affected systems of property rights to natural resources.

Development Projects and Use of Natural Resources in the Amazon Region

Since the end of the nineteenth century, the Brazilian Amazon region has been the location for several economic boom cycles, such as a rubber boom (Weinstein 1985), jute production (Gentil 1988), and mining extraction (Bezerra et al. 1996). All of them had variable but generally deleterious consequences for both local small producers (including indigenous, *caboclo*, and colonist populations) and the environment (Schmink and Wood 1992). Since the 1960s, the Brazilian government has been trying to promote economic development in the region by creating incentives for large-scale use of natural resources such as the timber industry, using land for pasture, mining, and cacao (*Theobroma cacao*) plantations. In order to make these endeavors feasible, the government has invested in infrastructure such as hydroelectric dams to generate energy, roads to facilitate transportation of products by land, and ports to facilitate river and coastal transportation (harbors).

However, as a result of development projects, unequal distribution of natural assets such as land and forest resources occurred among large and small producers, which, in turn, has led to social conflicts over the resources. The political ecology approach that emerged around the 1980s (Durham 1988) has begun to identify relationships between development plans and deleterious social and ecological consequences in an attempt to understand the role of each actor in such a social structure

(Chibnik 1994; Durham 1988; Grossman 1998; Moran 1981; Painter 1988; Schmink and Wood 1992; Sheridan 1988; Stonich 1993). One of the aspects addressed by political ecologists concerns property rights to natural resources (Schmink and Wood 1992); that is, how the development paradigm[1] becomes a barrier to protecting the environment, preserving the boundaries of Amazonian indigenous land, and defending the rights of small farmers (Schmink and Wood 1992).

Recent recognition that local small producers are key actors with respect to environmental conservation and that they are able to overcome individual strategic behavior, policy makers, practitioners, and scientists are now trying to include these local people in decision-making processes with regard to rights to natural resources as well as how to use and manage these resources. They recognize that local people are able to self-organize and self-govern their natural resources.

Instances of social movements of people seeking rights to land have spread throughout Latin America, particularly, in the Brazilian Amazon region (see Alston et al. 1999 for the case of landless social movement—MST—in frontier areas; Pace 1992; McDonald 1995). Local small producers are also joining efforts in order to define and legalize their rights to renewable natural resources, as in the case of extractive reserves (harvesting from rubber trees and other non-timber products) in a number of places in the Amazon (Allegretti 1990; Brown et al. 1995; Murrieta and Rueda 1995;Weigang and De Paula 1998). However, when and by which means individuals decide to participate in such a collective effort and what motivations or incentives are behind cooperation are gaps that still need to be filled in cases from rural areas in the Amazon region. Since Olson's (1965) pioneer work, studies on collective action have contributed greatly to understanding situations in which individuals are more prone to cooperate as opposed to cases in which they are not. In order to achieve successful cases of participation, several problems behind collective action need to be overcome as well (see section on Appropriation of Natural Resources in this chapter).

Property Rights to Natural Resources and Patterns of Resource Use and Distribution

While political ecology allows us to address issues on how socioeconomic inequality and differential political power contributes to environmental destruction, cultural ecology offers tools to analyze how an environment affects individuals' decisions or how individuals respond or adapt to a certain environmental setting (Netting 1976). In the Patos case, the issue is how attributes of a natural system influence local people's choice to assign a property rights regime.

Small rural producers generally rely on multiple natural resources from different ecological systems such as upland, floodplain, and water systems. In customary systems, different types of natural resources, patterns of land use, and demographic conditions affect local decisions regarding which type of property right should be assigned to which natural resource. Usually private ownership is found where land is not abundant, population density is high and frequency of use and productivity per area are high, such as the case in the Swiss Alps in which peasants privately own areas for cultivating grains, vineyards, and gardens (Netting 1976). In contrast, extensive farming such as shifting cultivation is usually found in areas where land scarcity and density of the local population are not prevalent, hence "rights to resources become less strict and explicit" (Netting 1993:161). In the higher altitude zones of the Andes that have heterogeneous environments, communal ownership is found associated with grazing areas and fallowing, while private control is associated with permanent irrigation, specialized horticulture, and long-term fallowing according to different ecological zones (Guillet 1987).

Thus, combinations of different types of property rights exist worldwide, taking into account ecological and economic attributes of a natural resource such as in the cases of the Andes (Guillet 1987), the Swiss Alps (Netting 1976), Peruvian lake communities (Leviel and Orlove 1990), the African floodplain (Thomas 1996), and Mexico (Bellon 1996). Among some indigenous Phillipine communities, Wiber (1993) also found a complex system of property rights to natural resources, where several systems coexist simultaneously. She argues that such a complex system is a result of complex local social entities and external and political influences, i.e., resources that are considered by outsiders as communally-owned are in reality held based on kin ties such as irrigation canals, individual ownership such as rice fields and gold mines, ownership by a group of individuals such as grazing areas but not the entire community (Wiber 1993). Wiber does not analyze the role of biophysical attributes in determining property systems, but these Phillipine customary rules appear to confirm that resources such as grazing areas and irrigation canals are held by groups of individuals rather than one individual under a private property regime.

In the next section, I discuss the concept of common-property regime which includes many different types of goods and rights, in order to address further questions on governance of natural resources as a whole. Because the Patos case deals with changes in property from "open access" to private regime and common-property regime as well as different types of natural resources, drawing the distinction between goods and rights is crucial for later analysis. The Patos floodplain ecosystem is of particular interest because of its attributes as a common-pool resource and because it is governed collectively under a customary system.

Goods and Property Rights: Private, Public, and Common

Misunderstanding of the terms "common-pool resource" and "common-property regime" is evident in some of the scholarly literature on natural sciences and environmental policy (Bromley 1992:3). Common-pool *resources* have been defined by some authors as resources that exhibit costly control of access and are subtractable (if one person uses the resource, another cannot), while communal property is defined as the property-right regime that may regulate the use of common pool resources or other types of valued goods where ownership is jointly held (Berkes 1996; Bromley et al. 1992; McCay and Acheson 1987). Bromley (1992:3) calls attention to this by saying that "There is no such thing as a common property *resource*." He points out the error of using the term *property* in that phrase through his definition: "...property is not an object but is rather a social relation that defines the property holder with respect to something of value against all others" (Bromley 1992:4). Thus, he and Ostrom (1992, 1990) propose the use of a more appropriate term to designate a common-pool resource that is related to the nature of a resource and common-property institution or common-property regime that is related to a social institution.

Common-pool resources are natural or man-made resources that exhibit high cost to exclude potential users (control of access) from obtaining subtractable resource units

(Ostrom 1992, 1990; Ostrom et al. 1994). To make clear the definition and concept of common-property regime, I provide brief definitions of private goods, public goods, and collective goods. Goods are defined as anything valued by humans which includes commodities produced for exchange or subsistence or natural resources which are not produced by humans but whose characteristics are affected by human use.

Private goods are subtractable and excludable at low cost, for example, bread on the market shelf or cars in a car sale store. Subtractability means that a unit used by an individual will not be available to anyone else. Exclusion refers to the relative cost of preventing individuals from enjoying the consumptive or non-consumptive aspects of a good without contributing to the provision of the good or its management (Ostrom et al. 1994).

Public goods or collective goods are non-excludable and non-subtractable (Taylor 1987); for example, fresh air. Non-subtractability means that the amount of a good available does not decrease as a result of one person's use, or if it does, at a very low rate. Non-excludability means that it is costly to prevent individual members of the group from appropriating it (Taylor 1987). As defined above, common-pool resources are goods that exhibit high cost of excludability and problems of subtractability.

Common-pool resources can be small or large in extent. Examples of small common-pool resources are lakes, ponds, forests, irrigation systems, and grazing areas. An example of a large common-pool resource is the internet system or the ocean. In analyzing common-pool resources it is useful to distinguish between the flow of resource units and the resource system producing the flow. Ostrom writes that "... resource systems are best thought of as stock variables that are capable, under favorable conditions, of producing a maximum quantity of a flow variable without harming the stock or the resource system itself" (1990:30). Examples of resource systems are lakes, forests, and grazing areas. A resource unit is the unit consumed or used by the user from the resource system (Ostrom 1990:30). Examples of resource units are the fish in the lakes, trees in the forests, and grass in the grazing areas.

Common-pool resources can be left without clear rules related to who can use them as an open-access regime. Common-pool resources may also be controlled through various institutional arrangements: common-property, private-property, or state-property regimes. An open-access situation is when anyone may have access to the common-pool resource and s/he may subtract as many units of the resource(s) as s/he desires. Hence, there is no rule controlling the use and access to a resource; it is a condition of free access to a resource.

Common property is a social institution that controls and regulates the access to and uses of goods having diverse properties. A private good can, for example, be owned by a household under a common property regime (McCay and Acheson 1987). Property rights[2] define rules that establish rights and duties for activities related to a resource.

Achieving excludability of a common-pool resource involves rules that define who the potential beneficiaries are. In other words, who may have access (authorized users) and who may not have access (outsiders) to a resource (Bromley 1992; Feeny et al. 1990; McCay and Acheson 1987; Ostrom 1992, 1990; Ostrom and Schlager 1996). In common-property regimes, rights of access are shared by a group of individuals and are exclusive to community[3] members, frequently called commoners (McCay and Acheson 1987). Non-members of a particular community are outsiders and are excluded from the common-pool resource. One example of rules of access is from Maine lobster management in the United States (Acheson 1987). Lobsters are caught in the ocean (public domain), and community-based lobster fishing territories are defined based on ownership of land. Commoners regulate access to lobster sites through entrance rules, and rights to access depend on age, length of residence, and status within a defined group of local residents ("harbor gang") (Acheson 1987). Acheson points out that "economic gains from the strategy of maintaining a strong defense of traditional boundaries are shown in higher mean numbers of lobsters per trap, more large and hence higher-priced lobsters, and higher gross income" (1987:58).

Harvesting rules regulate how many resource units can be withdrawn from a common-pool resource and when and by which means. Within a community that has developed a common-property regime, rules determine use rights among members, such, as the amount each user can take from the common-pool resource, how many times and when a user can go to the common-pool resource, defined spots that each user can use within a common-pool resource, among others (Feeny et al. 1990; McCay and Acheson 1987). Taking the same example from Maine, Acheson also discusses how lobster fishers regulate fisheries based on time (fishing seasons, when users may fish), place (fishing areas, where users may fish), and technology (types of fishing gear available, which gear different types of users may use). Another example is from forest and meadow commons in Japan (McKean 1982). Community leaders established rules of opening and closing dates for the harvest of some products, and guards controlled those lands from poaching among both commoners and outsiders. Like lobster fishers in Maine, Japanese villagers also established which harvesting tools could be used. They also have written rules crafting a graduated schedule of fines for violators (McKean 1982).

Exclusion of some individuals from accessing some natural resources may generate unequal distribution of natural assets among members within a village, such as the case of landless individuals. In cases in which individuals depend chiefly on natural resources for their subsistence, exclusion from harvesting a resource means being excluded from the main source of subsistence material. However, small communities that have long histories of strong social ties (e.g., kinship and co-parenthood systems) with systems of exchanging foods and products, sharing working tasks, and even practicing inter-marriage, solutions to alleviate situations of landless individuals are more likely to exist. While at community or household level, social ties or familial ties can reduce problems of inequality, at a larger scale, such as regional, resolving problems of unequal distribution of resources requires a more complex social organization, involving social mobilization and coordination. Instances from the Amazon region show that local people have been able to self-organize as a small or large group in order to defend and manage to some extent their surrounding natural systems.

Assurance of Rights to Natural Resources: Collective Action, Household Decision Making, and Social Capital

Since the 1960s, social mobilization has spread throughout rural areas in Brazil. During the 1960s and 1970s, the main concern was toward rights to land in order to reduce rural out-migration and poverty. During the 1980s and 1990s, an environmental component was incorporated into agrarian social movements (Allegretti 1990; Pace 1992). In frontier areas within the Amazon region, harsh land conflicts have been taking place, involving the organization of small rural producers—landless people—who are claiming rights to land (Alston et al. 1999). Non-frontier areas also experienced social conflict between small producers and large-scale ranchers. The Gurupá case, in the state of Pará, illustrates such a case in which small producers were involved in a coordinated political activism in order to defend their land from expropriation and a concentration of land ownership (Pace 1992). Concern with both land and overall forest resources, rubber tappers also organized in order to defend their access to forest from large ranchers' threats (Allegretti 1990). Therefore, competition over natural resources has been an important issue in the Amazon region with active response from local people. Some of these social movements have received support from external agencies, and others have not. Some have led to the creation of an extractive reserve (rubber tappers) and some to agrarian reform with intervention of the state, as opposed to other social conflicts that are still not resolved. The questions that are still unclear are when and by which means individuals decide to participate in a collective action. In my case study, household economy and structure as well as presence of social capital appear to be important variables that affect individuals' decisions on whether or not to participate in a collective endeavor.

Household Economy and Structure

In the past decades, studies of households have increased. Scholars have greatly contributed to the understanding of the internal decision making and structure of households. The importance of the household dates back to before industrialization (seventeenth century) when the household was considered a basic economic unit of society (Chayanov 1986).

Household is a social unit that fulfills several functions, such as production, consumption, distribution (pooling, exchanging, sharing, and consuming), transmission (transfer of property), biological and social reproduction (number and spacing of children in the household), and co-residence (living under the same roof and sharing activities in constructing and maintaining a dwelling) (Netting et al. 1994; Netting 1993; Wilk 1991, 1989). In one way or another, all these aspects are related to land tenure, showing how the maintenance of the household among producers depends heavily on land availability.

A household, as a productive unit, is engaged in training labor to work in several activities besides farming—livestock, hunting, gathering, fishing, and manufacturing—and developing responsibilities among members of the household to reduce the cost of monitoring and sanctioning, which Netting (1993) called implicit contracts. A skilled household labor force showed more efficiency than wage labor, and children of a landed household working on their father's land had higher productivity output than landless households (Netting 1993).

Another relevant function of a household is consumption. The subsistence needs of a household are produced by members of a household in many rural parts of the world (Chayanov 1986). Although households are connected to a market economy, they do not entirely depend on it. They frequently keep their autonomy, which protects them against uncertain fluctuations of the market (Netting 1993).

In particular, the decision of whether to cooperate in a larger group or to remain apart as a household, per se, is likely to occur at this domestic level. But, usually, field data on collective actions in rural settings have been gathered at village level, despite considering the household an important unit of analysis (Agrawal 1996; Narayan and Pritchet 1997; Varughese and Ostrom forthcoming; White 1996; White and Runge 1994). Because the household is not an isolated social unit, it is like an open system (Wilk 1991); i.e., the household is connected to the outside world, a larger system, in which members interact with members from other households inside and outside the community. In fact, cohesion among households contributes to build a community unit (Lima-Ayres 1992).

Nevertheless, differences in material assets as well as labor force across households may create opportunities for some households to participate in a collective action while constraining others from participating. Within a social group, several types of attributes may affect cooperative behavior: gender (male and female), age (children, young adults, and adults), material assets (sources of income, access to retirement), education (how many years of schooling), religion, land tenure (landholder, landless), among others. Heterogeneity of a group has been a contested variable in the analysis of successful collective actions (Gibson and Koontz 1997; Olson 1965; Ostrom 1999a, 1999b; Varughese and Ostrom forthcoming; Schlager and Bromquist 1998; Udehn 1993).

Heterogeneity can be a constraining factor to collective ventures. In a more homogeneous cultural-ecological setting, individuals would more easily agree to cooperate. However, Varughese and Ostrom (forthcoming), in analyzing cases from Nepal, did not find any consistent relationships between heterogeneity and success of collective action. Studies have shown that appropriate institutional arrangements are a key factor to a successful collective action in that individuals try to overcome problems of size (Agrawal 1996) as well as heterogeneity (Gibson and Koontz 1997; Schlager and Blomquist 1998; Varughese and Ostrom forthcoming). Besides household attributes, previous participation in sociopolitical organizations and mobilization contribute to enhance individuals' abilities to coordinate and to learn how to overcome some problems of collective action such as cheating or free-riding. Building social capital is likely to contribute to cooperative response among local people.

Social Capital: Internal and External Inputs

The literature on social capital is immense, covering many different types. Previous experiences with social capital through sociopolitical organizations—kinship systems, political and religious organizations—as well as involvement in leadership and membership roles are of particular interest in addressing cooperative behavior in the present case.

In rural settings, a history of individuals' participation in organizations geared toward political purposes, production systems, or even religious and recreational ends contribute to enhance the network among individuals at both household and community levels (Durston 1998; Fujita et al. 1999; Narayan and Prittchet 1997; White and Runge 1994). Constructing trust and long-term commitment among individuals within a social structure has been seen as a positive effect of social capital that creates incentives for individuals to work together (Coleman 1987; Putnam 1993; Ostrom 1999b, 1994, 1992). Through informal social arrangements, such as familial ties or relationships within a household unit, individuals learn social norms that convey values such as trust, reciprocity, and commitment. In peasant societies, familial or kinship ties among households are important factors that keep them close in a community-level structure. Despite kinship being considered more of a pre-existing form of social capital (Putnam 1993), it facilitates cooperation among individuals due to lower transaction costs (Durston 1998).

In his analysis of the history of institutional arrangements in southern Italy, Sabetti (1999) argues that the Catholic church enhances civic organization in contrast to Putnam's (1993) arguments. According to Putnam, the Catholic church has a more hierarchical structure than the Protestant church, and thus the latter offers ways of building social capital due to its less civic organization which is based upon vertical relationships like the patron-client system (Putnam 1993).

Instances from the Amazon region indicate a case similar to the situation in southern Italy: the church-sponsored associations provide primary political leadership, empower grassroot organizations, and encourage self-governance among villagers. Since the 1970s, the progressive sector of the Catholic Church has been actively supporting social movement in the Amazon rural areas through education, formation of leadership, providing information about human rights and rights to natural resources such as land, and encouraging rural workers' participation in unions and other grassroot organizations (Bruneau 1980; Paiva 1985; McDonald 1995). In the Amazon, the rural producers' education and political consciousness have been enhanced by several organizations linked to the Catholic church, such as Basic Christian Communities (CEB, see Bruneau 1980 and Paiva 1985), Federation of Agencies for Social Work and Education (FASE, see Leroy 1992), Movement for Brazilian National Education (MEB, see Brandão 1981 and Pimentel et al. 1997), and Land Pastoral Commission (CPT, see Paiva 1985). In particular, CPT and other fishing grassroot organizations have been strongly involved in the fishing movement in the Lower Amazon region (see Schönenberg 1994).

Narayan and Pritchet (1997) studied several communities in Tanzania and found that the greater the associational life is, the higher the social capital and household income will be. Membership was also a strong predictor of individual participation among communities in Haiti, in that experiences in associations allow individuals to learn how to share information, build trust, and construct rules and systems of monitoring and sanctioning (White 1996). Besides membership, the leadership role is also an important factor that affects both the origin and maintenance of a collective action (Fujita et al. 1999; White and Runge 1994). However, a leader may seek to pursue her/his own interest and leave everyone else worse off (Frohlich et al. 1971). Thus, a group needs to create some ways of controlling leaders' possible opportunistic behavior in order to obtain a positive outcome for the whole group. Systems of monitoring and sanctioning appear to be essential ways of supervising a leader's behavior or attitude.

Individuals may face a set of constraints that discourage them from cooperating, and thus choose an individual strategy, but by developing an efficient institutional arrangement and building social capital, individuals can create another set of opportunities that are likely to encourage them to collaborate with a group and overcome problems such as size of group, inequality, and opportunistic behavior. In order to analyze decision making among small rural producers from the Amazon region, and opportunities and constraints they face, it is important, though challenging, to look at the household level of analysis.

After discussing issues on how to specify property regimes to natural resources and their use and distribution among different users, the next questions are How does human action affect a natural system? and How can it be assessed? In the present study, multi-level and multi-temporal analyses are required to analyze change in property rights systems and how they are related to changes in forms of land use and rates of forest change.

Property Rights, Patterns of Land Use, and Forest Coverage

During the past three decades, the volume of empirical data on self-governance of natural resources by local users in developing and developed countries has increased. Successful cases of community-based management of fishing, forest, and irrigation systems (see Berkes 1989; McCay and Acheson 1987; McKean 1982; Netting 1976; Ostrom 1992; Tang 1992; Wade 1988) have shed more light on previous findings regarding the tragedy of the commons (Hardin 1968). There have been examples of failed and successful cases of management on a collective basis in the Amazon region with respect to fishing (see de Castro 2000; McGrath et al. 1999, 1996) and forest products (Allegretti 1990; Balée and Posey 1989; Brown et al. 1995; Mamirauá 1996; Weigang and DePaula 1998).

At first, an unclear distinction between open access and common-property rights led scholars and policy makers to believe that local people were not able to manage and govern their own resources (see section on The Governance of Natural Resources in this chapter for distinction between open access and common-property rights as well as between common-pool resource and common-property rights). Despite clear definitions of open access, common-property regime, and common-pool resources, the relationship between types of property regimes and nature conservation is not clear-cut. Cases of failures and successes are observed across all types of property regimes, whether private, common-property, or public. In the past, private property was considered one of the most appropriate ways to guarantee conservation of natural systems, along with state-owned regimes (Hardin 1968). However, researchers studying the Amazon forests argue that privatization is more deleterious to the environment than common-property regimes, leading to more deforestation (Beaumont and Walker 1996; May 1992). Hence it is important to consider the local context within which individuals are embedded to analyze which factors affect individuals' decision making on how to appropriate natural resources and how to use them (McCay and Jentoft 1998).

Studies of land use and forest coverage across the state of Indiana by the Center for the Study of Institutions, Population, and Environmental Change (CIPEC) team, found that several factors contribute to shaping the landscape, not only the property rights system. Previous experience with land and physical characteristics of land (e.g., soil fertility and topography) are key factors in defining forms of land use and forest coverage (Koontz et al. 1997). By using historical data on land use since the beginning of the twentieth century, McCracken et al. (1997) show an expansion of agriculture at the beginning of the century followed by a retraction allowing regrowth of secondary forest. These patterns are related to history of occupation, urbanization, modernization of agriculture, and timber industry. Regrowth of forested area has increased since the mid-1990s in response to the creation of units of conservation by the government. Schweik and Green (1999), studying units of conservation in southern Indiana, also concluded that institutional arrangements affect forms of land use and forest regeneration. Within the National Forest, recreational areas presented more soil exposure as opposed to wilderness areas that presented natural forest regrowth with older trees (Schweik and Green 1999).

Assessment of Patterns of Land Use and Forest Coverage: Across Spatial and Temporal Analysis

Changes in property regime may change resource users' choices in regard to what resources to use, how to use them, when and how long to use them, or whether to stop using them. These choices and decisions directly or indirectly affect the structure, composition, and function of an ecosystem. Cases of mixed forms of appropriation and use of multiple resources from various ecological zones or ecosystems may involve some effect of the way one natural system is used on the other ones.

In the Lower Amazon, use of both floodplain and upland ecosystems for pasture purposes has been steadily increasing in the past two decades (Arima and Uhl in press). In this ranching system, cows graze on cultivated pasture in the upland areas during the flood season (January to June) and move to floodplain natural grassland to graze during the dry season (July to December). Hence, clearing a forest for pasture in the floodplain is likely to have a consequential effect on the upland. In the Patos case, legal privatization of upland forest took place by the end of the 1980s, opening up opportunities for timber exploitation and long-term investment in land, such as cattle ranching and increasing crop production. With the collective purchase of floodplain area, it is expected that large areas of forest coverage will be altered. Two methodological tools have been used in order to address these questions on changes in land-use patterns and forest cover.

A combination of vegetation analysis at plot level (see Chapter 5 for description of methods and analysis), remote sensing analysis, and GIS (see Chapter 4 for description of methods and analysis) is necessary to address the effects of human-induced changes on forest ecosystems (Brondízio et al. 1993, in press; Brondízio 1996; Koontz et al. 1997; Li et al. 1994; McCracken et al. 1999, 1997; Moran et al. 1994, 1993, in press; Schweik and Green 1999). Ecological parameters such as forest structure (density and basal area) and composition (number and types of plant species) offer information with which to assess effects at plot level. Remote sensing analysis in conjunction with GIS provide tools to analyze patterns of land use at different spatial scales as well as time series data. A particular analysis that is key to the present study, combining both remote sensing and GIS, is the household-farm level analysis; that is, one can assess rates of clearing of a forest as well as amount of mature forest and secondary succession at farm-property (approximately 50 hectares each) level (see Brondízio et al. in press; McCracken et al. 1999; Moran et al. in press). With these tools at hand, analysis of land use and land cover can be conducted at farm-property, community, and landscape levels.

Organization of This Dissertation

Chapter 2 reviews a history of political-economic development of Santarém from the beginning of the twentieth century up to the present day, which involves direct use of several types of natural resources such as rubber trees, soil for growing jute fiber, and timber. The chapter also describes both the ecosystem and natural resources that exist in Santarém. The main focus of Chapter 3 is a household analysis undertaken in order to understand how household structure and economics affect cooperation among different local residents and governance of natural resources, considering strong social ties through kinship and co-parenthood systems. Chapter 4 describes and analyzes the history of a collective action whose goal was to guarantee local residents rights to upland resources. It describes the participation of all six communities located in the Gleba Ituqui. The last section of the chapter focuses on temporal changes in land-use patterns before and after privatization, which was, in fact, a result of the Ituqui collective action. Chapter 5 deals with analysis of the subsequent collective effort that involves only people from the Patos community whose goal was to guarantee rights to the floodplain. The last section of that chapter assesses the effects of such a joint effort on the upland forest, using plot-level analysis of vegetation. Chapter 6 focuses on the analysis of rights to forest resources at household level, and on the influences of social ties and reliance on a resource in developing these rights. Chapter 7 is the concluding chapter that focuses mainly on the motives that lead to collective action, the conditions faced by a household when choosing whether or not to participate, and, finally, what the relationships are between collective action, property rights, and conservation.

Endnotes

[1] The development paradigm from the 1960s through the 1970s and 1980s has led policy makers to attempts of "developing" Latin American countries through industrialization and modernization of traditional agriculture. Schmink and Wood (1992:6) state that the following assumptions underlie the developmentalist paradigm: (1) small producers are inefficient; (2) peasant people are culturally retrograde; (3) extractivist activity is backwards; (4) traditional knowledge is worthless; (5) tropical forests provide few economic goods and are biologically worthless with only a limited number of hardwoods; and (6) community property rights is antithetical to private property.

[2] As Ostrom and Schlager (1996:130) explain, rules are different from property rights: "... rights are the product of rules .... For every right an individual holds, rules exist that authorize or require particular actions in exercising that property right. Because rights define actions that individuals can take in relation to other individuals as regard to some 'thing,' if one individual has a right, someone else has a commensurate duty to observe that right. The duty that an individual owes another defines the actions the individual may, must, or must not take in relation to another and that other's property."

[3] Another concept that must be clarified in an interdisciplinary work is "community." Community in ecology is an association of interacting populations of plant and animal species (Ricklefs 1990:656). In social sciences the definition of the term is "a body of people having common organizations or interests, or living in the same place under the same regulations" (Crane and Angrosino 1974), and people share the same values and beliefs. The term used in this dissertation is related to a "community" defined by social scientists as a social group. One could also use "village" to refer to such a social group.

Chapter 2

SOCIAL-POLITICAL ECONOMY AND NATURAL RESOURCES

Introduction

Santarém has a long history of economic cycles during which various products were dominant—sugar cane, rubber, jute, timber, and fish. These cycles transformed the municipality into the main commercial center of the Lower Amazon. In past decades, this region was included in government development plans to expand agro-pastoral production and the timber industry. More recently, Santarém has been included in a large-scale program for expanding production of soybeans for export (Prefeitura de Santarém 1999).

The Lower Amazon, as elsewhere in the Amazon, is a rich environment that offers an immense array of economically valuable natural resources which explains one of the reasons why Santarém has been involved in these economic cycles. However, past and present patterns of exploitation of those natural resources have been contributing to the alteration of natural ecosystems concomitant to land conflict and problems of access to natural resources.

The Gleba Ituqui, or the Ituqui settlement, was one of the first places in the Amazon where local communities successfully self-organized and struggled to gain access and control over land in the upland ecosystem. The Patos community, part of the Ituqui settlement, is a particular community where subsequent group cooperation took place in order to assure individuals' rights to the floodplain and in which external and internal factors intermingled, affecting decision making at household level.

This chapter describes the history of occupation, the physical infrastructure and natural environment, and patterns of exploitation of natural resources at municipal (Santarém), settlement (the Gleba Ituqui), and community (the Patos community) levels in order to understand the political-economic, cultural, and ecological contexts in which Patos residents live.

Study Area

The Gleba Ituqui is located 55 km east of Santarém (State of Pará, Brazil) in the Lower Amazon[1], approximately 54°20'W and 2°30'S of Greenwich (Figure 2.1). The Ituqui settlement was created only at the end of the 1980s by the federal government and is composed of six communities covering an area of 16,589 hectares: Patos do Ituqui, Pau D'Arco, Santana do Ituqui, Cabeceira do Marajá, Serra Grande, and Nova Aliança (figures 4.1 and 4.2). Transportation from rural communities to the town of Santarém is available by bus or by boat. The municipality of Santarém covers an area of 24,154 km^2 and is mostly situated at the north and east margin of the Tapajós River at the confluence of the Amazon River. Due to its favorable geographic location, Santarém became the main commercial center of the Lower Amazon region. It is positioned between the two biggest Amazon cities—Belém and Manaus. The main transportation to Santarém for people from more distant areas is either by airplane or by boat. It is more difficult to reach the area year round by roads due to their poor maintenance.

The Lower Amazon region is characterized by a high and extremely variable annual precipitation, with 1,000 to 3,000 millimeters of annual rainfall, and an annual average temperature of 26°C (Junk 1984; RADAMBRASIL 1976). The relative humidity varies from 78 percent in October to 89 percent in May, with an annual mean of 84 percent (Barros 1986). The river level fluctuates within a range of five meters between the extreme of the dry season (July to December) and the flood season (January to June). During the peak of the flood season, a large portion of the floodplain is under water.

(Figure 2.1. is about here)

History of Occupation and Population

In 1542, the Portuguese arrived in Santarém where they encountered the native inhabitants, the Tapuyas, or generic Indians. The Tapuyas were catechized by Portuguese Jesuits, and most of them were annihilated by the beginning of the eighteenth century as a result of internal wars and diseases. Evidence of the first people in Santarém dates back to 11,400 to 10,000 B.C. when there were bands of Paleoindian hunter-gatherers in the area (Roosevelt 1994). However, the presence of elaborately painted, modeled, and incised pottery, large effigies of people, and traces of houses and hearths suggests a denser and more permanent occupation (Roosevelt 1994). Indeed, archaeologists and ethnologists have pointed out the existence of a more complex society in the past, around 1,000 to 2,000 years ago, which they consider to have been chiefdom societies. In the Tapajós area lived one such society named the Tapajós chiefdom (Carneiro 1995; Roosevelt 1994; Whitehead 1994). Chiefdoms are characterized by an organized society with political leadership and the presence of social strata including an elite group, as well as the practice of long-distance trade.

The city of Santarém was founded in 1848 by Federal Law No.145 at the same time as Manaus, the capital of the state of Amazonas (Fonseca 1996; Reis 1979). By that time in the mid-nineteenth century, the population was composed of Portuguese and Amazonian Indians and a large population of the *caboclos* ethnic group (see Chapter 3, section on Formation of *Caboclos* Population).

More recently, immigrants arrived in Santarém from northeastern Brazil during the rubber period and later during the gold rush of the mid-twentieth century. Other immigrants included Americans and Japanese. While a number of American entrepreneurs and families came during the rubber period at the end of the nineteenth century (Reis 1979, Weinstein 1985), a larger number of Japanese farmers arrived in Santarém to grow jute (*Corchorus capsularis*) in the early 1930s (Gentil 1988). Many Americans and Japanese have moved away, but Santarém is still a mixed society with a large *caboclo* population, smaller groups of northeastern and southern Brazilian people, and an even smaller number of American and Japanese descendants.

The most recent national survey (IBGE 1996, hereafter cited as Statistics 1996) indicates a population of 265,062 inhabitants in the Santarém municipality. The population has increased by almost six times since 1940 when there were 47,559 inhabitants (Figure 2.2) (Fonseca 1996; Gentil 1988; Statistics 1996). Since 1940, more people have been living in urban rather than rural areas. Currently, there are 180,018 inhabitants (68 percent) living in the urban zone, and 85,044 inhabitants (32 percent) are distributed throughout rural lands.

(Figure 2.2 is about here)

The Gleba Ituqui, which is partly rural communities, is mainly inhabited by *caboclo* with the exception of Nova Aliança, which is a new community and is occupied by recent colonists from the northeastern and southern regions of Brazil.

In particular, the history of occupation of the Patos community goes back to the beginning of the twentieth century, in the 1920s. Local residents reported that the first Patos residents were a couple that came from a nearby area, called Moisés. They established the first house in the bottomland zone close to the stream (see Natural History and Natural Resources in this chapter). Patos covers a history of six generations up to the present day. Today, the community is composed of two main families that hold strong kin connections, and they are the direct descendants of the first pioneer villagers (see Chapter 3, section Household Structure).

The Patos is composed of 203 inhabitants of which 112 are female and 91 are male residents. Almost two-thirds of the population is under 18 years old (males, 43 percent; females, 57 percent), a figure similar to national numbers as well as those from other developing countries, i.e., an age pyramid with a small elderly population at the top (Figure 2.3 and Table 2.1). Despite the fact that there are few individuals over 50 years old, some have reached the age of 80 and older. Figure 2.3 also indicates a larger number of females than males in most classes of ages, in particular between five and 14 years old, which might suggest a larger number of female-born babies. The average number of children per household is 5.6, an average similar to other *caboclo* populations from the Amazon (de Castro 2000; Siqueira 1997). One-third of the total children, which represents 56 children from 16 households, are living outside the community (Table 2.1).

(Figure 2.3 is about here)

(Table 2.1 is about here)

After describing how the city of Santarém, the Gleba Ituqui, and the Patos community have emerged and populated, the next section deals with current physical infrastructure in these areas.

Physical Infrastructure

Considering Santarém an important commercial area in the Amazon, the Brazilian government's plan for Amazonian development aimed to build two roads, a hydroelectric plant, and a large port in Santarém during the 1970s. There are two main roads that cross the Santarém municipality: the Santarém-Cuiabá (BR-163) and Transamazon (BR-320) highways.

The Santarém-Cuiabá highway, built by 1976, links Santarém to southern Brazil; the Transamazon, completed in 1972, links Santarém to other areas in the north. Lack of maintenance makes access along these roads very difficult, especially in the rainy season. Santarém's port was opened in 1974. In addition to fluvial and ground transportation, the Curuá-Una hydroelectric power plant was inaugurated in 1977. The total initial capacity was 40,000 kilowatts, but only half of that is being produced at present and is only sufficient enough to provide energy to the urban area. Rural communities (approximately 32 percent of the total population) still do not have electricity. Some communities have generators, and a small number use solar energy, but the majority has no electrical power at all.

In Santarém, elementary education is primarily public (87.6 percent); only 12.4 percent of schools are private. There are 69,403 students (26.2 percent of the total population) in elementary schools, 41,269 of whom are distributed throughout 441 public schools—40 schools in urban areas and 401 in rural areas (Statistics 1996). Most rural classrooms are multigrade, students from different grades—first through fourth grades—sit in the same class with the same teacher. There are 10,206 students distributed throughout 14 high schools. There are also three universities: two private universities (FIT, Faculdades Integradas do Tapajós, and ULBRA, Universidade Luterana do Brasil) and one public university (UFPA, Universidade Federal do Pará). All of these universities opened during the 1990s.

In Santarém, health care operates at three levels: federal through the National Health Foundation (FNS), state through the Pará State Health Secretariat (SESPA), and municipal through the Santarém Municipal Health Secretariat (SESMA). There are 10 hospitals and 55 health centers (emergency rooms). Ten centers are located in urban zones and 45 in rural areas, but this is an insufficient number for the more than 400 rural communities. It is difficult for rural people to obtain health care, particularly considering the limited transportation from remote areas to the nearest health center.

Agrarian Reform and Settlement Infrastructure

In the Brazilian agrarian reform project, the National Institute for Colonization and Agrarian Reform (INCRA) is in charge of creating some of the physical infrastructure at the community level, such as elementary schools, health center, wells, and roads. In the Gleba Ituqui, most of the communities now have elementary schools (first to fourth grades), wells close to the houses, and roads that connect to Santarém. Only Santana do Ituqui has an advanced elementary school through the eighth grade and is the only community in the Gleba Ituqui that has a health center. After the completion of the Santarém-Cuiabá and Transamazon highways, several other dirt roads were built along the upland plateau areas.

The Patos community is also provided with some infrastructure, such as wells close to the houses, one school, and a road that leads to Santarém and connects with other communities of the Ituqui settlement. There is one elementary school with only one classroom, one teacher, and two periods: morning (7 a.m.—11 a.m.) and afternoon (11:30 a.m—3:30 p.m.). Students in first through fourth grades sit in the same classroom but with different assignments and books. The level of education is very low; on average, Patos residents—husbands, wives and children—attend only two years (± one year) of elementary school. Thus, the low level of education occurs across gender and ages. The new generation has no better education than their parents or grandparents; they are still attending only a few years of school and sitting in a multigrade classroom.

In Patos, there is no health center, no wells in their lots, and, as in other communities, there is no electrical power—residents use gas lamps, kerosene, or candles. They are still dependent upon firewood because only some households have gas stoves. They have no running water, and thus still depend upon river water and public wells for most household purposes such as taking a bath, washing clothes, and cooking. Because they do not have running water in the upland lots located in plateau zones (see section on Natural History and Natural Resources), local residents have continually requested that wells be dug and that roads be built across community lots in order to facilitate their agricultural work and the flow of their production.

In order to receive medical assistance, Patos villagers must go to the nearby community of Santana do Ituqui or to the city of Santarém by boat or bus. They usually have to depend on a ride from a boat owner, which is complicated in the case of an emergency. There are collective buses and collective boats from the community to Santarém. There is only one private bus company with buses that run every other day. The ticket is US$2.25 per trip and it takes three or three-and-a-half hours to arrive in the city. But in order to take the bus, a resident has to walk half an hour from his/her house to the bus stop. There are two or three available boats, and they run in shifts so that every other day there is a boat going to Santarém while the other comes back. The ticket per trip per person costs US$ 3.50 and it takes six hours to arrive in the city. Usually local residents have to stay overnight in Santarém in the home of a relative or acquaintance. Retired people go to Santarém during the first week of every month to receive their retirement income at a bank. The nearest available phone line is in the Santana do Ituqui community, which is ten minutes by boat. This is the only line in the entire Ituqui settlement and it operates on solar energy. If it is raining, the line connection is either noisy or fails to function.

The next section describes the natural environment of the Gleba Ituqui. That along with the physical infrastructure information above, will provide an excellent base for understanding patterns of the use of natural resources, which are described in subsequent sections.

Natural History and Natural Resources

Brief Overview of the Origins of the Upland and Floodplain Ecosystems

Santarém is composed of three main geological formations: the Amazonian plateau, the Tapajós-Xingú plateau, and the Amazonian floodplain. Santarém presents a rich landscape with five major types of vegetation that can be found in these different formations: floodplain forests, savannas, ecological refuges, dense forests, and open forests (RADAMBRASIL 1976).

The Amazonian plateau originated during the tertiary period (1.8 million years ago) and its soil is mostly well-drained, yellow latosol (oxisol) which allows for the establishment of savanna and ecological refuge forests. The savanna vegetation is found in harsh areas with a short dry period and poor-nutrient soils. It is typically adapted to dry and fire conditions, manifesting xeromorphism, and its reproductive strategies are dependent upon cyclical fire. Savanna varies from dense areas to more open areas with shorter trees than upland dense forest of 4 to 10 meters tall. These trees have thick bark and tortuous branches (Prance 1979). Ecological refuges are areas with a dominance of herbaceous and shrubby plants due to hard soils, and they occur in small clusters that do not occupy large areas (RADAMBRASIL 1976).

The Tapajós-Xingú plateau also originated during the tertiary period and is drained by the Curuá-Una river. The altitude varies between 120 and 170 meters and the plateau is covered by a yellow latosol soil where upland forests predominate. Because this area is formed by a flat terrain, it is called locally *platôs*. Overall, its relief is either undulating or slightly undulating (Prance 1979; RADAMBRASIL 1976). The upland forest is classified into dense and open forests and is not subjected to seasonal overflowing. The upland dense forest presents the tallest trees and a high tree density as well as high plant species diversity. According to temperature and precipitation, it is classified as moist tropical forest. According to the Holdrige life zone system, tropical moist forest is found in areas with 2,000 to 4,000 millimeters of precipitation, and a mean temperature between 24°C and 32°C (Smith 1996). The upland open forest is characterized by lower tree density with a larger community of lianas and shrub species (RADAMBRASIL 1976).

The Amazonian floodplain ecosystem is composed of two types of floodplain areas: *várzea* and *igapó*. Following the definition provided by Junk (1984) and Prance (1979), *várzea* is the area washed by white-water rivers while *igapó* is drained by black-water rivers. The formation of *várzea* (white-water floodplain) and *igapó* (black-water floodplain) is related to the fluctuations of sea level during the Pleistocene era (Junk 1984).

During the Pleistocene epoch (1.8 million to 11,000 years ago) in the quaternary period, the climate underwent extreme fluctuations from cooling temperatures (ice ages, i.e., covered by glaciers) to warming interglacial periods when the glaciers retreated (California Museum of Paleontology 1997). During interglacial periods, the sea level rose to 130 meters due to water from the great glaciers. With the increase of sea level and velocity of currents, "rivers cut deep and broad valleys in the soft tertiary sediments of the Central Amazon" (Junk 1984). By 18,000 years ago, the last sea level drop reached 130 meters below today's level (Junk 1984).

The white-water rivers convey a high sediment load from the Andes, which quickly fills the valley, thus forming large white-water floodplain areas. In contrast, clear-water and black-water rivers carry loads from the shields of the Guyanas and central Brazil. White-water is mostly composed of illite and montmorillonite, whereas clear-water and black-water consist of more sandy and kaolinitic materials. Montmorillonite has a higher ion exchange capacity than kaolinitic clay, and illite is rich in potassium; these two facts make white-water floodplains more fertile than the clear- and black-water floodplains (Junk 1984). The process of sedimentation and erosion may cause an increase of one-meter depth in topsoil per year in the white-water floodplain (Junk 1984).

The Amazonian floodplain is predominantly covered by natural grassland, and its main type of soil is sand and, less frequently, latosol. Smaller areas of floodplain are covered with flooded forest which undergoes temporary flooding, and its trees are shorter and vegetation is more homogeneous than in upland dense forest. Some areas are dominated by trees in the palm family such as *Mauritia flexuosa* and *Euterpe oleraceae*. Islands of several square kilometers may appear or disappear within just a few decades. But large areas of the floodplain are relatively stable. For example, Marchantaria Island, near Manaus (AM), is about 1,000 to 2,000 years old (Junk 1984:219).

Between Upland and Floodplain: The Ituqui Settlement

Within Gleba Ituqui, communities are located between the Tapajós-Xingu plateau and the floodplain. The former presents variation in terms of relief, type of soil, and proximity to a water course. Hereafter, the Amazonian floodplain will be treated as a <u>floodplain ecosystem</u>, and the Tapajós-Xingu plateau as an <u>upland ecosystem</u>. The upland ecosystem can be divided into two zones according to its land-use history and the altitude of relief: <u>hillside</u> or <u>bottomland</u> zone and the <u>plateau</u> zone. Likewise, the floodplain ecosystem is composed of two zones according to its land cover: a flooded forest zone and a natural grassland zone (Figure 2.4).

(Figure 2.4 is about here)

In the Santana do Ituqui settlement, while houses are distributed along a bottomland, the private forest lots are located in the plateau zone. Because of private lot distance from the houses, people do not invest much in farming systems on the plateau; they dedicate more to intensive fishing activity. The residence is close to the river. Vegetation in the bottomland is mostly, if not all, secondary vegetation in several stages of succession. Part of the land in and south of Santana do Ituqui belongs to a large-scale rancher who opened large areas of pasture in this region (figures 4.1 and 4.2).

The Cabeceira do Marajá community is situated on the bottomland with small areas of flooded forest dominated by forest palm trees. The bottomland zone is characterized mostly by sandy soil that is poor in nutrients for farming purposes. Community members engage in fishing activities and some farming, and also sell timber to logging companies.

The entire community of Serra Grande is located in a plateau zone far away from any rivers or lakes, thus they do not fish. In fact, they have to buy fish from other communities, usually Santana do Ituqui or Cabeceira do Marajá. They invest more in farming and cattle and have also sold a great deal of economically valuable timber in the past. They continue to sell timber, but much less because most of the valuable wood has been wiped out.

Pau D'Arco is the Patos community's neighbor to the north. Both are situated in an area between floodplain and upland ecosystems. However, most of Pau D'arco's lots are located on the bottomland where the soil is sandy and currently covered by secondary vegetation. It has a small portion of land located in the plateau area. Pau D'Arco residents practice fishing for subsistence, farming, and sell *açai* palm fruit on a seasonal basis. They have sold almost all of their timber.

The Patos community is also located between both floodplain and upland ecosystems. The houses are distributed along the bottomland zone. There are five private lots located in the bottomland zone, and the remaining 23 lots are in the plateau zone. Given the importance of both floodplain and upland ecosystems and their natural resources, in-depth descriptions of these ecosystems follow.

Upland Ecosystem

The upland ecosystem is characterized by dense upland forest (Prance 1969).The hillside zone is mostly covered by secondary vegetation due to its older land-use history. It is a 600-hectare strip of land 1,200 meters wide located along the river adjacent to the floodplain ecosystem, where the houses are built. The plateau zone covers 1,700 hectares and is dominated by mature forest with numerous valuable wood species (Pitt 1969; RADAMBRASIL 1976; see also Chapter 5), including a few areas from which timber has been removed and some areas of recently established farmland.

The upland ecosystem is an area of slightly undulating relief with an average altitude of 200 meters. The predominant soil type is yellow latosol (oxisol), i.e., highly acidic, nutrient-poor soils (Falesi 1974; RADAMBRASIL 1976), interspersed with patches of anthropogenic black soils (*terra-preta do índio*), which exhibit high fertility (Balée 1994; Balée and Posey 1989).

The Upland ecosystem has an important component: the secondary forests. Three main classes of secondary succession forest were identified in the Patos upland ecosystem: advanced, intermediary, and initial (see Chapter 4 for more information on description of stages of secondary successions).

Floodplain Ecosystem

In Patos, the floodplain covers 200 hectares and includes two different zones: natural grassland and flooded forest. The transition between flooded and non-flooded areas is gradual rather than abrupt.

The natural grassland covers an immense area of the floodplain during the dry season. The most common grasses in this area are: *canarana* (*Echinochloa polystacha*), *arroz bravo* (*Leersia hexisandra* and *Oriza latifolia*), *muri* (*Paspalum fasciculatum*), and *canarana da folha miúda* (*Hymenachne amplexicaulis*). Besides grasses, macrophytes such as *flor roxa* (*Eichornia zuria*), *flor amarela* (*Ludivisia sedoides*), *mureru* (*Azola sp* or *Salvinia sp*) are present. During the flood season, most of the natural grassland is under water, forming huge lakes that serve for fishing during this period.

The flooded forest zone is dominated by *açai* palm trees (*Euterpe oleracea*), which bear a fruit consumed in great quantity in the community (see Chapter 3). *Açai* palm trees grow in large clusters, forming a type of *açai* forest. It is a clustering palm that reaches a height of 18 meters or more. In Patos, the *açai* forest is native, although this species is already under cultivation commercially in other areas of the Amazon region

(Anderson 1990; Anderson and Ioris 1992; Brondízio 1999, 1996; Brondízio and Siqueira 1997). The fruit ripens and is ready to be consumed once a year between July and September, if not managed. Brondízio (1996) shows that in the Amazon estuary, local small producers harvest *açai* fruit twice a year for commercial use as a result of local forest management (see Chapter 3).

Besides *açai*, there are some other economically beneficial palm trees, such as *patauá* (*Jessenia bataua*) that provides an appreciated edible fruit, *paxiúba* (*Socratea exorrhiza*) that can be used for construction, *buriti* (*Mauritia flexuosa*) whose fruit is consumed by both local residents and fish, and *caranã* (*Mauritia Armata*) that is used for making toys and provides edible fruits. Other valuable non-palm trees are *andiroba* (*Carapa guianensis*), *ucuúba* (*Virola guianensis*), and *cupiúba* (*Goupia glabra*). All three are used for medicinal purposes. *Mandioqueira* (*Qualia albiflora*) is a valuable wood, *ananin* (*Synphonia globulifera*) is used for fixing boat and *pracuúba* (*Mora paraensis*) is used for constructing boats. There are several other important plants and trees that are not listed in the present study.

Fish and game are also found in the floodplain ecosystem consisting of lakes, rivers, and streams. There is an immense diversity of fish populations, of which a large number of species are edible and highly valued at both local and national markets. The main season for fishing, according to local fishers is the dry season, because fish are easy to catch. In fact, they fish all year long, including the flood season. Despite fishing being an important element in the local economy, it is beyond the scope of the present study, (for more information on Amazon wetlands, see Junk 1997; Goulding et al. 1996; Goulding 1980).

History of Use of Natural Resources

Local populations have been using both floodplain and upland ecosystems across time. There are some resources that can be found in both ecosystems, such as game, timber, medicinal plants, and so on. Some resources are available one part of the year in the floodplain and the other part of the year in the upland, which is the case for pasture areas for raising cattle. During the dry season, cattle graze natural grassland in the floodplain ecosystem, and move to cultivated pasture in the upland during the flood season.

At the end of the nineteenth century, through external investment, rubber (*Hevea brasiliensis*) became the most important product from Santarém (Reis 1979). A wave of migration from northeastern Brazil arrived in the region in 1877 to work in the rubber fields (Fonseca 1996; Gentil 1988). The rubber boom lasted until the early 1920s when Asian rubber production foiled the initial plan to create an industrial rubber sector in the Amazon (Fonseca 1996; Weinstein 1985).

Immediately following the rubber boom, jute (*Corchorus capsularis*) was brought from India by a Japanese agronomist in the 1930s. Following him, other Japanese families arrived to grow this crop in the Amazon. Jute was a successful commodity for approximately four decades, from the 1930s into the 1980s (Gentil 1988). A number of people from the uplands moved to the floodplain. During the jute peak (i.e., 1954) a fiber-processing plant was inaugurated. By the 1970s, Southeast Asia had again outstripped the Amazonian production of jute. Hence, prices and demand steadily dropped. As a result of both the decline of jute production and the introduction of the motor boat, fishing activity, in turn, began to take over as the main source of cash income for the local population (McGrath et al. 1993a).

Currently, there are three fish-processing plants but only one works year round; the other two function only during the catfish season (Rufino 1999). Fishing is also an important source of income among the local population, and fish are caught in both rivers and lakes. The decline of hunting and gathering and the collapse of floodplain agriculture (jute) have led to an increase of fishing in the last decades (Rufino 1999). For commercial purposes, 3,700 tons of fish in 1992 and 4,412 tons in 1993 were unloaded in Santarém, and 129 different fish species were captured and sold at the local market (Rufino 1999).

In the last three or four decades, logging has also become one of the most important industries, with a large number of sawmills in the Lower Amazon. During the period of 1990 to 1991, Barros and Uhl (1996) recorded 1,295 logging companies in the Lower Amazon of which 1,191 were small firms, 98 were medium-scale businesses, and six were large companies. Since the 1950s, the timber industry has been an important activity in the floodplain. But only in the 1970s, after the opening of federal and state roads, did logging begin to take place in the upland (Barros and Uhl 1996). Table 2.2 lists the valuable-wood tree species in the Santarém market.

Unlike other commodities that follows market tendencies, manioc flour is always a product in high demand in the local market, because it is the staple food in the region (Table 2.3). Manioc root is cultivated mainly in the upland and in some higher areas of the floodplain, where it is harvested within six months (Carneiro 1993; Futemma et al. manuscript). Traditionally, the bitter manioc root (*Manihot esculenta*) is processed into flour, which is the form in which manioc is traded and consumed. According to official records, manioc production rose from 174 tons in 1990 to 326.6 tons in 1995 (Statistics 1996).

During the 1990s, the production of some annual crops, such as beans, corn, and tomatoes has steadily increased as well as that of some permanent plants, such as coffee, oranges, bananas, cacao, papayas, and mangoes (Statistics 1996). Although coffee production has increased—from 484 tons in 1990 to 962 tons in 1995— it still cannot meet the local demand; in other words, most coffee as well as several other products, are still imported from the southern states of Brazil (Table 2.3).

Animal production, such as cattle and chicken, also increased between 1990 and 1995 (Statistics 1996). The number of cattle rose from 299,874 in 1990 to 405,500 in 1995; chickens increased as well from 925,310 in 1990 to 1,331,800 in 1995. Cattle and chicken production is geared toward the Lower Amazon market.

Extractivism of some forest products such as *açai* (see chapters 3 and 5 for more on *açai* harvesting and regulations) has slowly increased while other products, such as charcoal, firewood, and timber, have fallen in recent years, according to official reports (Statistics 1996).

(Table 2.2 is about here)

(Table 2.3 is about here)

Today, the economy relies heavily on agricultural, fishery, and forestry products. Some commodities and goods come and go by ground transportation but most are transported by boat. Local rural producers usually buy and sell their goods and commodities in the Santarém local market. Most trade occurs in the form of face-to-face transactions. Producers also trade by exchanging products rather than paying in cash.

Current Patterns of Use of Natural Resources: The Patos Case

Both upland and floodplain ecosystems are characterized by different resources, and the patterns of how local people use them vary also. Analysis of rights and duties to main resources from the upland and bottomland ecosystems will be addressed in Chapter 6.

Upland Resources

Types of resources vary from the bottomland zone to the plateau and according to season. The bottomland zone has a long-term history of land use for agricultural purposes (annual crops and pasture area) as opposed to the plateau zone, where the exploitation has been more recent. In fact, since the privatization process in 1986 (see Chapter 3), local residents have been using the plateau more intensively than the bottomland zone for farming purposes due to impoverishment of the hillside soil and its occupation by houses.

Besides agriculture, local residents use these areas for hunting, logging, collecting raw material for domestic consumption (poles, firewood, palm leaves for walls and roofs, among others), and gathering wild fruits (e.g., *piquiá* and *uxi*).

Annual Cropping

Despite its sandy and nutrient-poor soil, local residents have used bottomland intensively to grow crops. The bottomland has a favorable environment: it is close to the river and lakes that provide water for both farming purposes and transportation. Manioc roots are commonly soaked in water for at least two to three days in order to be peeled and made ready for toasting as flour. In addition, before opening roads and highways, local rural people had to travel to the urban center by boat. Even today, they travel and transport their goods and commodities primarily by boat. These two facts explain why residents have used these areas that today are predominantly secondary vegetation with poor soil, as described in the previous section.

The plateau has been more recently exploited for growing annual crops. There are spots of black soil randomly distributed, called locally *terra preta do índio*, which is a very fertile soil. Lack of water is the main environmental constraint faced by local producers at the plateau zone. It is likely that this factor has been restricting locals from exploiting this land at larger scale (see Chapter 4 for more discussion on patterns of land use). Similar to bottomland, they grow primarily manioc (*Manihot esculenta*) and corn (*Zea mays*), and secondarily beans (*Phaseolus spp*) and rice on the plateau soils.

Local farmers practice the traditional shifting cultivation system. A farmer opens up an area by removing trees and other big plants such as vines and shrubs. After removing the vegetation, a farmer burns the area. Burning usually takes place on a hot and dry day during a period close to the rainy season—October and November—(Figure 2.5). Burned trees are frequently left in the field. The next step is to plant. While corn is grown from seeds, manioc is started from cuttings (parts of stems or stalk). Sowing takes place between December and January. After planting, a farmer may remove weeds one or two times during the season. Corn can be harvested after three months and manioc after at least one year. Regularly, corn and manioc are cultivated in the same field—

intercropped—by alternating rows of corn and manioc. Corn is not replanted again until the manioc is harvested, because the former needs sunlight to grow.

After harvesting all the crops, the field is left fallow for four to ten years, or more if it is a sandy soil and for only two years if it is a clay soil. Farmers clear both secondary and mature forests. They prefer to grow manioc, rice, and beans in secondary forest with sandy soils. In contrast, corn grows well in clay soils in both secondary and primary forest. The majority of farmers opened advanced secondary succession (71 percent of Patos farmers) in comparison to 18 percent who opened mature forest, followed by 11 percent who used initial secondary forest (young fallow).

(Figure 2.5 is about here)

Cultivated Pasture

Cultivated pastures were created in the region after the 1970s with tax holidays[2] and the Brazilian government's incentives to raise cattle. The first pasture areas in the Patos community were opened in 1992 and 1993 in the bottomland zones due to easier accessibility to water. To open a pasture area, a rancher first cuts down trees and any other medium- or large-sized plants, then burns them. For pasture purposes a rancher removes all the trees left in a field after burning. Cattle graze in the same upland field for six months during the flood season (January-July), and the field is left fallow for the other six months during the dry season (June-December), when cattle graze in the natural grassland of the floodplain. By shifting grazing fields every year, grass vegetation from both areas, upland and floodplain, can recover during the six months of fallow.

Timber

Economically valuable woods were long ago stripped from the bottomland zone. However, due to its unaltered conditions until few years ago, numerous marketable wood trees are still left in the plateau zone.

Because of its valuable trees (Table 2.2), logging has been an important activity for regional and local economy since the 1960s (Barros and Uhl 1996). Landholders from Patos simply sell the timber, because logging companies are in charge of cutting down trees and removing them from the forest plot to the sawmills. Extraction usually takes place during the dry season (July-December) when road conditions are better.

Frequently, these companies do not pay cash for a tree. They pay in different forms: helping local residents clear an area, carrying water, providing health assistance, providing cash loans, and mainly opening roads for them. In the beginning of the 1990s, a number of landholders in the Patos community reported that they sold timber in exchange for opening feeder roads across the community.

Non-Timber Products

Game is another important resource sought by Patos residents for their own consumption. They hunt in both bottomland and plateau zones all year long. The number of species and the size of individuals are larger in the upland mature forest than in the bottomland secondary forest (Table 2.4). Hunters use dogs to search for game and shotguns to kill the game. The main sources of protein for residents are game and fish (see Floodplain Resources).

Other valuable products in the upland mature forest—nowadays found only in the plateau zone—are *piquiá* (*Caryocar villosum*) and *uxi* (*Endopleura uxi*), delicacy fruits that residents consume and trade. They try to keep these trees undisturbed when clearing and/or burning. The *piquiá* trees produce fruits from January through March, and the *uxi* produces in March and April (Figure 2.5). According to residents, the quantity of *piquiá* and *uxi* fruits produced each year varies moderately. They simply pick those fruits from the ground once ripe. *Piquiá* is cooked before consumed, whereas *uxi* can be eaten as raw fruit.

Local residents still rely largely on domestic medicines—from both plants and animals—to cure some diseases. Moreover, they use different species of vines to make rope, baskets, and other products. In the bottomland, they collect palm leaf, which grows only in specific habitats and which is used for the construction of house roofs and walls. These raw materials are available throughout the year.

Floodplain Resources

The three main resources from the floodplain are natural grassland, fruit palm trees, and fish. Because of seasonal inundation of the floodplain, all of these products are available on a seasonal basis.

The Natural Grassland

The natural grasslands feed cattle only during the dry season (July-December). In the floodplain's natural grasslands, the cattle graze freely during the day and are kept in corrals during the night. During the day, cattle from all households graze together in the same area and are usually kept in the same corral. Owners take turns (shifts) tending the cattle on a daily basis. There is no management of this natural grassland; it recovers after every flood season. There is also no fence that delimits the grassland area for each household or even between communities (see Chapter 6 for issues on rights and duties to natural grassland).

The Açai *Palm Fruits*

Açai, Euterpe oleracea, usually lasts only a few months from August to November each year (Figure 2.5). The common name is derived from a thick drink that is a delicacy among local people. To harvest the fruit, a person needs to climb up to the top of a stem (18 to 20 meters high) and bring down the bunch of fruits, which may weigh about two kilograms. After harvesting it, they pick only the fruits and either sell them or prepare the juice for their own consumption. The fruit is only good for 24 hours, so it must go to market or be consumed very quickly, otherwise it becomes spoiled.

Açai trees grow in clumps, and the estimated density in Patos varies from 444 to 548 clumps per hectare with an average of 1,120 stems per hectare. These figures are similar to other areas in the Amazon for non-managed forests (Hiraoka 1994; Jardim and Kageyama 1994). Brondízio (1996) found that clump density can increase up to 50 percent in managed areas. In his study in the estuary, some sites present more than 800 clumps and 3,000 stems per hectare (Brondízio 1996). The residents of Patos practice no management techniques to enhance its productivity.

Other Floodplain Products

Fishing in the flooded forest is practiced more frequently during the flood season (January to June) when fish can migrate from the lakes and rivers to small streams across the flooded forest. Residents catch fish for their own consumption.

They also harvest medicinal plants—bark, fruits, and seeds. One important seed that was formerly sold in the market is *andiroba* (*Fevillea trilobata*); but, probably due to its drop in price, they do not trade it as much as before. They also hunt in this area (Table 2.4), but less often than in the upland forest. They used to cut valuable floodplain trees, but few of them are left in the area.

Final Considerations

Santarém is characterized by a mosaic landscape with diverse ecological systems from floodplain to upland. Local rural people exploit such varied natural resources in order to provide products for both local consumption and market demand. Thus, alongside this complex ecological system a complex sociopolitical structure and economic system has developed among these rural peasant populations. The maintenance of such a rich environment for the purpose of guaranteeing their own survival has opened space not only for self-governance but also for social conflicts (see chapters 4, 5, and 6).

The next chapter covers three main sociocultural aspects of peasant livelihood. First, it describes the household structure and the strength of relationships among members within and between households. Second, it focuses on household economy, describing its mode of production and dependence on natural resources. Finally, it describes Patos residents' livelihood beyond household domain, in a community-based sociopolitical organization.

Endnotes

[1] The Lower Amazon encompasses the following counties: Almerim, Oriximiná, Óbidos, Monte Alegre, Alenquer, Terra Santa, and Prainha.

[2] Tax holiday: tax exemptions for a grace period of time in every capital return. In the Amazon, this period was between 10 and 20 years (Moran, 1981).

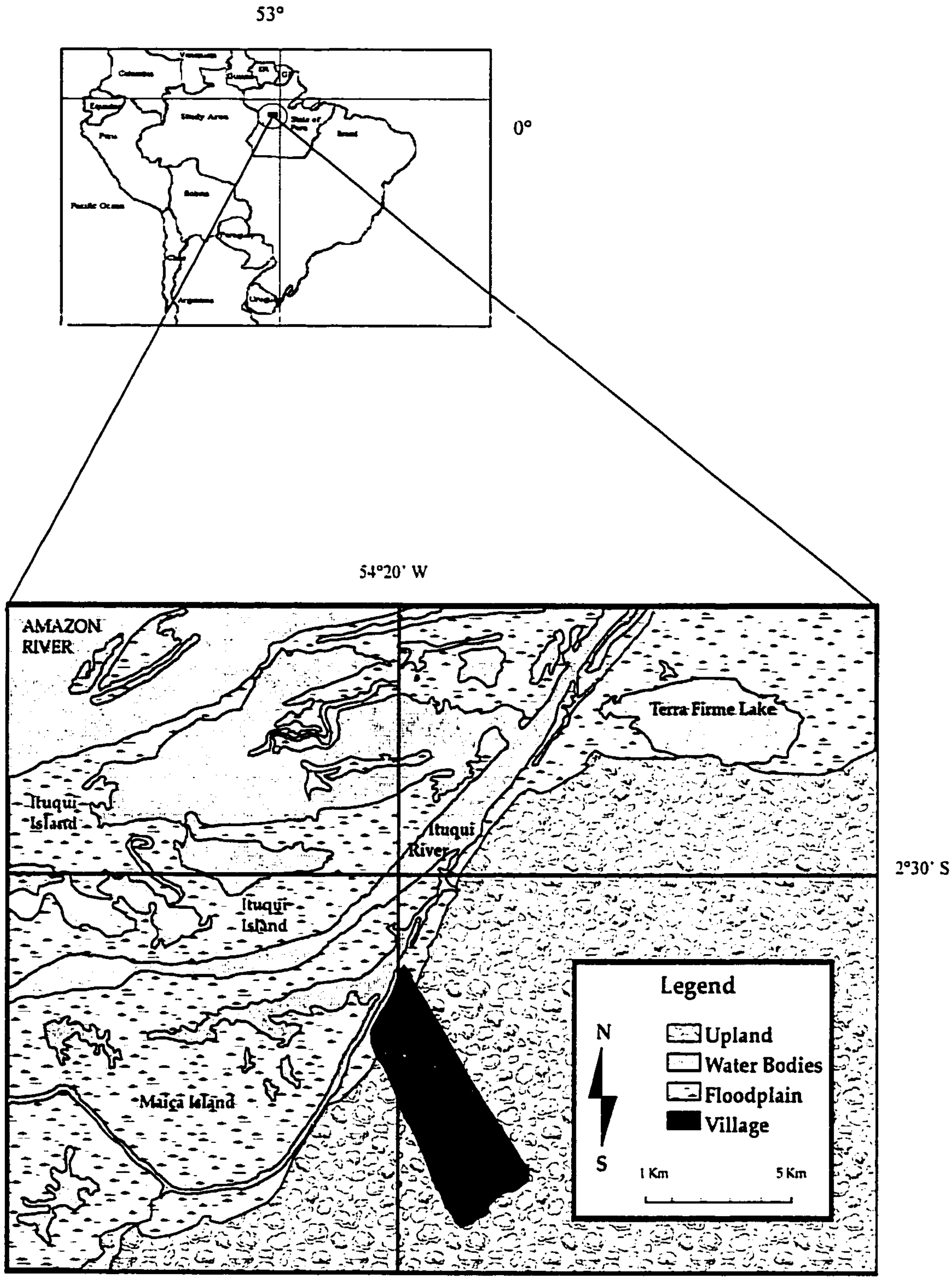

Figure 2.1. Map Depicting the Area of the Patos Community (at the bottom), Located in the State of Pará within Brazil and South America (at the top left), 1998

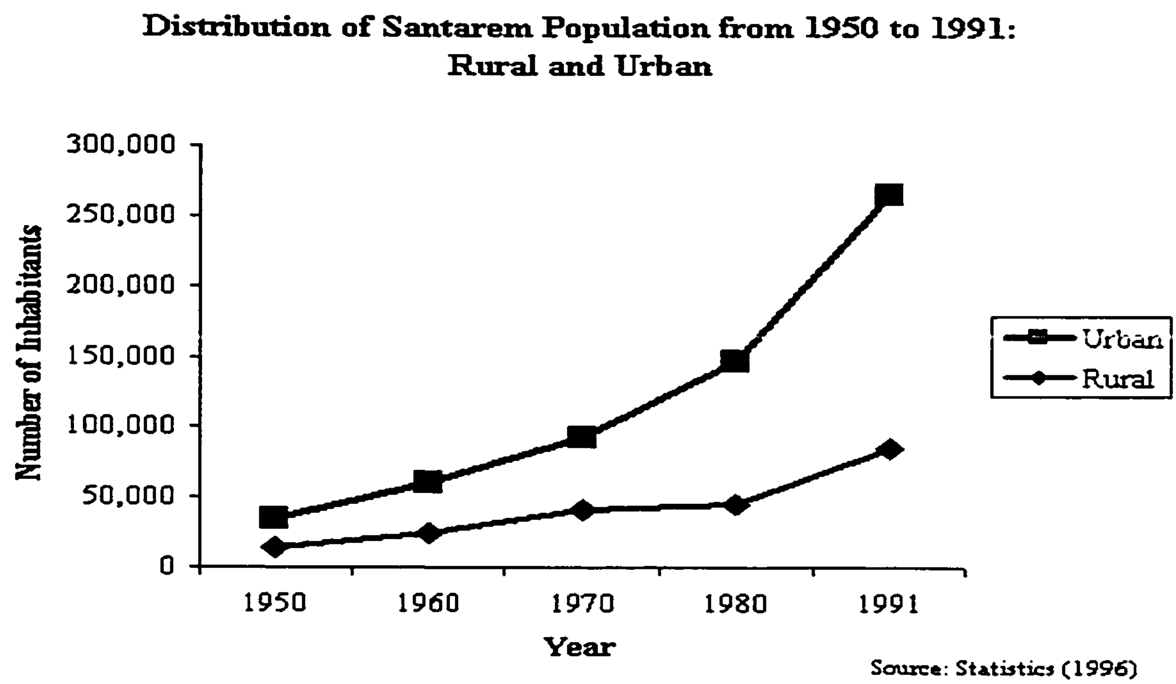

Figure 2.2. Distribution of Rural and Urban Populations in Santarém from 1950 to 1991

Figure 2.3. Distribution of People Who Live in the Patos Community by Sex and Age (data collection: 1997)

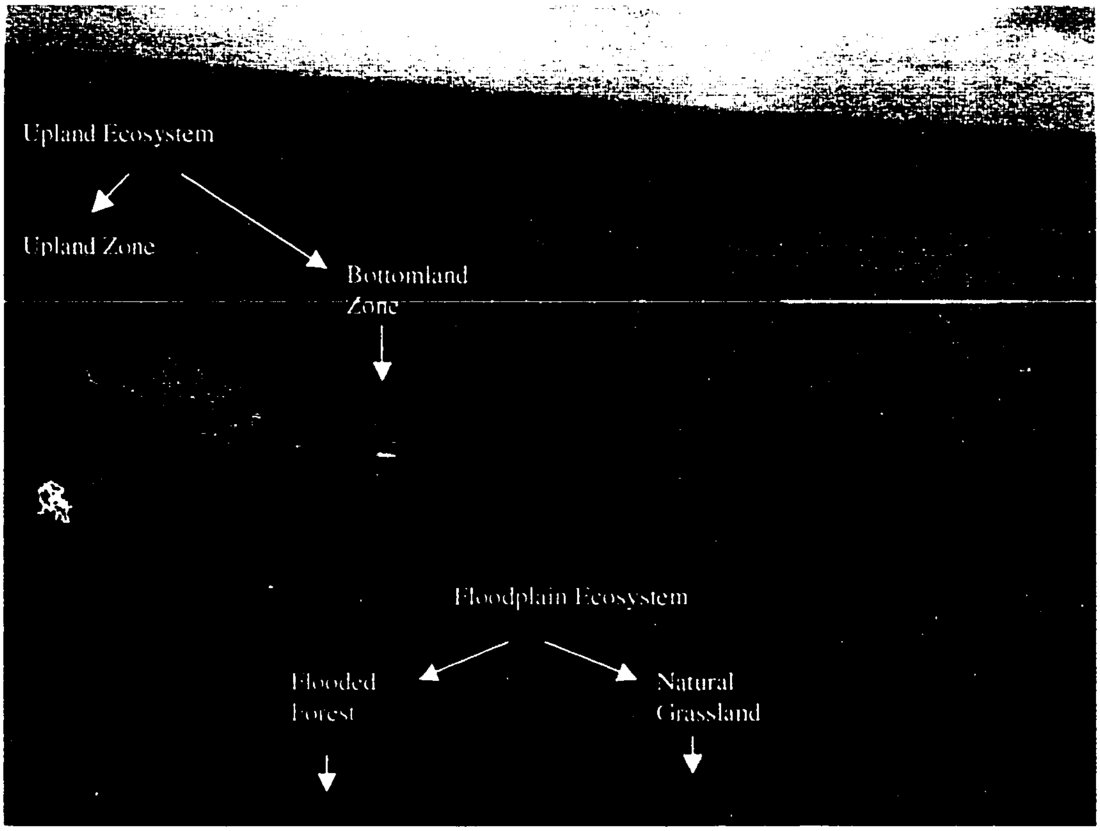

Figure 2.4. Aerial Overview of Ituqui Landscape. At the top left, the upland ecosystem is composed of upland forest and bottomland. Bottomland is considered part of the upland ecosystem because it is located at an intermediate level and does not get flooded. At the bottom, the floodplain ecosystem is composed of *açai* forest and grassland. On the right is the Ituqui River. Santarém, state of Pará, Brazil (July 1997, end of flood season).

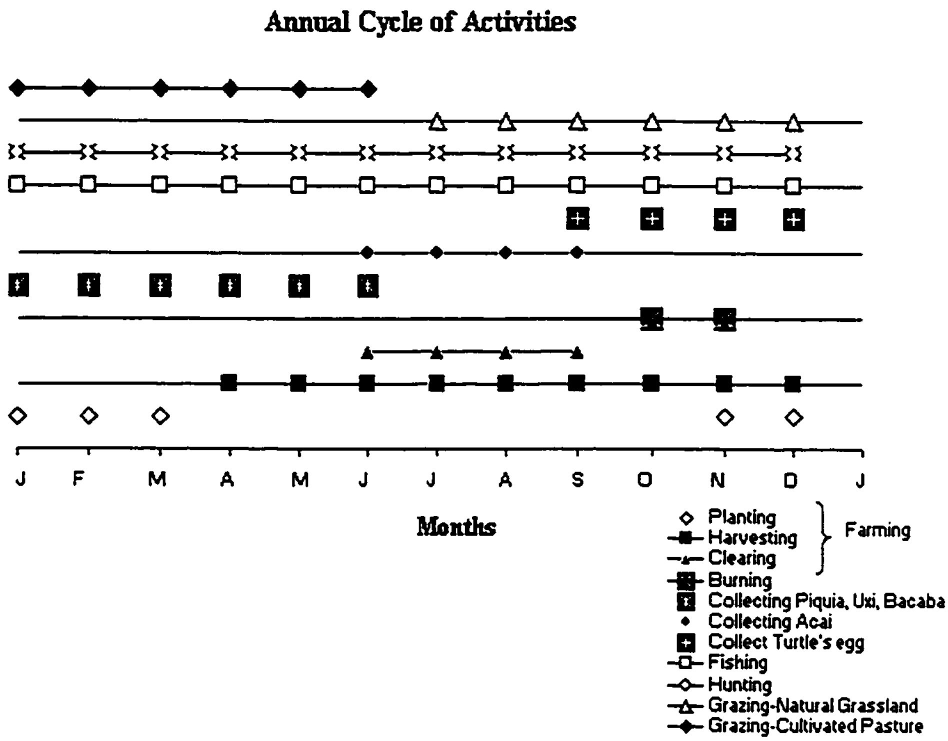

Figure 2.5. Distribution of Economic Activities All Year Long from Agricultural Tasks to Harvesting Work in the Patos Community

Table 2.1. Population Data for Children in the Patos Community

Demographic Characteristics	Average (Std Dev)	Frequency	Percent (%)
Frequency of Children Outside Community	-	56	30
Frequency of Children Inside Community	-	132	70
Total Frequency of Children		188	100
Frequency of Female Children over 18	-	16	12
Frequency of Male Children over 18	-	14	11
Frequency of Female Children under 18	-	58	44
Frequency of Male Children under 18	-	44	33
Total Frequency of Children Inside Community	-	132	100
Average of Children per Household (n = 33)	5.6 (± 3.2)	-	-

Table 2.2. List of Valuable Wood Tree Species in the Santarém Market

Scientific Name	Local Name
Bertholetia excelsa	Castanha-do-Pará
Carapa guianensis	Andiroba
Caryocar villosum	Piquiá
Clarisia racemosa	Guariúba
Couratarìa oblongifolia	Tauari
Goupia glabra	Cupiuba
Hymenea courbaril	Jutai-acu ou jatoba
Jaracaranda copaia	Caraúba ou parapará
Manilkara huberi	Maçaranduba
Qualea paraensis	Quaruba or Mandioqueira
Sclerolobium paniculatum	Taxi-pitomba
Simaruba amara	Marupá
Tachigalia myrmecophyla	Taxi-preto
Tetragastris altissima	Breu-sucuruba
Vochysia guianensis	Quaruba-tinga
Vochysia maxima	Quaruba verdadeiro
Virola michellii	Ucuúba preta

Table 2.3. Santarém Production during the 1990s

Products	1995	1994	1993	1992	1991	1990	Purposes
<u>Annual</u>							
Beans	7,328	5,137	4,474	4,521	6,556	6,612	Local
Manioc	326,600	306,000	235,250	236,850	200,900	173,900	Local
Corn	57,115	33,850	36,500	27,620	36,065	28,745	Local
Rice	26,870	23,850	26,880	7,820	21,850	13,896	Local
Tomato	1,928	1,883	1,654	1,490	820	607	Local
<u>Perennial</u>							
Coffee (ton)	962	962	959	829	677	484	Local
Black Pepper	1,317	1,320	1,234	382	5,469	5,828	Export
<u>Animals</u>							
Fish	md*	md	md	md	md	md	Local/Export
Cattle	405,500	403,000	386,262	369,450	327,067	299,874	Local
Chicken	1,331,800	1,229,200	1,116,625	1,030,380	964,225	925,310	Local
Pork	76,200	86,700	99,195	96,750	93,135	90,318	Local
<u>Extractivism</u>							
Açai (ton)	58	58	49	37	48	50	Local/Export
Charcoal (ton)	990	1,100	1,222	1,316	1,322	1,262	Local
Firewood(m^3)	362,000	390,000	452,000	535,720	587,820	580,000	Local
Timber (m^3)	93,200	120,826	66,280	55,970	50,322	57,498	Local/Export
Aromatics and Medicines		10	12	17	21	20	

*md = missing data

Table 2.4. List of Game in the Patos Community, 1998

Scientific Name	Local Name	Diet	Other Uses	Hunting Season	Habitat
MAMMALS					
Alouatta seniculus	Guariba	Fruits, aracnids, insects	Food	Flood Season	Flooded Forest and Upland Mature Forest
Aotus nancymae	Macaco-da-noite	Fruits	No	Flood Season	Flooded Forest and Upland Mature Forest
Ateles paniscus	Macaco-aranha	Fruits	Food	Flood Season	Flooded Forest and Upland Mature Forest
Cacajao calvus	Uacari		Food	Dry Season	Flooded Forest and Upland Mature Forest
Cebus apella	Macaco prego	Fruits, aracnids, insects	Food	Flood Season	Flooded Forest and Upland Mature Forest
Lagothris lagothrica	Macaco-barrigudo	Fruits	Food	Flood Season	Flooded Forest and Upland Mature Forest
Mazama americana	Veado-mateiro		Food	Flood Season	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest
Mazama gouazoubira	Veado-catingueiro	Roots, fruits, palm heart	Food	Flood Season	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest
Mazama spp	Veado Branco	Roots, fruits, palm heart	Food	Flood Season	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest
Mazama spp	Veado Roxo	Roots, fruits, palm heart			
Saguinus spp	Sagui	Fruits, seeds	Food	Flood Season	Flooded Forest and Upland Mature Forest
Saimiri spp.	Macaco-de-Cheiro	Fruits	Food	Flood Season	Flooded Forest and Upland Mature Forest
Tayassu peccari	Queixada	Fruits, roots, leaves, and seeds	Food	All Year	Flooded Forest and Upland Mature Forest
Tayassu tajacu	Cateto	Fruits, roots, leaves, and seeds	Food	All Year	Flooded Forest and Upland Mature Forest
RODENTS					
Agouti paca	Paca	Fruits, seeds, roots	Food	All Year	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest
Dasyprocta fuliginosa	Cutia	Fruits	Food	All Year	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest
Hydrochaeris hydrochaeris	Capivara	Grasses, seeds	Food	All year	Floodplain grassland
Tapirus terrestris	Anta	Fruits and leaves	Food	All Year	Flooded Forest, Upland Mature Forest, and Young and Advanced Sec. Forest

Table 2.4. (cont'd)

Scientific Name	Local Name	Diet	Other Uses	Hunting Season	Habitat
DIDELPHIDAE					
Myrmecophaga tridactyla	Tamanduá-bandeira	Ants and termites	No	-	Upland Mature and Young and Advanced Forests
Tamandua tetradactyla	Tamanduá-mirim	Ants and termites	No	-	Upland Mature and Young and Advanced Forests
Bradypus variegatus	Preguiça	Leaves (embaúba)	No	-	Upland Mature and Young and Advanced Forests
Priodontes maximus	Tatu-canastra	Worms and termites, fruits	Food	All Year	Young and Advanced Secondary Forest
Dasypus novemcinctus	Tatu-galinha	Worms and termites, fruits	Food	All Year	Young and Advanced Secondary Forest
Unknown	Tatu-utinga	Worms and termites, fruits	Food	All Year	Upland Mature and Young and Advanced Forests
Unknown	Tatu-rabo-de- couro	Worms and termites, fruits	Food	All Year	Upland Mature and Young and Advanced Forests
Unknown	Tatu grande	Worms and termites, fruits	Food	All Year	Young and Advanced Secondary Forest
CHELONIDAE					
Podocnemis expansa	Tartaruga da Amazônia		Food	Dry Season	Beach (dried lake)
Podocnemis unifilis	Tracajá		Food	Dry Season	Beach (dried lake)
Podocnemis sextuberculata	Pitiú or Iaca		Food	Dry Season	Beach (dried lake)
Podocnemis erythrocephala	Irapuca		Food	Dry Season	Beach (dried lake)
BIRDS					
	Patos	Fish	md*	md	md
	Carará	Fish	md	md	md
	Meiuá	Fish	md	md	md
	Mauari	Fish	md	md	md
	Garça grande	Fish	md	md	md
	Cueireiro	Earthworm	md	md	md
CANIDAE					
Nasua nasua	Quati	md	md	md	md
Potus flavus	Jupará	Fruits, mammals, rodents	md	md	md
Eira barbara	Irara	Fish	md	md	md
Lutra longicaudis	Lontra	md	md	md	md
Felis spp.	Jaguatirica/gatos	Mammals, rodents, birds	md	md	md
Puma concolor	Puma	md	md	md	md

*md = missing data

Chapter 3

THE *CABOCLO RIBEIRINHO* HOUSEHOLD AND COMMUNITY ORGANIZATION

Introduction

The main focus of this chapter is to describe household attributes among *caboclo ribeirinhos* from the Patos community and the local organization at the community level. Household is usually the basic social unit among peasant societies where decision making, production systems, and social reproduction take place (Chayanov 1986; Netting 1993; Netting et al. 1994; Wilk 1991, 1984). In the Amazon, several studies have indicated household as the basic social unit among native peasant populations (Chibnik 1994; Futemma 1995; Lima-Ayres 1992). Households may differ in their composition, structure, and function within a community.

Within a household unit, members are usually blood-related and work together in production systems such as agricultural tasks and small livestock (division of labor), they share information such as farming techniques and knowledge about the surrounding natural environment, and they pass down material assets, e.g., land, from one generation to the next.

Individuals from different households and within the same community may share kin relations or any other strong social bonds that contribute to enhance their livelihood. Households exchange labor and/or products, they work together in order to build community infrastructures such as soccer fields, churches, maintenance of dirt roads, and participating in political organizations.

Social connections created within and between households, in fact, contribute to build social capital among these rural small producers through trust and reciprocal exchange of material and information. Reliance among individuals within a social network is enhanced by building a common sense of commitment and responsibility toward one another (see chapters 4 and 5 for more information on social capital). Households help each other during hardship periods such as shortage of food due to loss of food production or health problems. Such social bonds among households contribute to form community cohesion (Lima-Ayres 1992).

Despite social connectedness and presence of group-oriented activities, households within a community may differ economically, socially, and politically. In Patos' case, households vary in several aspects: religion, household composition and size, labor availability, source of income, gender, political participation, and access to natural resources. These variations among households affect local social-political organization (chapters 4 and 5), pattern of exploiting natural resources (chapters 4 and 5), and control over these resources (Chapter 6).

This chapter has three main goals: (1) to describe *caboclo* cultural background; (2) to characterize household attributes from their structures to their economic aspects; and (3) to describe community social-political organization.

Data Collection

Household surveys were conducted during two periods: between June and August of 1997 and between August and November of 1998. The main purposes of these surveys were four-fold: (1) to collect data on social-economic attributes of all households; (2) to collect institutional data on governance of forest resources at household level; (3) to gather information on local political organization; and (4) to gather data on social structure such as kinship, co-parenthood, and acquaintance relationships within and between households.

In order to fully understand social-economic and political dynamics within both household and community, a total of 33 households were interviewed. Besides household surveys, group interviews were conducted through community-based meetings as well as smaller groups in order to gather information on social bonds, community political organization, collective events, and group-based management of floodplain resources.

Caboclo[1] Cultural Background

Two hundred years ago, a new people emerged in the Amazonian region out of the Directorate[2] system from 1757 to 1798 (Parker 1985). This population, called *caboclos*, originated primarily from miscegenation of Iberian and Amerindian people and the contact of native and European cultures (Wagley 1985; Parker 1989, 1985; Ross 1978). By the nineteenth century they dominated the Amazonian scene (Parker 1985). Other ethnic groups were later incorporated into this new peasant category, such as African slaves and northeastern Brazilians (Parker 1985; Wagley 1985; Weinstein 1985). Therefore, the physical traits of Amazonian native people were no longer limited to straight dark hair and brown skin. Rather, after the rubber boom, this Amazonian rural people resembled any group of Brazilians: brown, black, white, and any mixture thereof (Wagley 1953; Weinstein 1985).

The *caboclos* occupy a large extent of upland and floodplain environments, while

Indians are found mostly in the upland (Parker 1989). Those who live in the upland rely more on forest resources than their counterparts in the floodplain. Others live in an ambient between floodplain and upland, which is the case of the Patos community where local residents rely upon both upland and floodplain resources. While *varjeiro* is the term used by some local people who live in the floodplain (*várzea*) to identify themselves (Lima-Ayres 1992), *ribeirinhos* is the term used by those who live in the area between upland and floodplain.

Portuguese—the Brazilian national language—is spoken by the *caboclo* people, but their vocabulary presents terms and phrases borrowed from Língua Geral.[3] As with the Portuguese spoken by *caboclos*, the "folk" Catholicism practiced by rural Amazonians has incorporated many indigenous beliefs and concepts, most of which are of Tupian origin (Parker 1985:xxvii). They also practice shamanism and believe in animal spirits (Wagley 1985, 1953; Galvão 1951). Parker (1985) believes that the persistence of these indigenous elements in local Catholic thought is linked to the fact that these native peasants still live in a forest-riverine environment that is very similar to that of their Amerindian ancestors.

The dominant religion in the Patos community is also Catholicism, which is the official religion in Brazil. In Santarém county, the first church was built back in 1761 and named after the patron saint of Santarém, Igreja de Nossa Senhora da Conceição. Today there are numerous churches throughout urban and rural areas.

The Patos religious life, in fact, is based on both Catholic and Evangelical Churches. The Evangelical Church has been steadily growing over the past 20 years in both urban and rural areas (Parker 1985). Many rural communities throughout Santarém have both Catholic and Evangelical churches. Almost 80 percent of the Patos households still practice Catholicism. But since 1991-1992 when the Evangelical Church entered the community, five households have converted to the Evangelical religion (Table 3.1). There are three households in which spouses belong to different churches; the wives became Evangelic, and the husbands are still Catholic (see section on The Churches and the Sociopolitical Roles in this chapter).

(Table 3.1. is about here)

Due to a lack of enough priests to attend to all rural communities in Santarém, local residents are trained to conduct their own mass on a weekly basis and are the religious leaders of the community (Table 3.1). Catechists, the Catholic religious leaders at community level, catechists, also play important political roles in facilitating social mobilization and organization (see Chapter 4 or 5). There are both Catholic and Evangelic churches where followers meet. The Catholic church was built by local Catholic followers through a collective action (see Chapter 4 for more details on collective effort). In some cases in the Amazon, religious differences have divided *caboclo* communities into two or three groups, affecting the political, economic, and social life of these people (see Lima-Ayres 1992; Galvão 1951). Although there exist differences in religion in Patos, members from both Catholic and Evangelical beliefs are still trying to work together and collaborate with each other, including in the political arena.

Formation of the *Caboclo* Household

The roots of social organization of *caboclo* society also go back to the Directorate and Mission periods. The *caboclo* household unit is based not only on the nuclear family, but through history one can observe the existence of intermediate forms of the household between communal organization and the nuclear family (Lima-Ayres 1992).

The Mission (from 1700 to 1755) and Directorate (1757 to 1798) periods are key for the understanding of the *caboclo* social structure, in that they accommodated the Amerindian ancestors who gave rise to the contemporary *caboclo*. In addition, they represent the time when the conquerors and missionaries, especially Jesuits, started to use the Indians as a labor force that no longer consisted of slaves, but of individuals who earned very low salaries (MacLachlan 1973).

During the Mission Period, indigenous men, women, and children over 13 years old were part of the labor pool, although the majority of the labor force was male (MacLachlan 1973). According to Parker (1989), during the Mission Period the Indians were converted from subsistence to commodity producers. The Indians collected forest products for the Jesuits, who in turn traded them. Parker (1989) also indicates that during the Mission Period Indians still retained traditional cultural traits such as their tribal organization, kinship system, leadership, and ceremonies.

Similarly, in the Directorate Period, indigenous women, men, and children were employed as laborers.[4] Under the Directorate, major changes took place among Amerindians, including some changes in traditional socioeconomic life. Goods were exchanged between individual Indians and the local traders. This contributed to the deterioration of tribal existence from extended family kinship arrangements to simple and isolated nuclear family arrangements (Parker 1989). MacLachlan (1973) goes further by saying that the nuclear household was the most adaptive unit of social organization in the extractive economy of colonial times.

However, Parker (1989) points out that *aldeias* (villages) still exist today that are smaller in size than *caboclo* hamlets, a number of which are the *sedes* (seats) of *municípios* (counties). He also believes that a regional economy based upon the extraction of material resources reinforced the diffused and isolated pattern of small communities that characterizes contemporary *caboclo* settlements (Parker 1985:xxi). Nevertheless, Parker (1985:xxi-xxii) is convinced that *caboclos* are the result of the detribalization of Amerindians, evincing the destruction of communal Indian organization. Such a community life was seen by the Catholic missionaries as "primitive" and lacking organization (Maués et al. 1968:31).

Neither the complete dissolution of indigenous community organization nor the rise of a solely nuclear family took place. If one carefully analyzes *caboclo* social organization, it is not reduced to a simple nuclear family. In other words, they continue to have a communal organization to a certain extent, even though it might be smaller and less corporate than in the past (Futemma 1995). They are not completely isolated either, as has been claimed by some authors (Parker 1989; Wagley 1953).

In the Lower Amazon Basin, the household structure is composed of the nuclear family, the extended family, and other intermediate forms (Futemma 1995), with the inclusion of "fictive" kin (by co-parenthood). As Lima-Ayres (1992) points out, there exist also strong relationships between and within households through the kinship system.

Such relationships among households create a bonding system that characterizes most of the *caboclo* communities. A concept of community is provided by Gentil (1988:152) and Lima-Ayres (1992) in their belief that the contemporary community organization, or the concept of a community, was imposed upon Amazonian *caboclo* societies during the 1980s through the MEB, a Brazilian institution that took care of education at the county level. "Community" was not a term of reference used by the *caboclo* before the advent of the Movement for Brazilian National Education (MEB). Through this program, some communal organization was installed, involving the introduction of such institutions as the Catholic Church, small stores (*revenda* or *taverna*), the mothers' association (*Clube de Mães*), and the health center (*Casa de Saúde*) (Lima-Ayres 1992; Gentil 1988). In fact, according to Wagley (1953), community organization already existed when the MEB first arrived at the *caboclo* settlements. Thus, in general, the MEB did not create community organization, but rather institutionalized it.

Household Structure

Thirty-nine families live in the Patos community, where some families own private land (smallholder) and others have no land at all (landless) (see Chapter 5 for more details on categories of households based on land tenure). Despite living in separate homes, some families conduct agricultural activities on the same land, and they sometimes share tasks and pool output. Also, some families joinly make decisions about various issues, such as determining how to use a piece of land and regulating forest products together. The Patos families can be grouped into 33 households units, considering the following criteria: degree of social relationship and economic functions such as production and consumption, composition, and decision making. Families that are related on a first degree of consanguinity, cultivate together, share production output, and make decisions conjointly are considered members of the same household unit.

Five landless families share their livelihood closely with their landowner relatives. Landless families will be described in more detail in the next chapters, but it is worth mentioning here their unique situation in the sociocultural context of the Patos community. Landless and landowner families are usually kin-related to a variety of degrees and they historically carry out several functions together on a community (see next sections in this chapter) or kindred (groups of kin-households) basis. Hence, landless families here do have access to natural assets, such as land and game in the property of their landowning kin (see Chapter 6 for analysis of the relationship between social ties and access to forest products).

There is one household that is an outlier in comparison to other Patos households for a number of reasons. Its members (husband, wife, and three adolescent children) are outsiders who came from Santarém city and whose head is a mid-scale rancher. They own more than 50 cows and two pieces of private land. One private lot is located at the Maicá region (nearby Patos) and the other, in the bottomland zone of the Patos community. They have been living in Patos since the beginning of the 1990s but they have no kin relation to any other households. It is likely that they introduced the Evangelic religion into Patos upon their arrival. The most distinctive attribute of this household refers to the fact that they wanted to purchase the floodplain area. Thus, they were one of the main reasons why some households decided to organize and purchase the floodplain area (see Chapter 5 for detailed discussion on local organization and collective appropriation of the floodplain ecosystem). Therefore, for the purpose of analysis, only 32 households will be analyzed, and this outsider and mid-scale rancher household will be treated as a separate "group" of households (see Chapter 5 for groups of households).

Types of Households

The *caboclo* household may be organized in intermediate social forms—between nuclear family and community, as previously described—such as extended or multiple families, including relatives and non-relative members who live under the same roof (co-residents). In the Patos community, three major categories of households were identified (Table 3.2): solitary, single family or conjugal family unit (CFU), and extended family. A solitary household is composed of only one member. A single-family or CFU household is composed of only one nuclear family, either a married couple or widower/widow with or without children. The third category refers to the extended family household, which is either composed of more than one nuclear family or a widower/widow with married children, or one CFU plus other members such as an adopted child (*filho-de-criação*, see below).

(Table 3.2 is about here)

Table 3.2 shows that more than half of the community is composed of single-family households, with a high frequency of nuclear family (one married couple with children) that represents 46.9 percent of all of households. Another trait is the presence of eight widows, some of whom who live with their married children or adopted children, forming both CFU and extended-family households.

Approximately one-third of the households (24.8 percent) are represented by an extended family; it is mixed category with married children, adopted children and single parents. There are seven households (21.7 percent) where parents are in charge of these adopted children.

Adopted children, who are designated locally "*filho de criação*" (male adopted child) or "*filha de criação*" (female adopted child), are commonly found within *caboclo* communities (Gentil 1988; Nugent 1993; Wagley 1953). The *filho de criação* contributes a great deal to the maintenance of the household economy. He or she is usually a grandchild, nephew, or niece whose parents are not capable or available to raise a child. There exists a mutual commitment between *filho de criação* and adoptive parents. On the one hand, s/he takes care of his/her elderly adoptive parents. On the other hand, s/he may receive from the adoptive parents rights to material assets such as land (see Chapter 4).

Another interesting aspect of this relationship which differs from legal adoption is that biological parents may live in the same community, thus maintaining permanent contact with their children. In Patos, seven households have *filhos de criação*, and 12 cases are grandchildren who were adopted by grandparents. The total number of adopted children is 24, with some households having adopted more than one child.

Social Bonds

Kinship System

Despite the dissolution of community life that has been claimed by some scholars (McLachlan 1973; Parker 1985), the *caboclo* social structure still relies very much on kinship ties throughout the Amazon region (Lima-Ayres 1992; Wagley 1953). In Patos, kin ties have been created in several ways. First, kin relations are established through blood bonds between biological parents and children. Second, an outsider may marry someone from Patos and s/he becomes part of the community (exogamous marriage).[5] A third way of creating kin ties is through adoption of a child, as previously described.

Studying two floodplain communities, Futemma (1995) observed that each community is usually composed of two or three main families that are all related, either through marriage or birth. Parallel to intra-village marriage (endogamous), inter-village or exogamous marriage is common. In the latter, the female or male member moves from one community to another, and, in many cases, the whole family may move with a married daughter or son. Exogamous marriage is the case of 77 percent of households (Table 3.3). Endogamous marriage can also take place between two Patos residents, usually kinfolks, which strengthens even more the bonds between households. Apparently, among *caboclo* populations, there is no clear rule about marriage—that is, whether a child (male or female) should or must marry someone from the same community or any particular family.

In order to evaluate the kin ties among the Patos households, an index was created based on simple calculation of the number of households with which a particular household holds a kin tie. According to the number of relations, four categories of relationship were identified: none, weak, moderate, and strong (Table 3.4). If a household holds no kin relations with any other household, it falls into the "none" category. A weak degree of relationship is a case in which a household has kin ties with only one or two other households. Those households that have kin ties with three or four other households are classified as moderate. Finally, strong connections are present when a household has kin relations with more than 10 other households.

In Patos, one household has no relationship at all with any other household. More than two-thirds of the households have from moderate to strong kin ties to one another, in contrast to 31.3 percent which show a weak bond and hold a kin tie with only one or two other households. In general, Table 3.4 shows that most of the Patos households, 96.9 percent, are linked through kinship relations. Knowledge of such a familial bonds is necessary to understand governance of upland forest resources at household level (Chapter 6).

(Table 3.3 is about here)

(Table 3.4 is about here)

Co-Parenthood System

One crucial aspect of the Catholic religion which plays a substantial role in the *caboclo* economic and kinship system is the *compadrio* system (or co-parenthood). The co-parenthood relationship is an important social trait of the Amazon *caboclo* borrowed from Iberian culture, and is very widespread throughout Brazilian social, economic, and political life (Wagley 1953:152). The co-parenthood system allows an extension of relationships beyond the kinship circle. The parents of a child invite a man and a woman to serve as sponsors[6] at their child's baptism. This co-parenthood system played a very important role during the Rubber Boom (Wagley 1953; Weinstein 1985) and jute period (Gentil 1988).

Co-parenthood relationships may show how important the kinship system is for *caboclo* culture. Although it is a fictive kinship, it assures individual *caboclos* of bonding and mutual dependence through these relationships. As in other *caboclo* populations, in the Patos community, *compadrio* relations also serve to facilitate economic transactions and political relations. Co-fathers extend political and economic favors to each other and to their godchildren (Futemma 1995; Wagley 1953). The relationship between two old friends, between two cousins, between a landholder and a landless household, or between neighbors who are co-fathers is generally a friendly and respectful one. Co-mothers cooperate in manufacturing manioc flour, looking after each other's children, and helping each other in the preparation of large meals. Thus, *compadrio* relations that extend from borrowing land for farming purposes to providing health support allow members of different households to keep close ties and enhance mutual trust.

Head of the Household

Disaggregating social structure to analyze the roles played by men, women, and children has been documented since Wagley's work on *caboclo* society (1953). Apparently, men were the heads of households, but Wagley observed that in their absence or in daily life, household roles were different. Men and women made decisions together by talking over business deals, and women would decide what to do for the maintenance of the household. In the absence of a husband, a woman assumed the responsibilities of household control, becoming the head of household. In fact, some women became dominant figures within the family or neighborhoods (Wagley 1953).

In a more recent study of the three *caboclo* communities along the Upper Solimões River (Amazonia state), Lima-Ayres (1992) does not refer to a head of household. Instead she describes a head couple of the household, i.e., the father and the mother. On the one hand, the nuclear family seems to be more important in these examples as a producing and consuming unit than any extended family, matrifocal or otherwise. On the other hand, in some contemporary *caboclo* communities there exist more than one form of social organization, such as extended family, or multiple family households that contribute to the maintenance of *caboclo* economic life. Agreeing with Lima-Ayres' classification, three types of households were identified in the Patos community: female-headed, male-headed, and double-headed households.

Among Patos households, there is a defined division of tasks between men and women. Women usually carry out both domestic and agricultural tasks (see section Household Economy in this chapter). Because wives assume a decisive role within the household sphere, where both husbands and wives are in charge of the household livelihood, decisions are made and responsibilities are taken by the two of them, when present. In this case, a household is coded as double-headed. Thus, any household which has both wife and husband, were classified as double-headed households. Only those of widows were female-headed, while widowers' were male-headed. Two-thirds of the households, 22 cases, are characterized as double-headed (Table 3.3).

Household Economy

As described in Chapter 2, Patos residents are provided with a variety of natural resources from floodplain and upland ecosystems. Usually, availability of each resource changes seasonally. Figure 2.5 indicates the availability of the main resources throughout the year. As a whole, local residents have available resources all year long that supply them not only with cash income but also with food.

The Patos household economy is based upon a mixed economy, similar to *caboclo* economy elsewhere in the Amazon region (see Diversified Economy: *Caboclo* High Resilience). In other words, each household usually is dedicated to more than one activity, such as production systems, hourly work, and extractivism, among others. Table 3.5 shows that one-fourth of the households grow crops for cash income while practicing other activities to supply subsistence needs, such as fishing, hunting, and small livestock. While 28.1 percent of the households produce only for subsistence needs, more than half (56.2 percent) invest in at least two cash income activities, such as cattle and commercial agriculture, or receive a retirement salary. Being a market-oriented and/or subsistence-oriented economy contributes to enhance differences across households. Source of income, in fact, was an important factor in facilitating a collective action that occurred in the Patos community (see Chapter 5). Investing in market-oriented crops depends also upon land availability and security. Many of the subsistence-oriented households are landless (see Chapter 4), which limits their production systems due to lack of land.

(Table 3.5 is about here)

Farming System

There were 28 households (87.5 percent) that invested in field crops. Following regional patterns, the main crops cultivated in these areas continue to be manioc (*Manihot esculenta*) and corn (*Zea mays*), followed by beans (*Phaseolus vulgaris*) and rice (*Oriza sativa*). Eighty-six percent of these households invested in manioc and 47 percent in corn. Only four households cultivated beans. Although perennial crops are not very popular among Patos farmers, six households have planted some perennial trees such as avocado, orange, cacao, and banana. They cultivated on a small scale for both household consumption and market sales.

Manioc and corn earn the main cash income for most of the Patos households. Sixty-nine percent of households planted for both subsistence and market purposes against 31 percent that planted only for subsistence. Farmers usually sell manioc flour to either nearby floodplain communities or to the urban population in Santarém. Corn and beans are mostly produced for market purposes. Some households also use corn for feeding chickens. For subsistence purposes, they cultivate 0.25 hectare (one "tarefa") of manioc roots in order to obtain from 50 to 60 kilograms of manioc flour per month. According to local residents, this is a rough estimate of average consumption of flour per household.

Manioc is very time-consuming from plantation to processing. It takes approximately 1,050 hours per hectare in comparison to corn (560 hours per hectare) and beans (318 hours per hectare) (Futemma et al. manuscript). In addition to being a staple food, another reason why farmers are still primarily investing in manioc is probably because of the variety of products that can be obtained from its raw roots: dry bread (*beijú seco*), manioc cake (*beijú cica*), soft bread (*beijú mole*), tapioca flour (*farinha de tapioca*), tapioca fresh dough (*tapioquinha*), livestock fodder (*carimã*), and fermented beverages (*tarubá*), among others. Furthermore, it is adapted to poor sandy and well-drained Amazonian soils.

Sharecropping is a common practice among the Patos farmers. With privatization, land was distributed to most of the households back in 1987 (see Chapter 4); however, today one-third of households have no land—mostly landholders' married children. Thus, these landless households (LL)[7] have to cultivate on someone else's land. In 1998, there were nine households that owned private property (PL) and shared their land with the LL farmers; in this case, 11 households. Usually, LL households cultivate in more than one private lot. In turn, each PL household allows more than one LL household to cultivate in the lot. In other words, several farmers from different households work on the same private lot. Sharecropping usually involves only annual crops such as manioc and corn, because of the LL household's temporary rights of usufruct.

During conversations and interviews, both wives and husbands showed equal knowledge about some crops and their cultivation. They responded mutually to any question regarding economic activities, which suggests an equal process of decision making over these issues. Whether to share land and with whom are also decisions that involve participation of wife, husband, and older children.

In regard to division of labor, every member of a household contributes to farming work. Usually men clear the forest area by cutting down and removing trees, which is physically arduous work. There are three ways in which the clearing tasks can be carried out: (1) hire one or more laborers to do the task manually; (2) exchange working days with members of different households, taking shifts and making payments through labor rather than money; and (3) pay someone to cut down all the trees with a chain saw. In this case, the work is sometimes paid for "in trees." One or two individuals can carry out the burning task. Planting and harvesting activities involve everyone's participation, women, men, and children, as well as processing manioc into flour.

In particular, children participate actively in all kinds of work from cropping to fishing and raising cattle (see below). In Patos, they start to work at an early age, nine or 10 years old or even before, helping in all kinds of activities as observed in other studies on *caboclo* populations (Futemma 1995; Wagley 1953). Girls at age eight or 10 help in all kinds of household tasks and participate in lighter farming activities. Boys, at 10 or 12 years old, help their parents in agricultural tasks—farming and ranching—as well fishing activities. In sum, individuals from nine to 65 years old participate in agricultural activities; there was even a case of a 74-year-old male farmer working heavily in farming production from clearing forest to harvesting.

Cattle Production

There are basically two systems for cattle production: cows for transportation (subsistence-oriented) and fattening (market-oriented). There are five households that raise only one or two cows for pulling a wooden cart while five others invest in the fattening system for commercial purposes, holding from nine to 17 heads per household.

Partnership is a common practice among Patos households, because one partner has either no land or no sufficient capital but has labor, and the other partner contributes land, capital, and labor, if available. Each partner owns a certain number of animals. For

LL households, renting a cultivated pasture area is another common way of acquiring land for grazing, but there is only one household that has no land and raises cattle for commercial purposes through the partnership strategy. It is a male-oriented activity. Boys at early ages, eight or 10, help to take care of cattle on a daily basis. The milking activity is more for household consumption, and usually boys or an adult male carries out this activity; rarely do women do the milking.

Patos is surrounded by large-scale ranching farms, the exchange of labor and products (animals) between local villagers and ranchers is common. In fact, a number of Patos male residents work as cowboys for these ranchers, on a temporary basis. Partnerships also occur among residents from different communities, for example, an LL household from Patos raises cattle with a landholder from the Pau D'Arco community who holds more than 30 heads. As mentioned, Patos residents maintain regular contact with their neighbors, both villagers and ranchers (see Social Relations beyond Community Boundaries).

Hunting and Fishing

Hunting and fishing are largely subsistence-oriented activities. They are the main sources of proteins for the household diet. Households hunt and fish almost everyday all year long in nearby lakes and streams. There are approximately 27 households that invest in hunting activity and 26 households that catch fish for consumption. Usually households with only female members do not fish nor hunt, they usually exchange fish or game for another product.

Households hunt very frequently, almost every day, in order to obtain some source of meat (see Table 2.4 for a list of main game found in the Patos forest areas). If the hunted game is large, such as deer (*Mazana spp*) or *queixada* (wild pig, *Tayassu peccari*), hunters might share the meat with more than one household. They also might salt an animal after cleaning in order to keep it for a couple of days.

Fishing has always been an important source of income for household maintenance as well. Fishing is mainly a male activity, but women do occasionally fish. Little boys, eight or 10 years old, may also fish, contributing to their household subsistence. Patos residents catch fish from lakes, streams, and rivers all year long. According to locals, there are several lakes surrounding the Patos community, based on the lakes' boundaries and ownership. There are at least three large-scale ranchers who claim exclusive ownership of some lakes. Patos also claims collective rights to a particular lake adjacent to the bottomland zone. Each rancher owns his/her own lake and allows local villagers to fish, but with restrictions in terms of amount caught and period of the year when people may fish. Likewise, anyone from surrounding areas can fish in the Patos's lake. Patos fishers catch diverse types of fish, from catfish to scaled fish (see Isaac et al. 1996 for classification of consumptive fish). Among catfish are *Lyposarcus pardalis* (*acari*), *Hypophthalmus* spp (*mapará*), and *Brachiplatystoma flavicans* (*dourada*). Scaled fish are *Semaprochilodus* spp (*jaraqui*), *Prochilodus nigricans* (*corimatá*), and *Plagioscion* spp (*pescada*). In Patos, small-scale fishing is conducted by several different techniques, such as hook and line, longline, harpoon, and small- and large-mesh net (see de Castro 2000, Smith 1979, and Goulding 1980 for descriptions and uses of fishing gear). Usually, small-scale fishers keep caught fish in a cooler with ice up to the time it is to be sold or consumed. Fishers either sell their products to local residents or take them to the Santarém market. The motor boat is an important asset for professional fishers in order to transport their products, or the fishers have to sell to a local middle-man or pay a fare for a boat trip to the local market. Only one Patos household owns a motor boat. Despite its fluctuating price throughout the year, fish is an abundant natural resource in the region, and small-scale fishers can always obtain cash, sometimes a lot and sometime very little.

However, due to fishing accords in the Patos community, which prohibit commercial fishing, only three households are still fishing for commercial purposes. Since the 1960s, commercial fishing has become one of the main activities, if not the main, across riparian communities from the Lower Amazon region (de Castro 2000; McGrath et al. 1993a). In other words, fishing is a very important activity for regional, municipal, and household economies. As mentioned, Santarém is the main commercial center of the Lower Amazon region, exporting fish to other cities of Pará state and southern states of Brazil. Because of its expansion, fishing has been a cause of a large number of conflicts that involve artisanal fishers, commercial-oriented fishers, and large-scale ranchers (de Castro 2000; Schöenenberg 1994). In order to solve problems of overexploitation of fish stock and social conflicts, local fishers have organized to regulate fishing activities and access to lakes and rivers through fishing accords (de Castro 2000). In order to regulate lakes adjacent to their own communities, the Patos residents decided to reach an agreement as well, involving fishers from neighboring communities, such as the Ituqui and Maicá areas.

Patos residents reported some incidents with respect to fishing that involved confrontations among residents, non-residents, and large-scale ranchers. After negotiating with their neighbors, Patos residents decided to create some rules to control use and access to lake resources, which state basically that nobody can fish for commercial purposes all year long, only for subsistence purposes. There is no clear restriction with regard to fishing gear, as there is in other accords in the region. However, some Patos residents who have always been dedicated mostly to fishing activities, and consider themselves fishers are now willing to give up this activity and try to invest in cattle. As mentioned above, fish is an important and abundant resource in the Lower Amazon region, but, its description and analysis is beyond the scope of the present study (for more details, see de Castro 2000; McGrath et al. 1999, 1996, 1993a, 1993b; Rufino 1999; Rufino and Isaac 1994; Schönenberg 1994).

Logging

Logging is a special case of an activity that does not directly involve the Patos household labor force. In past years, with the introduction of the chain saw, Patos residents have hired someone who owns a chain saw to carry out the tasks of cutting trees, for household needs. For commercial purposes, logging companies are always in charge of cutting trees and transporting those logs from forest lot to sawmills in Santarém. Loggers use chain saws to cut trees and bulldozers to drag logs out of the forest lot and bring them to trails, where a truck is loaded to take them to sawmills. In order to reach a harvesting area within a forest lot, loggers open several trails as well main roads. Usually, the seller does not monitor the logging companies' work; only afterward, she or he may count the number of stumps in order to check how many trees were removed.

Another change brought by the presence of the chain saw is better availability of wooden construction material for local residents. More households are now interested in changing their house material from palm leaves to wood. There are 22 wooden houses and seven leaf-walled houses with dirt floor, and four mud-walled houses. In fact, the type of housing a person has is a kind of social status indicator. Households with wooden houses are considered better off (higher economic status) than leaf-walled or mud-walled houses (lower economic status).

Açai Harvesting

Açai, Euterpe oleracea, is a highly valued natural product among Patos residents. It fulfills two important roles in the household economy of the community: local consumption and cash income. It is a delicious juice that is extracted from palm fruit. Local villagers consume *açai* juice at any time of the day either with the main meal or just as a complementary diet. They also use it as a condiment with manioc flour, fish, and shrimp, among other foods. It is very popular among urban people, including those from Santarém.

In order to evaluate the importance of *açai* in Santarém, I visited four main places within the downtown area where they sell *açai*-flavored ice-cream and *açai* juice to interview the owners. These local *açai* houses attend to local demand and export frozen juice, on a small scale, to Manaus (capital of Amazonas) and/or other smaller Amazon towns. Even in southern states of Brazil, such as São Paulo and Rio de Janeiro, *açai* has become a delicacy in recent years. In order to provide *açai* to urban consumers throughout the year, buyers acquire raw *açai* fruit from several rural communities near Santarém, and during a period between June and August, they also buy from Patos. The price of *açai* fruit varies from US$0.30 per liter at the beginning of the season to US$0.72 per liter at the end of the season. Each buyer purchases from 550 to more than 900 liters per day in the peak of the season.

In Patos, each collector harvests around 36 liters per day. Liter refers to the amount of raw fruit, which weights approximately 20 kilograms. If one household collects and sells 72 liters, it raises from US$17.60 (72 x US$0.30 – US$4.00 cost of transport) to US$47.84 per day (72 x US$0.72 – US$4.00 cost of transport). Per month, a household may raise from US$440.00 (US$17.60 x 25 days) to US$1,196 (US$47.84 x 25 days). This is a very rough calculation but it suggests a high profit return for a household from harvesting *açai* during its season. Due to exclusion of traditional users from entering the *açai* forest to harvest it, there exists ongoing internal conflict not only in Patos but also in nearby communities where *açai* forests are even larger (see Chapter 5).

There are 30 households involved in *açai* harvesting, and most of them sell it in the Santarém market. There are, at least, three Patos residents who work as middle-men in that they buy *açai* from local harvesters and sell the fruit to *açai* houses, as described above. For most of the *açai* harvesters to leave the community in order to trade by themselves is more expensive than to sell to local middle-men. They would have to pay for a boat that costs US$4.50 one way per person and US$0.50 per sack of *açai* (60 kilograms). Besides, they would have to sleep over in Santarém in order to catch the one returning boat the next day, thus spending more money on food.

Division of labor is more specialized in harvesting than in other activities related to *açai* production. Someone needs to climb several *açai* trees, averaging 20 to 25 meters tall, in order to collect the fruits. Thus, mainly young children between the ages of eight and 15, primarily boys, are in charge of harvesting the bunches of *açai*. Adult males can also collect *açai*, at a smaller scale. Finally, adult females are responsible for preparing the juice.

In order to obtain the *açai* juice, they first wash the fruits in water, then sift the fruits twice by using a coarse sieve in order or get rid of peels. To have a pure juice without peels, they strain it once or twice through a fine-grained sieve. Because there is no refrigerator or freezer in the community, this juice lasts only one or two days. For commercial purposes, they do not process the *açai* fruit; it is sold completely raw. They simply take the fruits off the bunch in order to have them loose and ready to pack.

Other Secondary Activities

Patos residents practice several other activities that contribute to household economy, but they are not covered in detail in the present study. They rank from extractivist activities to paid labor work.

Patos residents also harvest medicinal plants—bark, fruits, and seeds—and even hunt animals for health care purposes. One important seed that was formerly sold in the market is *andiroba* (*Fevillea trilobata*), but, probably due to a drop in price, they do not trade it as much as they did more than 10 years ago. Harvesting and processing these natural products are carried out by both women and men. There is only one woman in the entire community who makes baskets. The younger generation is no longer interested in this type of handicraft work. The basket maker collects the raw material (palm leaves, grass leaves, stems, etc) and she designs and weaves all by herself. She makes baskets for processing manioc (tipiti), for sieving *açai* and manioc flour (sievers), and for storage of any product. She sells them to local residents.

As mentioned, a number of male members may work temporarily as cowboys, as hourly workers during some agricultural periods such as harvesting, and as carpenters. Some make and fix fishing gear to raise some money as well. Women may work as housekeepers for some nearby large-scale ranching families.

Diversified Economy: The *Caboclo* High Resilience

The regional economy has played an important role in the history of Amazonia; however, *caboclo* culture has exhibited a resilience which might indicate an ecological adaptation to peculiarities of Amazonian habitats. As peasant people, Amazonian *caboclos* participate in a mixed economy, laboring for cash and subsistence (Gentil 1988; Moran 1974; Parker 1985; Wagley 1985; Weinstein 1985). Many scholars have commented on the flexibility of their household economy, which may change from one year to the next, depending on economic opportunities or environmental conditions (McGrath et al. 1993a, 1993b; Moran 1974).

This native peasant population is considered to be well adapted to Amazonian economic and ecological conditions, in that they display a flexible economic behavior, moving in and out of the market without major effects on their lifestyle (Moran 1993, 1974). In fact, some scholars have shown how fast these people are able to shift from one activity to another in a very short period of time. Miller (1985) and Schmink (1986) observed that they moved rapidly to take advantage of the wave of the rubber trade and just as quickly returned to traditional economic activities when the market went down. Gentil (1988) mentions that, as a result of a major 1882 flooding in the Lower Amazon Basin, many cattle were killed and cacao fields were lost (Alden 1976), leading *caboclos* to quickly change their economic activities. Between 1930 and 1980 they raised jute due to the influence of the Japanese community (Gentil 1988). By the 1980s they abandoned jute production and increasingly turned to fishing and cattle raising (McGrath et al. 1993a, 1993b).

Moreover, the reliance of these native peasant people on subsistence activities and their desire to be autonomous producers led to the persistence of their way of life (Moran 1993, 1979, 1974; Wagley 1985). Subsistence activity is one of the key traits of *caboclo* culture (Parker 1985). Such a mixed economy suggests an adaptation of *caboclo ribeirinho* to a diversified environment that guarantees them some economic autonomy and flexibility and most of all survivorship.

Community Sociopolitical Organization

Historically, joint effort between households has been a common practice in the Patos community. Collective work varies from church construction to cleaning up dirt roads to farming tasks. Besides group-oriented activities, residents are provided with some community-based organizations as well as the community political structure.

Community Political Structure

Local political structure is represented by a community council composed of a coordinator, a secretary, a treasurer, and the social promoter (*animadora*). The coordinator has held this position for more than 10 years and belongs to one of the main Patos' families, which holds strong kin connections with other households. He is 62 years old and in charge of representing the community, promoting community-level social events such as bingo, and coordinating meetings, among other community-based activities. The secretary/treasurer is a 55 year-old female former elementary teacher and is responsible for keeping agenda and minutes of the meetings as secretary and maintaining community accounts as treasurer. The promoter is a 61 year-old female and a Catholic leader (catechist) who is responsible for calling meetings and for helping the coordinator to organize social events and other collective activities.

In 1998, during the field work period, the rise of an opposition party was taking place due to disagreements and dissatisfaction with the then coordinator and political structure. A proposal for reforming that structure was put forth by the opposing group. They proposed not only new names for the community's government but also a new political structure in which functions are more decentralized than the current one (see Appendix 3.1). Although they proposed new leadership, they tried to conciliate old and new leading individuals from the community and placed them in different positions of the political structure.

The opposition group reported that several meetings as well as individual conversations took place in order to explain and propose to everyone in the community the new political arrangement. Afterwards, they collected signatures from everyone who supported the new structure. A list of signatures indicates that more than 50 percent of voters supported the new reform. It is worth mentioning that they included an agenda of intentions in which they proposed to pursue improvements for the community, such as digging wells in the plateau zone, opening new roads, building a health center, installing a phone line, lake preservation (Ituqui Island; for more details on fishing studies, see McGrath et al. 1999, 1996, 1993a, 1993b), remodelling the elementary school, erecting electrical power lines, and building houses for everyone. It would be interesting to conduct a follow-up visit in order to verify whether this new structure was implemented and its outcomes.

Community-Based Activities

In the case of farming, such a collective effort is called locally *puxirum*. *Puxirum* illustrates the social ties within the kinship system. In the past, it contributed to minimizing the lack of labor by sharing labor efforts and allowed for more equal distribution of land because no one permanently owned a piece of land. Rights to land before privatization of the upland (see Chapter 4) were based on a "first come first served," followed by rights of usufruct, an informal contract among households involving reciprocal exchange of labor (de Castro 2000). This working group effort is used to develop tasks that demand a higher labor input than is available in a single household. Even though they work together (either *puxirum* or simply exchanging a day's work) in order to accomplish farming tasks, households usually do not share the output. Rather, each household grows its own field crop.

In addition to large working groups, it is still common today for members of two or three households to join together to accomplish certain tasks. Women join each other to process manioc flour and prepare manioc products (cakes, biscuits, manioc starch, among others). They also exchange information on gardening and may carry out cultivating activities together. Men usually fish and hunt in groups. It is very common to see a group of three to five men hunting together or a group of two men fishing. Unlike farming, the output of hunting and fishing is pooled and split among partners.

Activities such as sharing labor and the exchange of food and products all contribute to cementing some form of mutual commitment among members. But such collaboration takes place more in a small group of households rather than large groups. They learn that when they work together they are better off, sharing the load of work and responsibilities. Transmission of information is also another key issue in household cooperative behavior. They frequently share information about new technologies such as improvement of crop productivity, new production strategies such as the "green field," or even about news on environmental and land policies. Someone may act opportunistically in that s/he does not contribute to household livelihood, and s/he probably will be shamed by other villagers, through gossip or verbal warnings. Thus, working together and the existence of some forms of controlling opportunistic behavior contribute to build a sense of commitment and reciprocity, which in turn, contribute to lower transaction costs and to facilitate group-oriented activities (see chapters 4 and 5 for more information on cooperative behavior). Thus, long-term experience of living and sharing several aspects of life together has contributed to locals' finding diverse means to overcome collective action problems.

At the community level, a soccer game is very popular entertainment. Formally, these are organized through the Patos Soccer Club. There is a president and a vice president who are in charge of organizing a team, promoting intra- and inter-community tournaments, and scheduling players to maintain the soccer field. In Patos' case, only men play soccer, but it is very common in other parts of the Amazon region to see women play soccer and participate in intra- and inter-community tournaments. Players from other communities frequently come to join the local team to play an informal championship. In Patos, as in other communities in Santarém, men play practically every day at dawn. Thus, soccer is an important social event whereby communities can get together and exchange information, thus building a wide network among rural communities from floodplain and upland areas.

Besides soccer, there are social events on a community basis such as parties and bingo games. Usually, besides being a form of entertainment, the main purpose of these events is to raise money for community infrastructure. As in soccer games, local residents invite people from other communities to their parties and any other social events. Religious parties connected to the Catholic Church are very common (see below) on behalf of each community's patron saint. However, in past years, locals have complained about the lack of initiative among committee members in promoting more social events for raising funds.

Community Political Organizations

At community level, there are some representatives of grassroot organizations, namely: the Union of Rural Workers of Santarém (STR-Santarém) and the Rural

Producers Association of the Gleba Ituqui (ACACI).

The STR's representative at community level is called locally *delegado*, and his assistant is *vice-delegado*. They are responsible for representing members and passing information from STR on to local producers. They are also in charge of coordinating meetings at the community level and receiving the annual membership fees from members to transfer to the STR treasurer. There are 39 residents who are affiliated with STR, 15 women and 24 men (see also Chapter 4).

ACACI is an inter-community association which encompasses five communities: Pau D'Arco, Patos do Ituqui, Serra Grande, Santana do Ituqui, and Cabeceira do Marajá. The president and the treasurer of this association are from the Pau D'Arco community, the vice president and the secretary are from Serra Grande. ACACI performs an intermediary role between small producers and official banks such as the Amazon Bank (BASA). The association is in charge of representing local small producers who want to receive farm credit line from BASA. The only way small producers can contact the local bank is through ACACI; therefore, in order to borrow money from the bank, a producer needs to be member of a local association.

The Patos members also have been involved in some organizations and fulfilled leadership and membership roles inside and outside their community. Table 3.1 shows that one-third of the households participate in leading roles within the community arena, including women (7.7 percent) and men (23 percent), and they have actively contributed to land movements as well (see Chapter 4). However, for participation in political activities or organizations that involve a large group of individuals or the entire community, it is hard to get everyone's cooperation and to conciliate divergent interests among households in order to reach a common goal (see chapters 4 and 5 for internal social conflicts).

The Churches and Their Sociopolitical Roles

As previously mentioned, the Patos community currently has two churches: the Catholic Church and an Assembly of God, Evangelical Protestant (*Assembléia de Deus*) Church. According to local oral history, the first Catholic Church was founded around 1968. This first church was replaced by a new building, as previously mentioned, as a result of a collective work. The Evangelical Church was brought, into Patos, between 1991 and 1992, by an outside rancher whose family is now living in the community. Both Catholicism and Evangelicalism have played some sociopolitical roles in these local people's lives.

Catholicism became more strengthened in the 1970s through the participation of the Federation of Agencies for Social Work and Education (FASE) and the Movement for Brazilian National Education (MEB) in the region as a whole. FASE's main objectives are to empower civil society by strengthening local organization, to incorporate democratic practices into people's everyday lives in order to provide them with welfare and a better standard of living (see Chapter 4). Agents of FASE worked during the 1970s and 1980s with residents from the Gleba Ituqui, including the Patos community. MEB also sought to raise the political consciouness of local inhabitants through the process of learning, training, and participating (see Chapter 4). Thus, it is likely that these external agents—MEB and FASE—have contributed to providing locals with more political information about their rights and have helped raise their political consciousness.

The Evangelical church, on the other hand, came to Patos with religious purposes only. However, the outside rancher's interests led him to create some allies within the Patos community. He is creating social ties through establishing partnerships in cattle raising or lending land for crop field purposes to landless individuals. He also provides help to others such as giving rides to local people in the case of health problems or any other emergency situations. Despite his connections with some residents from Patos, especially with Evangelical residents, religion has apparently not been a cause of social conflict within the Patos community such as the case of disagreements over resources. Besides internal relationships, Patos residents also maintain contact with people from the surrounding area, such as ranchers and other communities.

Social Relations: Beyond Community Boundaries

In addition to intra- and inter-household relationships within a community, there exist also relations with other neighboring communities as well as large-scale ranchers. Patos residents keep close contact with almost all upland and floodplain communities from both Ituqui and Maicá regions by promoting social events together (e.g., parties), organizing religious meetings and soccer tournaments, forming economic partnerships, etc. Due to the history of land movement, Patos residents have very close relationships with people from four other Ituqui communities: Pau D'Arco, Cabeceira do Marajá, Santana do Ituqui, and Serra Grande (see Chapter 4). ACACI, in fact, it is an example of this type of inter-community organization.

The relationships with large-scale ranchers take place on a more economic basis. Some residents from Patos, in particular, have been working for two large-scale ranchers who hold lands near the community. Despite some conflict over access to some resources such as fish, turtles, and game, Patos residents try to maintain a friendly relationship with these ranchers.

Final Considerations

Individuals interact on a daily basis with one another at different levels. In the present case, residents from the Patos community interact with members from the same household, with different households inside the community, with individuals from different communities, and with large-scale ranching neighbors. Within and between households, social bonds such as kinship and co-parenthood ties contribute to establish long-term commitment among members and keep different forms of reciprocal exchanges among them. These internal relations, at both household and community levels, contribute to the maintenance of the Patos livelihood based upon a mixed economy geared toward primarily subsistence, and secondarily market sales.

On the one hand, relations beyond community boundaries allow local residents to build a larger social network in order to overcome eventual economic, political, or ecological constraints. On the other hand, divergent interests among different actors (outsiders versus insiders) have been the cause of harsh social conflict. The following chapters address issues on cooperative behavior toward assuring rights to some natural systems, such as upland (Chapter 4) and floodplain (Chapter 5) areas as well as regulations controlling some of the main natural resources (Chapter 6)

Endnotes

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[1] The term *caboclo* has recently been a focus of discussion in literature, due to stereotypes and pejorative concepts surrounding it (for detailed discussion, see Lima-Ayres 1992; Nugent 1993). This term is not used by *caboclos* to identify themselves (Nugent 1993; Parker 1985, 1989; Ross 1978; Wagley 1985), since it indicates people who are "rural backwoodsmen" (Parker 1989) of a lower socioeconomic status than their own (Miller 1985). Also, Lima-Ayres (1992:1-4) points out the confusion of scholars and officials surrounding the term *caboclo*. She basically divides the *caboclo* into two concepts: colloquial or relational and academic or analytical. In colloquial speech, the term refers to "a complex category of social classification that includes geographical, racial, and class dimensions" (Lima-Ayres 1992:1). In Brazil, there exists a diversity of rural people classified according to each region's geography, historical colonization, and ethnic origins; thus, *caboclos* are recognized by Brazilians as a rural Amazonian people (Lima-Ayres 1992:1). Finally, in colloquial speech, *caboclo* is also used as a social classification, in that the Amazonian upper class is classified as "white," whereas the lower rural class is referred to as *caboclo* (Lima-Ayres 1992:2). In opposition to colloquial speech, the concept of *caboclo* as used in anthropology refers to the Amazonian peasantry. Ayres adopts the anthropological term *caboclo* to refer to small rural producers who are linked, to a certain extent, to local markets.

[2] During the eighteenth century (1757 to 1799), the Directorate took place in the Brazilian Amazon Region. The Directorate was composed of villages of Amerindians controlled by a Portuguese director. The Indians were lumped together in these small villages, and they were forced to work for the Portuguese people for little or no pay. Each village specialized in an activity such as hunting, farming, or gathering in order to increase productivity. Parker (1985) suggests that in that period many European cultural traits were imposed upon those Amerindians, such as christianization and the family as a social unit.

[3] Língua Geral, introduced by the Jesuits during the Mission Period, is a modified Tupi language. It was used by *caboclo* people until the second half of the nineteenth century (Wagley 1985; Parker 1985:xxvi).

[4] During the Directorate, the women were in charge of domestic tasks or collecting industries, such as wild cotton (MacLachlan 1973:213-4; Parker 1989). Further, due to hard working conditions, including excessive hours, low wages, and heavy tasks, it was difficult to secure a stable male and female Amerindian labor force (MacLachlan 1973:214).

[5] "Endogamy refers to a marriage in which both members of the couple were born in the same local community. Exogamy refers to a marriage in which one or both members of the couple were born outside the community" (Futemma 1995).

[6] "The sponsors become godfather and godmother to the child, and the same rite establishes a strong relationship not only between the godchild (*afilhado*) and his/her godparents but also between the parents of the child and the godparents, who become co-mothers (*comadres*) and co-fathers (*compadres*) to each other" (Wagley 1953:150). The terms co-parents and co-parenthood evolved from this relationship.

[7] See chapters 4 and 5 for more information on categories of households according to land tenure.

Table 3.1. Distribution of Households According to Religious and Political Participation in the Patos Community

Cultural-Political Attributes	Frequency	Percent (%)
Religious Life	(n=32 households)	
Catholic Religion	26	81.3
Evangelical Religion	3	9.4
Catholic-Evangelical Religion*	3	9.4
TOTAL (rounded percent)	32	100.0
	(n=31 wives) and (n= 26 husbands)	
Religious Leadership		
Wife	2	6.4
Husband	2	7.7
Political Leadership		
Wife	3	9.7
Husband	9	34.6
Union Membership		
Wife	15	48.4
Husband	24	92.3
Mothers' Club Membership-Wife	8	25.8
Soccer's Club Membership-Husband	13	50.0
Land Movement Participation		
Wife	6	19.4
Husband	13	50.0

*In all cases, wives have converted to Evangelical religion, and husbands continue to be Catholic

Table 3.2. Classification of the Patos Households According to Their Composition: The Roles and the Position Held by Each Member within a Household (n = 32)

Household Typology	Frequency	Percent (%)
Solitary (Single Adult) Household		
Widow Alone	2	6.2
Daughter Alone	1	3.1
Husband Alone	1	3.1
Subtotal	4	12.4
Single-Family Household or Conjugal Family Unit (CFU)		
Married Couple Alone	3	9.3
Married Couple with Children	15	46.9
Widow with Children + Adopted Children	2	6.2
Subtotal	20	62.4
Extended-Family Household		
CFU + Descendent Generation + Adopted Children	1	3.1
CFU + Adopted Children	2	6.2
CFU + Widow	2	6.2
Widower + Married Son's Family	1	3.1
Widow + Married Daughter's Family + Adopted Children	2	6.2
Subtotal	8	24.8
TOTAL (rounded percent)	32	100.0

Table 3.3. Demographic Data at Household Level from the Patos Community (n = 32)

Demographic Characteristics	Average (Std Dev)	Frequency of Households	Percent (%)
Frequency of Households	-	32	100
Frequency of Female-Headed Household	-	7	22
Frequency of Male-Headed Household	-	3	9
Frequency of Double-Headed Household	-	22	69
Total	-	32	100
Frequency of Endogamous Marriage	-	7	23
Frequency of Exogamous Marriage	-	24	77
Total	-	31*	100
Average of Wife Age per Household	44 (± 17.7)	-	-
Average of Husband Age per Household	48 (± 15.8)	-	-

* There is one household that is composed of an unmarried daughter (21 years old) whose parents died, and whose younger brother and sister moved out.

Table 3.4. Distribution of Households According to Degree of Kin Relations among Them in the Patos Community (n = 32)

Number of Relations Between Households	Degree of Kin Ties	Frequency	Percent (%)
0	No	1	3.1
1-2	Weak	10	31.3
3-4	Moderate	5	15.6
> 10	Strong	16	50.0
TOTAL		32	100.0

* An index was created in order to assess the degree of kin relation between households. The number of relations indicates the number of kin ties that a particular household has with other household(s). Kin tie is characterized by a first degree of consanguinity.

Table 3.5. Distribution of Households According to Types of Activities Carried Out by Each Household in the Patos Community (n = 32)

Types of Activities*	Frequency	Percent (%)
Subsistence-Oriented Agriculture	9	28.1
Subsistence-Oriented Agriculture + Retirement	2	6.3
Market-Oriented Agriculture	8	25.0
Market-Oriented Agriculture + Retirement	2	6.3
Market-Oriented Agriculture + Cattle	5	15.6
Market-Oriented Agriculture + Market-Oriented Fishing	1	3.1
Market-Oriented Agriculture + Market-Oriented Fishing + Cattle	1	3.1
Market-Oriented Fishing + Cattle	1	3.1
Off-Farm Activities	3	9.4
TOTAL (rounded percent)	32	100.0

* Practically all of the households carry out subsistence activities such as small livestock (chicken, pigs, ducks), hunting, fishing, and harvesting wild fruits and other basic natural products for their livelihood. Hunting and fishing, however, are not practiced by all households. Exchange of products is common between households that cultivate but do not hunt or fish and those who do.

Appendix 3.1

Proposal of new sociopolitical structure presented by opposition local group for the Patos community.

Current Structure

Position	Number of Individuals
Coordinator	1
Secretary	1
Accountant	1
Community Promoter	1

Proposed Structure

Position	Number of Individuals
Head	2
Secretary	2
Accountant	2
Director of Finances	1
Director of Social Services	1
Director of Infrastructure	1
Counseling Committee	3
Special Supporting Group	10

Proposed Agenda: Project for Community Development

01. Roads
02. Health center
03. Phone line
04. Infrastructure: sewage
05. Lake preservation (Ituqui lakes)
06. Remodelling elementary school
07. Electrical power line
08. House for community meetings
09. Opening of trails (streets) within community
10. Opening trails to link other communities
11. Privatization of lots for landless families
12. Community-based store house
13. Housing for every family

Chapter 4

LAND CONFLICT, COLLECTIVE ACTION, LAND REFORM, AND LAND-USE CHANGES

Introduction

This chapter focuses on cooperative behavior and the history of political participation and the learning process of the people from the Gleba Ituqui that led to land reform, which, in turn, led to changes in land-use patterns. Ituqui's struggle for land is similar to cases from rural areas throughout Latin America. Export-led agriculture, stock (cattle), and land reform were the major economic targets among the Latin American governments in order to develop isolated rural areas. Political ecologists have shown that instead of reducing poverty, these economic development projects have created more social inequality, with a large landless population, more land concentration—small number of large landholdings as opposed to large number of smallholdings—rural exodus, land conflict, and environmental degradation (Bedoya 1995; Durham 1988; Painter 1988; Schmink and Wood 1992, Sheridan 1988; Stonich 1993).

Land conflicts have emerged in several places in the Amazon region since the 1960s. These conflicts have been reported mainly in frontier areas of the Amazon, where land invasion usually takes place (Alston et al. 1999; Schmink and Wood 1987). Unlike new frontier areas, Ituqui portrays a case of land conflict between small rural producers and large-scale ranchers in an old frontier; that is, these native peasant people have been living in the area for more than 80 years (see History of Land Reform and Local Social Movement, in this chapter).

Studying land conflict in frontier areas of the Brazilian Amazon region, Alston et al. (1999) observed that many factors affect decisions made by the National Institute for Colonization and Agrarian Reform's (INCRA) regarding the areas in which a land reform should take place. Usually, places with harsh conflict between large-scale farmers and landless people are those where INCRA intervenes first. Conflicts often involve land invasion by landless people. These invasions frequently take place where properties are close to market, with road facilities, and land with no beneficial use (clearings).[1] Successful cases of invasion and land reform have occurred where a landless group was well organized and well coordinated (Alston et al. 1999).

As previously mentioned, cooperation and local organization, changes in property regime, and change in land-use patterns are the main focus of the present chapter. Residents from the Ituqui settlement, facing threats of losing their rights to land, decided to cooperate in a collective effort to confront the cattle company and request from the federal government their rights to the land. Ituqui's local organization along with external support from non-governmental agencies, led to a successful case of land reform (see History of Land Reform and Local Social Movement).

On the one hand, land tenure security is considered an important condition to a more appropriate investment in the land (Alston et al.1999). On the other hand, privatization is considered by other scholars as one of the causes of more deforestation in the Amazon (Beaumont and Walker 1996; May 1992). Additionally, environmental degradation—mainly deforestation—as a result of these development projects, has been observed in several places such as the Brazilian Transamazon area and the Southern Pará, Peru, Central America, and Mexico (Bedoya 1988; Moran 1981; Painter 1988, Schmink and Wood 1992; Sheridan 1988; Stonich 1993).

Considering land tenure changes through land reform in the Ituqui settlement, this chapter has two goals: (1) to understand the process and the result of the collective action that led to a land reform among native peasant people in the Lower Amazon; (2) to analyze whether and how land reform has affected land-use patterns at landscape and household-property levels.

This chapter first describes and analyzes the history of struggle for land in the Ituqui settlement that underlies the formation of social capital where local political participation led to a collective action and land reform (Part I). Second, the chapter assesses changes in land use-patterns at settlement (Gleba) and household-property (Patos) levels by using remote sensing and GIS (Geographic Information Systems) techniques (Part II).

PART I

Collective Action: The Gleba Ituqui Case

Collective Action and Social Capital

The Ituqui case was chosen in order to help understand theoretical questions why some individuals collaborate and other do not in particular contexts. It is related to why it is important to understand under which circumstances collective action emerges and how it is maintained. Rational choice theory has been the core of most collective action studies based on the assumption that individuals will choose to participate if it means they will be better off than they would be by not participating. In other words, they will behave on behalf of their own self-interest. Early works on collective action argued that only under external pressure, either from the state, some kind of coercion, or through selective benefits, would individuals cooperate with one another (Olson 1965). Taylor (1987) challenges this approach, arguing that individuals may act altruistically and that they are able to cooperate voluntarily without any external intervention. Several other scholars, using a broadly defined rational choice theory, have shown that local participation is possible without any external intervention, depending upon the incentives and circumstances individuals face (Berkes 1989; Bromley 1992; McKean 1995,1982; Ostrom 1990; Wade 1988).

Experimental results have shown that individuals do cooperate in specific situations where they are allowed to communicate with each other, gain information about each other, and when they experience the same situations more than once (Ostrom 1997). Ostrom (1997) goes further, arguing that each individual will go beyond narrow rational choice in order to not only overcome self-interest goals but also to create social bonds based on strong reciprocity, reputation, and trust. The creation of social bonds, in this case, refers to formation of social capital that enhances and strengthens social structure, and thus improves future beneficial outcomes (Ostrom 1995). Studies considering a long history of self-organization and other local social networks reveal the existence of social capital among some rural communities from developing countries (Durston 1998; Narayan and Pritchett 1997; White and Runge 1994; White 1996). These authors show that these communities are able to build social capital based on a pre-existing social network of strong trust and reciprocity (see Chapter 3 for more information about community-based organization and activities), as well as by exercising political participation and membership in local associations.

In a case which has involved land conflict, local residents from the Gleba Ituqui, have struggled to gain legal access to the uplands by joining a collective effort to ask for land reform and redistribution. Their experiences in political participation—membership and leadership—have contributed to building social capital, which in turn was an important factor that led to a successful collective action (see more information about social capital in Chapter 5).

Data Collection

Institutional Data

In order to gather information on the history of land reform and the facts surrounding it, I visited numerous non-governmental and governmental organizations. For data regarding land tenure, agricultural policies, and development projects, I interviewed officials from the National Institute for Agrarian Reform and Colonization (INCRA), the State Rural Extension Agency (EMATER), the National Cacao Research and Extension Program (CEPLAC), the Amazon Bank (BASA), and the Bank of Brazil (BB). Data on agricultural production at county level were gathered from the Brazilian Statistics and Census Bureau (IBGE). For information about rights regarding rural workers and their political engagement, I interviewed agents from the Union of Rural Workers of Santarém (STR-Santarém) and the Federation of Agencies for Social Work and Education (FASE). In regard to the Brazilian environmental law and timber exploitation, I interviewed agents and visited units of conservation under responsibility of the Brazilian Institute for Renewable Natural Resources and the Environment (IBAMA) and the Superintendency of Development of Amazonia (SUDAM). I conducted a search regarding historical data on social movement and land reform in the Ituqui settlement (local newspapers) in the Library Cristóvão Sena located in Santarém.

In addition, I visited the five other Ituqui communities—Pau D'Arco, Santana do Ituqui, Cabeceira do Marajá, and Serra Grande—and I interviewed coordinators and groups of residents in each community in order to gather more information about the political organization and social activities among communities.

History of Land Reform and Local Social Movement

The settlement history of the Gleba Ituqui is marked by two periods: the period before privatization with state intervention but local mobilization, and the subsequent period with the emergence of new actors in this social-political arena.

Expropriation and Settlement

Although the human occupation of the Ituqui region goes back 10,000-11,000 years (Roosevelt 1994; see Chapter 2 for a more in-depth historical account), current Ituqui residents have lived in the area only since the 1920s. Although these local Ituqui residents have been living there for about 80 years, the ownership of the upland areas has always belonged to wealthy families from Santarém or individual large-scale ranchers. In other words, the Ituqui residents have had no de jure rights to the land, even though they have always had access to the land (de facto). The private property regime in the upland ecosystem can be traced back to the time of *sesmarias* (see Benatti 1996 for more information about *sesmarias*) in the nineteenth century. A *sesmaria* was the land title issued by the Portuguese government, which assigned land rights to the local elite.

From the *sesmaria* time up to 1987, Ituqui upland lots were owned sequentially by four different individuals: the first three owners in succession were wealthy families from Santarém, and the fourth was a rancher from the Southeast of Brazil who acquired the Ituqui land from the last *sesmaria* inheritor in the mid-1970s. The rancher owned a big cattle company and bought the land initially to sell timber and, afterward to establish pasture for cattle ranching (see Local Organization and External Support, in this chapter).

After two decades of fighting, INCRA—the governmental office in charge of agrarian reform—expropriated the land in 1987 and established a large settlement project in the region).[2] The upland ecosystem was divided into approximately 300 private parcels averaging around 56 hectares (± 20 hectares) (figures 4.1 and 4.2). Most of the families or single males older than 18 years were given rights-of-use. In this dissertation, the group of residents that holds those rights to the upland area are hereafter called Private-Landholders. Yet, according to INCRA policy, these landholders are only allowed to occupy and use the land; they may not sell it. They hold rights of usufruct (*Autorização de Ocupação*) until they receive the definitive land title. Due to the cost of titling land and the time involved, INCRA has been very slow in delivering land titles to new settlers throughout the Amazon (Alston et al. 1999), not only in frontier areas.

(Figure 4.1 about here)

(Figure 4.2 about here)

In the Patos community case, the upland ecosystem was divided into 28 parcels of approximately 50 hectares each (figures 4.1 and 4.2). After the privatization, households with no land emerged—landless—as a result of two factors. First, children who were younger than 18 years old at the time of privatization did not receive any land; now they are older than 18 and most of them are married with no land. Consequently, they have to use their parents' private lots to provide food and cash income for their families (see Landless Households: Sharecroppers and Land-Use Patterns in this chapter). Second, members from outside Patos who married someone from the community and formed new families now have no private land. Therefore, the privatization event created two distinct groups of households: Private-Landholder (PL) and Landless (LL). Currently, there are 10 LL households and 22 PL households.

In regard to LL households in the Patos community, there is a case of particular interest, which involved a system of monitoring and serious punishment to combat the problem of free-riding during the land movement. Local farmers did not allow a particular farming household from the Patos community to gain rights to a lot due to the household head's previous betrayal. He had formerly worked as an assistant for the large-scale rancher (the same who was threatening Ituqui residents) and did not participate in the movement at any time, according to villagers' reports. Today, this particular household is still living in the community but has rights to only a small area for keeping their house. Their five sons are now all older than 18 and are moving to other nearby areas where INCRA is issuing land titles to new farmers. Although there still exists resentment between this household and other members of the community, the head and his sons are permitted to farm in some kin-related and/or acquaintances' private lots (see Land Reform and Land-Use Patterns in this chapter).

Local Organization and External Support

There are three main institutions that played fundamental roles during the land social movement in the Ituqui region—FASE. MEB. and STR—Santarém. and the Land Pastoral Commission (CPT) played a secondary role. FASE, MEB, and CPT all have their roots in the Catholic Church, and the main goals of these groups or agencies are to combat poverty and inequality among rural area residents in the belief that rural people need to be educated and conscious about their rights as small farmers (Paiva 1985).

MEB was a program created by the Catholic Church in 1961 that aimed to reduce illiteracy in the Brazilian territory (Pimentel et al. 1997). Different from the national and official education in public and private schools, MEB's method of education was based upon Paulo Freire's method of consciousness raising. Freire was a Brazilian educator and his methodology proposed not only the elimination of illiteracy, but also the creation of individuals who are more conscious of their exploitation by the more powerful people within a society (Brandão 1981). That is, he sought a method of student participation in the process of learning because he proposed a two-way rather than one-way relationship between student and teacher. A two-way relationship conveys the idea of a reciprocal exchange of information between student and teacher instead of the flow of information only from teacher to student (Brandão 1981). The method is geared toward illiterate adults and it is an attempt to deal with students' everyday life.

In 1964, Bishop Tiago Ryan brought MEB to Santarém, with the main goal of working with both urban and rural communities in order to educate local people. Due to the isolation of several communities, the main channel of education was through radio, called Educational Radio, in order to reach all of these distant areas. Even today, all types of communication and information are transmitted through radio as a result of the lack of telephone lines and/or reliable transportation. During the military government regime in Brazil (1964 to 1985), MEB had to follow the official national educational system, but after the mid-1980s, it returned to its previous methodology of seeking individual political consciousness and participation. MEB established some collaborative work with such local agencies as the Union of Rural Workers of Santarém (STR-Santarém) in order to continue its work in rural areas and to contribute to the formation of local leadership (Pimentel et al. 1997).

FASE was founded in 1961 by a North American priest in conjunction with the National Conference of the Brazilian Bishops (CNBB). It arrived in Santarém by the end of the 1960s. Its main objectives are to strengthen civic organizations and promote local participation in political, economic, and social arenas at the community, regional, and/or national levels. Similar to MEB, FASE seeks to provide education and training of community leadership, and its founding members are ex-priests of the Catholic Church. It is not officially linked to the Catholic Church but it holds eclesiastic origins (Leroy, pers. comm.).

Within rural communities' social organizations, FASE helped to create a small store (*Grupo de Revenda*) where local villagers buy and sell products in order to eliminate a middle-man and thus increase producers' incomes while lowering product prices. The Ituqui region and its agrarian conflict was the first in which FASE actively and directly supported the community and it did so for 12 years from 1975 to 1987.

During this period, FASE provided information about land tenure issues in terms of different rights to land—rights of usufruct and rights of controlling it. In addition, FASE's members also recommended that local villagers ask for help from STR-Santarém to hire a lawyer who could represent them against the large-scale rancher, and to create committees to represent each village. Prior to FASE's intervention in the Ituqui region, MEB worked during the beginning of the 1970s in this region, also to promote education among adults and local organization.

The role of the Catholic Church in enhancing civic organization was also observed in southern Italy (Sabetti 1999). The Church-sponsored associations contributed to local villagers' participation in self-governing efforts, and exercising membership in these associations provided them with political leadership and social capital. "A large part of the voluntary-action sector throughout Italy is connected with social movements inspired by the teachings of the Catholic Church" (Sabetti 1999:370). In Santarém, the fishers' grassroot organization also has strong connections with the Catholic Church. In addition, in rural communities, Catholic representatives—catechists—play a key political role at the community level (de Castro 2000). Pace (1992) also points out the importance of the progressive sector of the Catholic church to promote small farmers' mobilization among some communities from the Eastern Amazon. Likewise, Allegretti (1990) argues that Catholic agents played an influential role in mobilizing rubber tappers from the western Amazon.

In Santarém, FASE members have worked closely with the STR-Santarém, providing members with intensive education and training geared toward acquiring knowledge about their rights as small rural farmers (Leroy 1992). The STR-Santarém was created in 1972 but was linked to the military government; only in 1977-78 did the STR separate from government hands and become an autonomous organization. This organization is composed of a President, Vice-President, Secretary, Treasurer, and other staff members. Each rural community has two representatives—*delegado* and *vice-delegado*—who play intermediary roles between STR and small rural producers. STR fulfills several functions, dealing with rural producers' rights to land, rural workers' wages, retirement, health care, among others. This organization also provides short-term training programs for small rural producers in farming techniques and soil management. In particular, STR-Santarém owns a rubber processing plant to give rubber tappers technical support. However, with dropping demand at local markets, this plant was practically inactive for several years; then the demand slowly increased again, so that by 1998 STR was planning to reactivate it.

Each member must pay an annual fee to the STR-Santarém, which gives producers full rights to retirement salary and public health care. In past years, STR-Santarém has been setting up a number of collaborations with both governmental and non-governmental agencies for working together in projects of land reform and management of forest resources (mainly extractive reserves).

Another agency linked to the Catholic Church and that has also collaborated with the Ituqui residents is the Land Pastoral Commission group (CPT). CPT was founded in 1975 by bishops, priests, and followers, and started working with FASE by 1974-75 in a project to implement education for unionizing rural producers and/or workers. In other words, CPT's main goal was to fight poverty through strength in civil organization as well as empowerment of poor people in order to teach them to fight for their own civil rights. In Santarém, CPT has been more involved in fisher grassroot organizations rather than with rural farmers. FASE and CPT have their foundations in the Liberation Theology, with Leonardo Boff as the main representative in Brazil and throughout Latin America. However, discussion of the role and implications of Liberation Theology is beyond the scope of the present study (for more information see Boff 1988, 1987, 1984; Gutierrez 1996; McGovern 1989).

The history of the Ituqui fight for land is filled with violence and struggle among the residents over a period of approximately15 years. As previously mentioned, in 1974, a large-scale rancher, owner of a cattle company, bought the area of Ituqui which encompasses all the areas occupied by the seven Ituqui communities (see Chapter 2). The purpose of this company was to cut valuable trees for logging, then establish a pasture to raise cattle.[3] This project had support from the Brazilian agency for Amazonian Development—SUDAM (Leroy 1992). However, the presence of native Ituqui residents in the area represented a barrier for the company to accomplish its plan of exploiting the entire upland ecosystem. Thus, the company tried to expel people from the land, which in turn triggered conflict between local residents from the Ituqui region and the cattle company. Supported by the institutions described above, such as FASE, MEB, STR, and CPT, local residents learned how to claim rights to their land.

During the movement, farming production was carried out on a collective basis; yet the cattle company would create all types of constraints in order to prevent local residents from farming on those lands. The cattle company hired some policemen with support from IBDF, then the Brazilian Agency for Forestry, in order to keep local residents from using the upland areas—prohibiting locals from opening both mature forest and fallows (Leroy 1992). Losing its control over locals, the cattle company decided to invade Ituqui residents' field crops and destroyed them completely. Residents tried to ask for help from the Santarém Courthouse and other official agencies, but their petitions were ignored.

From this time on, FASE and CPT decided to help empower local residents in terms of organization and coordination of the movement. The movement became very tense and strong to the point of the cattle company's owner being killed, around the mid-1980s. But it is not clear who was responsible for his death or the facts behind it. During the land movement in the Santarém region, another death occurred. In 1982, the president of STR-Santarém was killed in an accidental fire at the STR's office after several violent confrontations with local police and INCRA officials (Leroy 1992). The president was a former squatter who was leading a movement for land in another Santarém area. Other fire attacks at the STR's office took place throughout the 1980s during the land movement, now more widespread in the region. In Ituqui, the land movement ended with INCRA's intervention by the end of the 1980s, following the death of the rancher. In 1987, the Brazilian government established the Ituqui settlement, called locally Gleba Ituqui, and local residents gained usufruct rights to the land (see Chapter 2). The Ituqui agrarian history is considered the first large-scale collective effort for gaining rights to land in the Amazon region (Leroy 1992).

Alston et al. (1999), studying land reform and land conflict in frontier areas of the Brazilian Amazon, argue that INCRA's intervention and resolution has been taking place where extreme violence, including deaths, are occurring. However, INCRA's intervention in those areas was to reduce tension and avoid more deaths rather than stimulate more violence. In reality, in past years, violence seems to have become landless people's strategy to call INCRA's attention and intervention (Alston et al. 1999). In the Ituqui case, it is not clear whether harsh conflicts involving deaths were a political strategy adopted by local producers or if those extreme outcomes were simply a result of intense and long-term conflict.

During this process of claiming the land, there were a number of leaders in the Gleba Ituqui, and a committee representing each community. Coordination of tasks and communications among local committees and members of all Patos villages provided local farmers with political knowledge and the capability to organize and even initiate a movement to defend their rights. The head of the overall movement from the Pau D'Arco community was the main informant between local leaders and government agencies. He also coordinated the division of tasks among all of the local leaders who were organized in committees at the community level. There were at least 15 leaders during that time from all the communities who were organized to transmit information to local villagers as well as to coordinate meetings and assignment of tasks in terms of sharing food, carrying out farming tasks collectively, and delimiting territory by opening trails in order to separate each lot of forest. During this period, women started participating more actively in the political movement (Leroy 1992), which will be addressed in the next section.

Collective Action and Women's Political Participation

There have been an increasing number of studies on women's participation in Latin America in both rural and urban areas (Deere and León 1987; Jelin 1990; Stephen 1997a). Studies in Brazil show the engagement of women in social movements since the

1970s, in several places from southern (Caldeira 1990; Spindel 1987; Stephen 1997) to northern and northeasten (Campbell 1996; Deere and Léon 1999) regions. Most of these movements took place in rural areas and are linked to improvement of family life, such as gaining rights to land (Campbell 1996; Deere and León 1999, 1990). As a result of rural women's movement during the 1980s, female rural workers gained rights to land title through the Brazilian Constitution in 1988 (Deere and León 1999).

Leaving the domestic domain and participating in the public sphere are not easy actions to take. Rural women have to conciliate a double burden—domestic tasks and income-generating activities—with voluntary cooperation. But for these women, joining a movement means a beneficial return for both themselves and their families. Despite the sociocultural constraints that women face in order to collaborate with a group, they have been playing leading roles outside the household: but such leadership has not been formally recognized.

There were a number of female leaders in the Gleba Ituqui during the process of claiming land. Although the political participation of men was dominant during that period, women started participating very actively in the movement (Leroy 1992), and some played leading roles. Their roles have been overlooked by formal and institutionalized male leadership. In the Patos community, there are two cases of female leaders who were leaders at both regional and community levels, but they were not formally recognized. The first, Sebastiana,[4] was actively involved from 1970 to1980 in this movement for land, and, although she she passed away in 1994, she is still considered to have been one of the leading individuals during the whole movement. The second, Raimunda, fulfills several positions within the Patos community. She is the main monitor of the Catholic Church (*catequista*), and she is the community promoter (*animadora*); she is also considered to be the actual head of the community by several villagers, in opposition to the official male coordinator.

Both women are seen as good leaders by local residents who consider them to be sound advisers and skillful negotiators, possessing initiative, leadership skills, and friendly personalities. In addition to occupying several positions within the community, Sebastiana and Raimunda also fulfilled their functions as farmers and housewives. Raimunda is also a midwife (*parteira*) and has assisted in the delivery of almost all of the village's children. Most of all, she is the wife of one of the key male leaders of the Ituqui region; he was very active during the land movement. As in the case of female leaders in Xapuri, Acre (Campbell 1996), Sebastiana and Raimunda have been exceptional leading individuals among the rural women and key agents beyond their domestic realm.

In the past decades, women have been assuming some of the community-level positions that had previously been filled only by male residents (see Chapter 3 for the Patos community sociopolitical structure). There is a school with one female teacher, who is also the principal and the community-level accountant. Although the *delegado* of STR is a male member, 15 female residents out of 39 adult females are affiliated with this grassroot organization. The reason why these women are STR members is mainly due to access to retirement and health care benefits.

Other changes are that a larger number of females have enrolled in elementary schools, and a number of young female residents have moved to the town of Santarém to become elementary teachers. The number of female teachers has increased among rural communities, as observed among floodplain communities (Futemma 1995) and in Xapuri

(Campbell 1996). The explanation of why a larger number of females than males is going to school is probably related to the division of labor among young residents. While a young son has to work with his father (fishing, hunting, farming, or ranching), a young woman can move to town and attend school. Today, most of the schools' principals and teachers in the rural sector are women. Women's increased education has provided them with opportunities to participate more actively outside the household and assume administrative or political positions not previously available to them.

An organization which did not survive in the Patos community (1963 to1966), but which is still in existence in several rural communities in Santarém (de Castro 2000), is the Mothers' Club. This club is linked to CPT and its purpose is to encourage female community-level activities among female residents in order to improve families' well-being. Some of the collective activities are making bread and making clothing for fund raising. It is not clear why this club did not succeed, but probably it was due to the lack of a market to sell these products and a lack of clear goals.

Unlike the Mothers' Club, a successful case of organization and task coordination under a female's hands (Raimunda's) was the building of a new Catholic Church. A couple of times every week, a group of residents (women and men of all ages) under Raimunda's coordination worked in day-long shifts. She was in charge of organizing shifts and commanding tasks. This collective activity required a coordinated schedule. After months of this working-group endeavor, the church was built.

Women have also achieved political positions at the municipal level. In 1994, the first female, Maria, was elected president of the Rural Workers' Union of Santarém. This fact indicates an increasing political participation and the official enrollment of women in the political arena even beyond the community level. Maria is from a rural community in Santarém. She was also a farmer and a *catequista* of the Catholic Church. She was in her late twenties and single when she was elected. Likewise, the presence of female membership and leadership in rural unions was registered by Deere and León (1999) for the states of Pernambuco and Paraíba in northeastern Brazil and Acre in the Western Amazon (Campbell 1996). The exceptional female leaders, Sebastiana and Raimunda, have been examples to the young generation, as in the case of Xapuri, where young females with higher levels of education are more involved in the women's group work (Campbell 1996).

Land Reform Aftermath and Settlement Drawback

Providing smallholders with rights to land is a part of the Brazilian national agrarian reform. The agrarian reform includes the provision of some infrastructures in order to allow smallholders to work on their own lands and provide subsistence needs. Hence, the Brazilian government agency INCRA is supposed to provide local communities with wells, roads, health centers, elementary schools, and farm bank loans.

There are several types of credit programs, the Special Program of Credit Line for Agrarian Reform—PROCERA—is geared toward agrarian reform areas (BASA 1997), which is the case of the Gleba Ituqui (INCRA 1994). Despite the fact that they are still claiming the need for wells and roads, some of them have received bank loans to either invest in cattle ranching or farming. With the lack of infrastructure, such as wells and roads, local farmers are still producing on a small scale, that is, more toward subsistence needs. As a result, a large number of farmers are now in debt to local banks—Amazon

Bank (BASA) or Bank of Brazil (BB)—because they did not produce enough surplus to payoff their debts.

Besides credit line shortcomings (see Part II on this chapter for discussion of farming credit line), communities from the Gleba Ituqui are still lacking a health center, wells in the plateau zone, and feeder roads (see Chapter 2). Local residents are constantly petitioning INCRA to implement these infrastructures. With regard to feeder roads, a large number of Ituqui smallholders, including Patos villagers, have been bartering wood with timber companies in exchange for opening roads. This situation has led to alteration of forest composition and structure (see more details, Chapter 5) as well as poorly maintained roads throughout the Ituqui region.

Land Tenure and Inheritance

Another important aspect that arose with privatization is the transference of rights to land to the next generation. Transmission of assets such a land is similar between men and women; that is, both daughters and sons may receive any material asset. It was almost unanimous among landholders about criteria regarding who has rights to land. The land will be transferred to those children who work on the land (in this case, either for pasture or crop growing). If a married female or male child is farming the land s/he will probably receive a piece of land. Therefore, children who leave the community or are not involved in agricultural production, have no rights to inherit land. However, inheritance of land is still not clear, considering that private land ownership is a new household asset, approximately ten years old. Nevertheless, the criteria for inheritance reported by most of landholders is land use. *Filhos de criaçao* may receive land as well if they work the land as any biological children. In the present community, there are two cases in which *filhas de criação* (female adopted children) received de facto rights to land from their adoptive parents.

In short, the success of this cooperation among at least six communities does not mean improvement in the form of land-use patterns or sustainable use of forest; rather it may indicate low agricultural productivity, low investment, but a high rate of removal of trees (see next section).

PART II

Land Reform and Land-Use Changes: Implications to Agricultural Intensification

Land tenure has been pointed out by several scholars as one of the key factors that define patterns as well as change in land use. Lack of defined land tenure systems has contributed to increased deforestation in several regions throughout the world (Alston et al.1999; Gibson et al. 2000). In the 1960s, state or private control of natural resources was considered the only way of guaranteeing the conservation of natural systems (Hardin 1968). In the Amazon region, more recently, there has been empirical evidence indicating the effect of land parcellization on rates of deforestation (Beaumont and Walker 1996; May 1992; McCracken et al. 1999). Regardless of ecological or social consequences of privatization, it has been the main type of property regime implemented by the Brazilian government in order to distribute and regulate land among small producers through agrarian reform. One aspect that has not been extensively addressed in the literature is the implication of land reform on household decision making regarding patterns of land use, agriculture intensification, and, consequently, conservation of forest cover.

Alston et al. (1999) point out that lack of defined land tenure—land insecurity—is more likely to drive individuals to use land in an abusive way. In the Brazilian Amazon, small producers do not invest in soil improvements by opening new areas of forest, or extensive systems. In most cases, they prefer to invest in annual temporary crops rather perennial ones. Whereas, large-scale farmers are opening more pasture areas in order to protect their land from landless invasion and expropriation. Cleared land is considered "beneficial use" by the National Institute of Colonization and Agrarian Reform of the Brazilian government, and thus not subject to expropriation. Current definition of "beneficial use" creates incentives for landholders to cut more trees, increasing deforestation rates (Alston et al. 1999).

The distribution of land, through a process of land reform, started in the 1960s as part of a large program of development in the Brazilian Amazon region. Land reform along with incentives to export-led agriculture and stock (cattle) were the major economic targets among several Latin American countries in order to develop isolated rural areas. In the Brazilian Amazon, government incentives for cattle ranching—in the form of tax incentives and credit lines—have led to an increase in the number and size of pasture areas among large- and small-scale producers (Fearnside 1989; Hecht 1993).

As previous studies in the Amazon have shown, several internal socioeconomic factors affect the household decision-making process regarding whether to open a mature forest or a secondary forest, whether to grow annual, perennial, or pasture areas, or simply to abandon the land (Brondízio et al. in press; McCracken et al. in press; Moran

1981; Murphy et al. 1997; Pichón 1997). In other words, households may face different opportunities and constraints that are not observed at larger scale, such as at regional or even at community level. Labor availability, gender differences, and source of income are some of the factors observed by previous studies, which affect land use in kind and degree. Usually, small farmers depend heavily, if not exclusively, on household labor (Boserup 1965; Chayanov 1986 reviewed in Netting 1993), limiting production among those households that have little active labor available. However, if they can afford it, some small producers may hire labor to accomplish household agricultural tasks. To do so, a household has to have some source of income such as cash crops or a retirement salary from an elderly household member. In the same token, during the past two decades, literature has expanded on recognition of women's contributions to household livelihood in terms of participating in production systems as well as in the decision-making process (Bruijn et al. 1997; Deere and Léon 1987; Gianotten et al. 1994; Hamilton 1998; Kabeer 1994; Rocheleau et al. 1996; among others). Another aspect of the gender issue is related to the right to land ownership. Only with the new 1988 Federal Constitution (Constitution of 1988), have the Brazilian rural women gained the same rights to titled land as men have (Deere and Léon 1999). Land title also gives women access to agricultural credit loans; however, studies on how rural women producers are dealing with this recent agrarian context and are taking advantage of this new opportunity are still scarce.

In order to address these issues with respect to the relationships between changes in land tenure and forms of land use, I look at an Amazonian *caboclo* settlement—the Gleba Ituqui in the Santarém region of Pará state—that began to experience land reform by the end of the 1980s. This analysis is organized in two levels. At the settlement level, Gleba do Ituqui, I present and discuss land-cover and land-use changes taking place across 282 farm lots settled during the period from 1986 (initial settlement) to 1997. In order to provide a more detailed analysis of the relationship between socioeconomic and environmental factors influencing land-use change, I analyze the household level of 27 farm lots of the Ituqui settlement—the Patos do Ituqui community with particular emphasis on five main variables: (1) land tenure (before and after privatization); (2) location of lot—bottomland or plateau—proxy to water source; (3) access to credit line; (4) retirement salary; and (5) gender of the head of household.

Among the Patos private smallholders, several are not investing in the land, while others are opening pasture and/or growing crops. It would be expected that, with privatization, everyone who holds a private lot and has access to credit line would be investing in land, considering land availability, labor availability, land security, and financial support. Why are some households investing and other are not? Although privatization provides local villagers with land security and financial support, at household level they may face some opportunities and/or constraints that affect their decision on whether and how to invest in the land.

This work combines a georeferenced household-level survey, interviews, and participant observation with remote sensing data (Landsat TM images 1986 and 1997) and vector data representing property boundaries and roads organized within a geographic information system. These data help us to address key questions on land-use change and to understand the role of infrastructure of environmental factors (e.g., access to water) upon the success of a government-sponsored settlement. Furthermore, it points to the intrinsic linkages between upland and floodplain areas in relation to land use and the regional economy. Santarém has been the focus of intensive research of the LBA (The Large-Scale Biosphere Atmosphere Experiment in Amazonia) program. This study aims to contribute to the understanding of the human dimensions of the land-cover change processes taking place in the region.

Methodology

To assess the effects of land reform, two sets of data were gathered in order to evaluate spatial and temporal changes in land-use patterns, covering periods before and after privatization: remotely-sensed data (satellite images) and *in situ* data (field reconnaissance and interviews with local small producers). Methods used in the present study are based heavily upon previous work of both the Anthropological Center for Training and Research on Global Environmental Change (ACT) and the Center for the Study of Institutions, Population, and Environmental Change (CIPEC) teams at Indiana University (Brondízio et al. in press, 1996, 1993; Green et al. 1999; Mausel et al. 1993; McCraken et al.1999; Moran et al. in press, 1994,1993).

Remote Sensing Data

Image analysis for this study involved several steps from collection of different types of ground data in the field digital image to data analysis at the computer laboratory. Two Landsat 5 TM scenes (July 29, 1986, and July 21, 1997) for path 227 and row 62 were radiometrically and atmospherically corrected and analyzed. Topographic maps (1:100,000) were used as the base for georeferencing and registration processes. A hybrid classification procedure was used, integrating statistical analysis of spectral data and field data (training sample) representing different land-cover types.

Ground Data

Fieldwork was conducted in 1997 and 1998, during which ground data (reconnaissance of the area or ground truth), history of land use, and Global Positioning Space (GPS) points were collected.

Through ground truth data, different types of land cover (mature forest and secondary successions) and land use (field crop, pasture areas, and roads) in the field were recognized. Training sample protocols were filled out in order to register characteristics such as type of forest or direct use of the land, approximate age of secondary succession, height of trees, diameter of trees, and canopy cover. Ten farmers from the Patos community were interviewed, and 110 training samples were filled out in Patos and throughout the Gleba Ituqui and areas surrounding Santarém city. One Landsat 5 TM scene (1986) was taken to the field in order to carry out ground truth data and farmers' interviews.

The 1997 image coincides with fieldwork (July 1997), which helped to reduce errors in data analyses. In addition, the two images cover a very proximate seasonal period: both are from July, which helped control possible radiometric errors of analysis as well.

Data Analysis

In order to conduct classification analysis of the 1986 and 1997 TM scenes, pre-processing steps were carried out. The images were georeferenced using topographic maps (1:100,000) that had been scanned and converted to a raster layer. The two scanned images were georeferenced and geocorrected using Imagine version 8.3.1 software. The next step involved the radiometric calibration of the two TM scenes using Imagine and Excel, followed by unsupervised and supervised classifications. The final stages included a transition matrix and a household-property level analysis using a vector layer representing a property grid.

The unsupervised classification was also run on Imagine software. Unsupervised classification was an important step toward selecting some of the areas of interest, such as stages of secondary succession and differentiated field crops from pasture areas. Thus, unsupervised classification was a tool used before and during the supervised classification processes.

Training sample data were first entered into Imagine to create signature files for each class. Afterward, probability based on maximum likelihood was the main classifier used in the present analysis. In order to extract each class, statistical separability (Transformed Divergence) and contingency tests were run several times while comparing signature files derived from both training samples and unsupervised classes. Conceptual and comparative analyses of spectral signatures were also important instruments to separate each class more accurately. In order to correct or minimize problems of misclassifications and cloudiness, techniques to enhance or correct those errors were applied, such as filters, masks, and polygon filling (Imagine version 8.3.1). Finally, the quality of the classifications was assessed using an accuracy assessment tool in Imagine 8.3.1. Kappa statistics indicated a rate of overall accuracy of 79 percent for the 1986 TM scene and 93 percent for the 1997 TM scene. An accuracy assessment in situ was recently conducted, in July of 2000, confirming the accuracy of the present classification. Finally, a transition matrix was run on Imagine 8.3.1, following procedures similarly used by Brondízio et al. (in press) and McCracken et al. (1999).

A Geographical Information System (GIS) was assembled including classified and transitioning images, property and road grid, and selected variables derived from interview data. The property and road grid was generated using a combination of ArcView, Imagine, and PhotoShop. The technique used was developed by an ACT team that has been working intensively at a site in Altamira (Eastern Amazonia) and providing useful methodological tools for studying dynamics of land use and land cover at different scales and across time (Brondízio et al. in press; McCracken et al. 1999; Moran et al. in press).

Eight classes of land use and land cover were identified (figures 4.1 and 4.2): forest (mature upland dense forest), SS1 (initial secondary succession), SS2 (intermediary to advanced secondary succession), floodplain areas (merging classes of flooded forest and natural grassland), pasture (cultivated grasses such as *braquiarão*, *Brachiaria spp*), farming (annual field crop such as manioc and corn), bare soils (roads and urban areas), and water (all types). By using training samples and ground truth data as well as analysis of spectral signatures it was possible to discriminate between those classes, especially SS1 and SS2, and pasture and annual field crop. Unlike other studies carried out in the Amazon region by the ACT team, in the present study, vegetation inventory of different stages of secondary succession was not conducted. Inventory was carried out only in mature forest areas. However, a CIPEC training sample protocol (see more information on www.cipec.org.) that included aggregated structural measures of land-cover classes, such as information on height, dbh, density, canopy closure, and species dominance and, when possible, land-use history from interviews. We collected 110 training samples distributed across all land-cover classes.

Data from training samples provide some information to discriminate SS1 from SS2. SS1 is characterized by trees of 2 to 3 ½ meters tall (emergent over five meters) and, on average, one to four-and-a-half years old. SS2 is between five and 15 years old with trees of 7 to 10 meters tall (emergent over 15 meters). Mature forest is 25 years old or more with trees above 15 meters in height, and emergent can reach above 35 meters.

Changes in Land-Use Patterns and Types of Land Cover

After analyzing the process that led to privatization of the upland ecosystem and creation of the Gleba Ituqui settlement, this section aims to analyze how that land reform affected land-use patterns at settlement and household levels by comparing remotely sensed data, before (1986) and after (1997) privatization.

Land-Use Patterns at Settlement Level

Overall, for the entire area of the Gleba Ituqui, deforestation rates of mature forest and SS2 have increased since privatization in 1987 (figures 4.3, 4.4, 4.5). An average of approximately 3 percent per lot was removed. Areas of annual crops, pasture, and SS1 have increased, yet at lower rates—less than an average of 2 percent per lot, which means approximately one hectare per lot (Table 4.1).

Another change that has taken place since land reform is a process of upward displacement of land use from bottomland (close to stream) to plateau (distant from stream but closer to roads) (Figure 4.5). Eight percent (23) of private lots are located in the bottomland zone, and 92 percent (283) are in the plateau, which explains why farmers are starting to use the plateau as well. Prior to privatization, mature forest in the plateau zone was practically intact (see Figure 4.5); afterward, the area of mature forest was reduced in both ecological zones, around 27 percent among bottomland lots and 15 percent among plateau lots (Figure 4.5a).

Figures from the transition matrix (Figure 4.5b) indicate that a larger area of mature forest (2.5 percent of the lot area) was converted into pasture when compared to areas of SS2 (less than one percent of the lot area), followed by conversion of SS1 (between 0.2 percent and 0.7 percent). In general, the conversion of forested vegetation into pasture was higher in bottomland than in the plateau (Figure 4.5b). Before privatization, there was a very small pasture area in the bottomland, averaging to one percent of a lot area, and no pasture in the plateau area. Even after legal access to plateau, bottomland forests have been the preferred place to raise cattle due to its proximity to water (crucial during the dry season); but, slowly, cattle raisers are clearing more areas in the plateau zone. Lack of water helps to explain why this upward displacement to the plateau area has been more significant; otherwise, plateau lots would have been altered at much higher rates.

Areas opened for annual crops such as manioc and corn were also larger in the bottomland in 1986, but after privatization farmers began opening more plateau area, as indicated by Figure 4.5c. Across the bottomland lots, farmers are opening slightly more SS2 (1.5 percent of the lot area) than mature forest (one percent of the lot area) for annual crops, which indicates an intensification process in this area. Among plateau lots, the removal of mature forest, SS2, and SS1 are on average similar (less than 0.5 percent of the lot area, see Figure 4.5c). That is, among plateau lots, there is a mixed system of intensification and extensification of land use. Crop fields continue to be the main form of land use even after privatization, as opposed to initial expectations that cultivated pasture would be larger than crop field by 1997.

(Figure 4.3 about here)

(Figure 4.4 about here)

(Figure 4.5 about here)

(Table 4.1 about here)

Socioeconomic and Ecological Factors and Land-Use Patterns at Household-Property Level: The Patos do Ituqui Case

Similar to patterns observed at the settlement level, farmers from the Patos community are also still using more of the bottomland areas than the plateau (Figure 4.6). Clearings of mature forest and SS2 also increased after privatization, yet at a very low rate, averaging 77 percent of forest per lot in 1986 and decreasing to 76.5 percent in 1997 (Table 4.2). Areas of SS1 increased on average more than 4 percent per property, followed by crop field (2.6 percent) and pasture (1.3 percent). Similar to patterns observed for the entire Gleba Ituqui, local farmers are still opening more area for growing crops rather than raising cattle (Table 4.2). In fact, large areas of pasture, more than 500 or 1,000 hectares, can be observed surrounding the Gleba Ituqui (figures 4.3 and 4.4) opened by cattle raisers before 1986. The presence of these large-scale ranchers indicates the importance of cattle in the municipality and/or region, which affects small producers' decisions regarding how they use their land.

(Figure 4.6 is about here)

(Table 4.2 is about here)

At the farm-property level, opportunities and constraints faced by each household lead to different patterns of land use. As expected, households that had access to formal credit opened more land for farming (5 percent) than those who did not get loans (less than 1 percent) despite credit line shortcomings (Figure 4.7b). Considering that lots average 52 hectares, households with credit are cultivating around 2.6 hectares vs. 0.5 hectare among those who did not receive credit. In regard to pasture, very few households invested in cattle. This figure also indicates a larger amount of SS1 and SS2 among credited households (around 10 percent and 5 percent per lot, respectively) than non-credit households (around 5.5 percent and 0.2 percent per lot, respectively). As a result, households that did not receive credit have a larger area of mature forest (90 percent per lot) than those with credit, who have less than 80 percent of mature forest (Figure 4.7b).

In general, households that have retirement salary are opening slightly more land for agricultural purposes than those who do not receive a retirement salary, as shown by pasture, annual crops, and SS1 (Figure 4.7b). Consequently, households with retirement income have less mature forest (around 55 percent) than those households that do not receive a retirement salary (more than 75 percent).

As expected, figures indicate that female-headed households are opening smaller areas for field crop (3 percent) than double-headed households (6 percent) and no female households raise cattle (Figure 4.7d). Lack of labor is probably the main reason why these female heads are not investing in agriculture, choosing to either cultivate some manioc for subsistence needs or not cultivate at all.

(Figure 4.7 is about here)

To conclude, a homogeneous land-use pattern was expected across private property lots. However, a more uneven distribution of cleared and forested land has been observed; i.e., only some households are using their private lots while others are not, due to lack of incentives. One question that remains is whether farmers are moving toward more intensive or extensive use of the soil. In the bottomland with long-use history, a slightly larger area of SS2 has been cleared than mature forest, indicating an intensification of land. However, in the plateau lots with more recent history of land use, there is no such pattern of intensification, and farmers are clearing mature and secondary forests at similar rates. In fact, Figure 4.5 also indicates that more farmers are opening more mature forest across plateau lots which indicates an initial extensive system (see next section). Some are simply leaving their land completely intact, probably only selling commercial wood. Thus currently, at landscape level, there is no single production system—intensive, extensive, or regressive (deintensification)—among the Ituqui producers. Rather, they occur concomitantly.

(Figure 4.7 about here)

(Table 4.2 about here)

After Land Reform: Agriculture Expansion or Retraction?

Property rights regime is not a determinant factor that defines patterns of intensification or guarantees forest conservation. Rather, analysis at household-property level reveals that ecological and socioeconomic factors faced by households affect their response to how to use a piece of land and whether or not to adopt a more intensive system of production. Guillet (1987), studying farmers from the Andean mountainous region, observed that in places characterized by houseplot control of land, among other ecological and social attributes, intensive agriculture was found. As opposed to places that are characterized by communal control of land, where deintensification of production took place (Guillet 1987). In the Patos case, microanalysis at household level indicates that within the same property regime—private property—different patterns of land use and different systems of production are found across households, depending on ecological and socioeconomic factors. Some farmers are intensifying, some are using a more extensive system, and some are reducing their production in a regressive process, called deintensification by Guillet (1987).

Intensification of agriculture implies maximization of a production per area with increasing production and increasing frequency of cultivation of the same land with technological input (Boseurp 1965), whereas extensive systems underlie low production per area, clearance of new forest areas for cropping after a drop in soil fertility, and low investment in technology. If a farmer uses the same piece of land continuously or permanently or clears a fallow for cropping, s/he is using the land in an intensive manner. In contrast, if a farmer uses a piece of land only temporarily, after one or two harvets, s/he opens new areas of mature forest, hence practicing an extensive system. A third type is the process of deintensification, when a farmer reduces a farming production or even abandons her/his lands (Guillet 1987).

There are several factors that affect farmers' choices of whether to practice an intensive system, extensive system, or reduce agricultural production. Guillet (1987), studying the Andean farmers, observed that intensification and deintensification coexist simultaneously, depending on types of ecological and socioeconomic and cultural aspects. Factors such as lower terrain, distance to village nucleus, lack of water, and communal control limit intensive agriculture. Whereas, houseplot management, plots close to village nucleus, availability of water, and alfafa meadows encourage intensification (alfafa is a semi-perennial crop that contributes to maintaining soil fertility and continuous cultivation). Deintensification occurs as a result of several factors such as land abandonment, development of domestic cycle, migration (lack of labor), communal resource management, and environmental hazard—erosion, landslides, mudslides, and flooding (Guillet 1987).

Similarly, intensive, extensive, and regressive (deintensified) systems of agriculture were found side by side among the Patos small farmers as a result of several internal and external factors: regional political-economy, land forms, and household economy and structure. Factors such as unsuccessful previous experience with credit line led Patos producers to respond more as risk-averse, whereas factors such as female-headed households with insufficient labor and lack of water source led to a reduction or abandonment of farming production. In contrast, other factors like green field leasing and water availability have contributed to a more intensive system.

Household-Property Analysis: Opportunities and Constraints to Agriculture Intensification

As mentioned, the agrarian reform includes the provision of some infrastructures in order to allow small producers to work on their own lands and provide for subsistence needs. Among other provisions, the Brazilian government agency INCRA is supposed to to open wells, build roads, and facilitate farm bank loans, but it is falling short of its responsibilities.

With regard to feeder roads, a large number of Ituqui smallholders, including the Patos villagers, had to barter wood with timber companies in exchange for opening roads. This situation has led to alteration of forest composition and structure as well as poorly maintained roads throughout the Ituqui region. Besides lack of infrastructure, credit shortcomings are preventing small producers from investing in land. Some are investing very little or even abandoning the private lot (deintensification process), while others are clearing new areas of mature forest (extensive system). Those who are fortunate enough to be closer to water source and to have labor are heavily investing and using regrowth forest (intensification process).

Steps toward Agriculture Retraction: Deintensification

Agricultural Credit Flaws. Because of debts, several households are now apprehensive to withdraw money from the official bank due to several reasons that are addressed below. Eleven households from Patos borrowed money from the local bank between 1990 and 1991, but apparently only three of them paid off their debts. In general, these farmers argue that manioc production does not compensate enough economically to pay off debts.

During the second credit line in 1994, only five farmers from Patos borrowed money. A similar situation of risk-aversion behavior in regard to bank loans was observed by Chibnik (1994) among riverine farmers in Peru who were afraid of receiving loans for rice production and of holding a debt. In recent years, the local bank (BASA) changed its policies to finance only cash crops such as coffee, manioc, and corn, but not cattle. During the third credit line in 1998, an even smaller number of farmers were interested in borrowing money from the bank due to the above reasons. In fact, many of them were willing to invest in cattle ranching rather than annual or perennial cash crops. It is worth mentioning that for these landholders, investing in perennial crops such as coffee means that they have to wait at least two to three years or more to receive any financial return. Even if they grow corn or manioc, from their viewpoint it is not a worthwhile investment. Finally, due to the lack of an immediate water source in the plateau areas and lack of available feeder roads to transport products, local farmers argue that it is not possible to produce for commercial purposes. Thus, risk of withdrawing a credit loan, lack of water, and lack of roads are leading to a process of deintensification.

Because of a large number of debtors, BASA decided to negotiate with smallholders only through an association. Thus, BASA no longer deals directly with a producer. S/he has to be a member of an official association in order to have access to a credit line. In the Gleba Ituqui, the Rural Producers Association of the Gleba Ituqui (ACACI) was created with approval of INCRA. Its role is to represent Ituqui smallholders in loan transactions, to monitor producers who owe money to the banks and to help them pay off their debts. However, ACACI has not been efficient in any of its functions; it has played a weak role among smallholders thus far, based on criteria of accomplishment of its function, participation of small producers, and changing its representative (election). The association is not fulfilling its function in monitoring small producers' production and payment of debts, participation of small producers in decision making is low, and the representatives have been in power since its foundation, almost 13 years. The bottom line is that associations should be more autonomous with strong participation of small producers by proposing new forms of land use and decision making and providing a system of election, thus changing its representative in order to avoid concentration of power in a few local leaders.

Therefore, credit lines are indeed an important incentive to help small farmers and to promote a more sustainable use of land (agriculture intensive system), but credit programs need to be more carefully planned to consider local infrastructure conditions, the local environment, variation in gender and labor force across households, the local producers' demand, and a more efficient manner of transmitting information and providing small farmers with extension services.

Head of Household. Considering access to farm credit to hire labor for carrying out heavy tasks and their participation in other activities, why do female-headed households in the Patos community use land at a lower rate than double-headed households? In the Patos community, there are five female-headed households among smallholders and three among the landless group. Most of them are widows with little or no labor available to carry out agricultural activities. Those who receive retirement payments can hire someone to perform these tasks, but those who cannot afford paid labor either raise a small-scale field crop or do not farm. Retirement for those widows means a secure source of income, and, for them, farming is not worth the investment of money, time, and energy. They prefer to keep the retirement income. As a result, the amount of mature forest and fallow land is larger among female-headed households (more than 75 percent) than among double-headed households (around 60 percent) (Figure 4.7d). A female-headed household is an example of the importance of a domestic cycle with aging parents and children moving out, which result in reduction in production. Other situations of deintensification are related to out-migration and land abandonment.

Out-Migration and Private Lot Abandonment. There are four smallholders in Patos who abandoned their lots. As in other places in the Amazon, there are three types of lot abandonment. First, smallholders sell some or all of the timber from a forest, then abandon it. Second, complete abandonment of the lot, without touching it, neither for selling timber nor for agricultural purposes. Third, departure from the community but requesting that someone, usually a relative, take care of the lot. The reasons for abandonment seem to be the same as the reasons that some households are not investing in land production at all: lack of a stable and suitable farm credit line and lack of local infrastructure, such as a source of water (wells) and feeder roads.

Lack of economic opportunity or lack of a better infrastructure (school, health care, electrical power lines) is still contributing to drive young adults to move out in search of better economic activity or more attractive places which, at first, seem to provide them with a more secure welfare. A household's private land does not seem to indicate a secure life to the young generation, as suggested by some households whose composition is a lonely mother. Sometimes, one or two married children will stay to take care of their parents and, eventually, will receive a piece of the private lot. One third of the total Patos adult children (from16 households) have been living elsewhere in the 1980s and 1990s because of job opportunities, education, and marriage. At the beginning of the gold mining boom in the Itaituba region, another county south of Santarém along the Tapajós River, a large number of Patos male residents went away to work in the gold mines. Approximately 17 of them returned. Several had died or completely disappeared without any news. The main causes of death were/are malaria and physical violence between miners and mining managers. Out-migration and land abandonment are contributing to a regression of agriculture, again leading to a process of deintensification (Guillet 1987).

Fortunately, local smallholders are able to overcome some of these problems of labor shortage, landless households, and risky credit line and adopt new agricultural strategies. In this case, sharecropping and green fields are two strategies found among

Patos farmers. These strategies along with availability of water seem to allow them to invest in a more intensive system.

Farming System: Intensive versus Extensive

Netting (1976) observed that intensification is found in places with high density population, scarcity of land, and high production per area as opposed to the extensive system that occurs in areas with low population, abundance of land, and low productivity as in the case of the shifting cultivation in the Amazon region. Besides Netting's (1976) great contribution to the consideration of ecological and economic attributes of natural resources as important variables for explaining intensive and extensive systems of agriculture, he did not consider the fact of the two systems existing side by side as found by Guillet (1987). I argue that history of land use (or occupation) and water availability affect farmers' decisions at household-property level of whether to invest in an extensive or an intensive system.

History of Land Use and Water Availability. In new areas of colonization, families have to invest in infrastructure such as building houses and fences. To do so, they usually have to use more forest resources, which leads to a higher rate of deforestation at initial stages of occupation than later stages (Brondízio et al. in press). In addition to being settled, using secondary forests contributes to reduce removal of mature forests. Observations of using fallow for agricultural purposes as a part of swidden systems among native populations of the Amazon region brought another view of agriculture intensification (Padoch1989). Instead of clearing new areas of forest for cultivation purposes, small farmers use fallow areas. Besides contributing to the understanding of the use of secondary forests, Brondízio and Siqueira (1997) also bring a new view of how small producers are able to intensify production and maintain their forested area. Studying the agroforestry system among small farmers from an estuary area in the Amazon, Brondízio and Siqueira (1997) observed the ability of local collectors of a particular palm tree fruit (*açai*, *Euterpe olearacea*) to organize themselves and manage it in order to increase palm production, keeping forest stands. Recognition that farmers also invest in secondary succession has contributed to a more optimistic perspective on forest conservation (Dubois 1990; Moran et al. 1994) in that farmers can increase crop production and maintain forest coverage.

In the Ituqui case, the bottomland zone is characterized by a long history of land use as opposed to the plateau zone, which has been recently used—since land reform (1987). Results indicate that the Ituqui farmers are using more SS2 for cropping and pasture purposes than mature forest in the bottomland zone (Figure 4.5). In contrast, a larger area of mature forest has been removed for agricultural purposes than SS2 and SS1 in the plateau zone. Hence, farmers are practicing an extensive system in areas of recent use—the plateau zones. Whether to choose a mature or secondary forest depends on the types of crops. According to local farmers, rice grows better in a mature forest's soils, while corn and manioc are more suitable for soils from secondary forests. Availability of labor also affects decisions of whether to clear secondary or mature forest for cultivation. Clearing a mature forest is hard work (big trees) but tasks become easier in later stages in regard to weeding: only one or two times during the whole harvesting season. In contrast, fallows may be easier to clear at first (smaller trees), but a large amount of weeds grow in less fertile soil, demanding more weeding time: four to five times during a season. Therefore, households that have little labor may choose to use mature forest instead of secondary one.

Availability of a water source contributes to explaining intensification of private lots in bottomland. Lack of water in the plateau area is one of the main complaints among farmers from the Ituqui settlement as a constraint to investing more in farming production. Guillet (1987) also found that availability of water is an important factor for creating favorable conditions to practice intensive agriculture.

As mentioned previously, two other constraints that the Patos smallholders face and try to overcome in order to continue investing and intensifying their production are landlessness and credit shortcomings. These local smallholders adopted some strategies that create more opportunities to intensify their agricultural production and provide land for cultivation for those who do not have it.

Landless Households: Sharecroppers. As mentioned previously, with privatization, a landless population emerged in the Gleba Ituqui. In the Patos community, there are 10 households that own no land (the LL households); therefore, they do not have access to a credit line either. The LLs own no land but they have their own house located in an area that averages 30 meters by 50 meters. Eight of these 10 households are involved in agricultural production, mainly for subsistence, and secondarily for cash income. There are five landless households that are smallholders' relatives (one case of a married child, one case of a parent, and three cases of siblings). In these cases, landless households can cultivate continuously in their relative's lot. In cases where a landless family is not kin-related, they frequently plant in more than one private lot. In fact, they change the lot constantly, if not every season. They usually clear secondary forest, unless the owner wants them to remove a mature forest for future use, probably for pasture.

In raising cattle, landless households usually join a landholder as a partner. The former invests labor, and the latter invests the land. Overall, sharecroppers help landholders with labor, but they largely produce for subsistence needs rather than cash income. They grow mostly annual crops, considering the temporary availability of land.

Green Field Leasing Strategy. As previously discussed, after unsuccessful experience, the credit loan is now perceived as a risky investment. People argue that cattle ranching is one of the economic activities that produces enough income to pay back loans. Another strategy that has been adopted by these smallholders in the past years is to sell the unharvested manioc crop to a second party who is a producer of manioc flour outside the community, this is called a green field—*roça verde*. In this case, landholders clear the area, burn the field and plant, then they sell *roça verde* to a flour producer who harvests the manioc roots and transports them to a processing plant to make the flour. This is the case of one retired head of a Patos household that has no available family labor, and thus he could hire help only for clearing and planting but not for harvesting and making the manioc flour, which requires a large number of labor hours (525 hours per person per hectare, Futemma et al. manuscript). This *roça verde* has become an attractive economic strategy among these smallholders in order to obtain some surplus to pay off bank loans. Such a strategy allows local smallholders who lack labor to continue intensifying their agricultural production.

Final Considerations

The result of approximately fifteen years of fighting to gain rights to the upland forest that ended up with land reform has given rise to two new groups of actors within the Ituqui settlement: smallholder and landless households. The history of the land movement reveals the formation of social capital through both pre-existing local organization and external support. The Ituqui residents have collaborated in a collective effort to defend their rights from external threat and pursue their legal use and access to land until a federal governmental agency intervened in the case. Land reform implies a more intensive and productive use of land in order to provide local residents with food and cash income with help from official bank loans. However, credit line shortcomings and lack of infrastructure are not motivating smallholders to invest time and energy in their lands; rather, they are either abandoning the land or simply selling timber.

Defined land tenure is not enough to guarantee agriculture intensification and conservation of forest. In fact, which factors are affecting a farmer's decision depend on the scale of analysis. At community or settlement level, privatization of upland forest has led to an overall increase in cleared areas for cultivated pasture and field crops. However, analysis at household-property level reveals that some farmers are intensifying their production as opposed to others who are using the land in a more extensive way.

In fact, large areas of forested vegetation (mature forest and SS2) indicate that in ten years rates of increasing cleared areas were relatively low among smallholders from the Gleba Ituqui. After land reform, most of the vegetation coverage is still represented by mature forest, 76.5 percent in the Patos community and 83 percent in the Gleba Ituqui. Ituqui is an example of a non-frontier area that has long been occupied by native small farmers as opposed to colonists in frontier areas who present a high rate of deforestation at the initial stage of agrarian reform (occupation). Colonists need raw materials from forests in order to build their houses and fences; that is, they have to create some infrastructures at the beginning, which leads to higher deforestation rates than later stages (Brondízio et al. in press). In the plateau, an uneven distribution of forms of land use (annual crops and pasture areas) is observed among Patos' private lots. Paying attention to household dynamics and local biophysical attributes, factors other than land tenure play important roles in defining land use patterns. These include credit lines, retirement, and gender of the head of a household. Unstable and unsuitable credit lines and unequal distribution of land may explain why forms of land use differ across households within the same community. Finally, results show that forest removal within Gleba Ituqui boundaries are still due to annual crops rather than to pasture which characterizes the traditional or long-term history of a land-use system among local smallholders.

Small producers from Patos also show an adaptive strategy in order to overcome risk of withdrawing credit line and lack of land and labor (landless households) such as green field leasing and share-cropping. In fact, these strategies also create more opportunities for local farmers to invest in intensive production.

Although logging is important for local economy, it was not possible to detect removal of wood from the forest through remote sensing analysis. Logging has been one of the major activities in the region, removing a large amount of timber from the entire area. Unfortunately, data are based on local reports (local residents and logging companies), and thus, logged mature forest areas could not be distinguished from non-logged areas. To conclude, the present study shows the importance of looking at differences in household structure and economy and biophysical characteristics of a setting in order to understand variation in patterns of land use and types of forest coverage within a region and even within the same community.

Endnotes

[1] One of the criteria for land expropriation policy is that land without beneficial use is more likely to be expropriated than land that has beneficial use. A simple clearing of a forest is considered beneficial use, according to INCRA's definition.

[2] The land was expropriated by decree 94.169, and the settlement project (Gleba Ituqui) was created by decree INCRA/no. 806/87 on 19 September 1987. The settlement encompasses six communities: Patos do Ituqui, Pau D'Arco, Cabeceira do Marajá, Serra Grande, Santana do Ituqui, and Nova Aliança.

[3] To exploit timber and open pasture, the company was supposed to have technical support from SUDAM and IBDF.

[4] In order to protect individuals' identities, fictitious names are used.

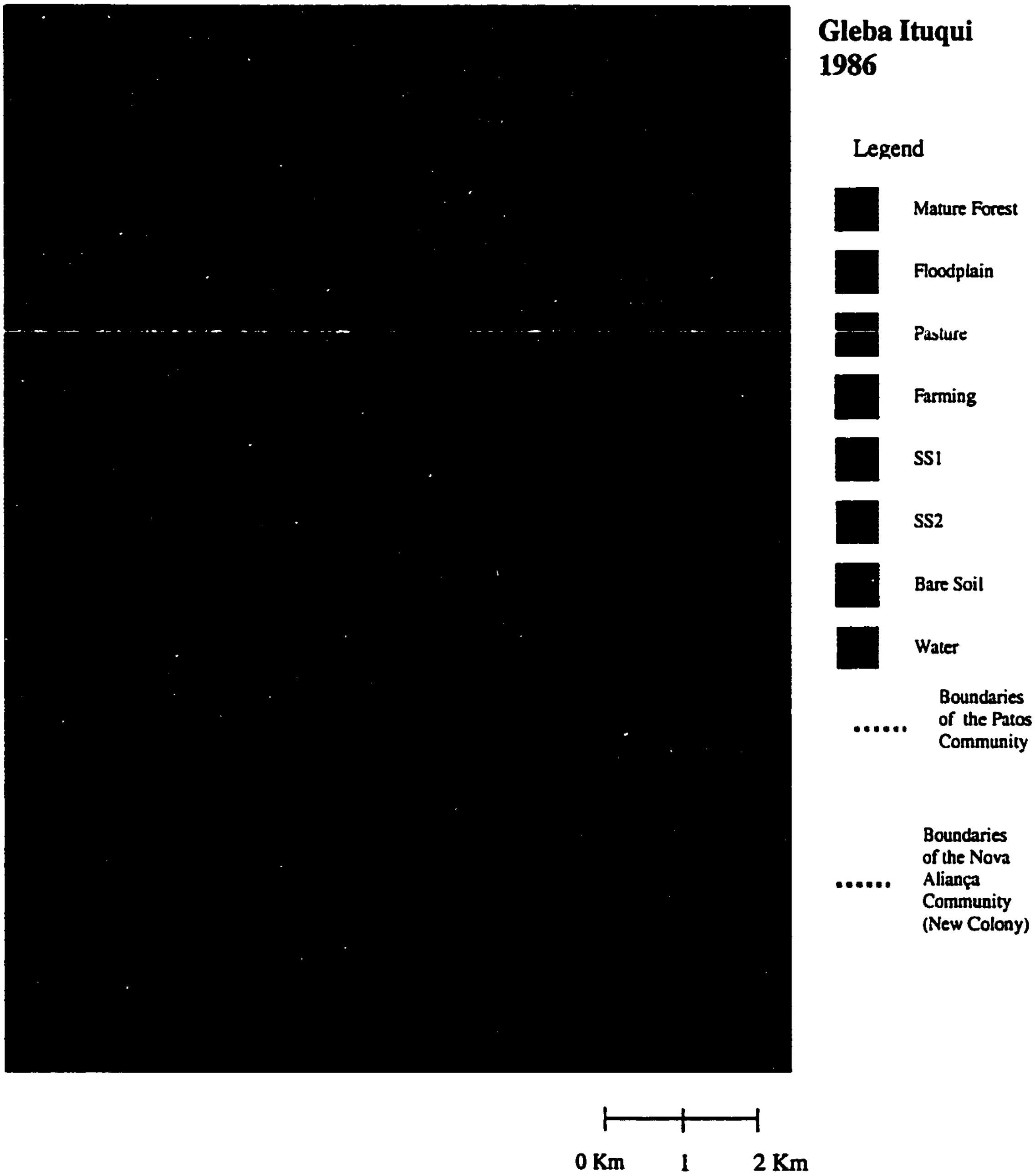

Figure 4.1. Classified Image (TM-1986) and Property Grid of the Gleba Ituqui before Privatization, Depicting Areas of Farming, Pasture, Bare Soil, Secondary Succession, and Mature Forest

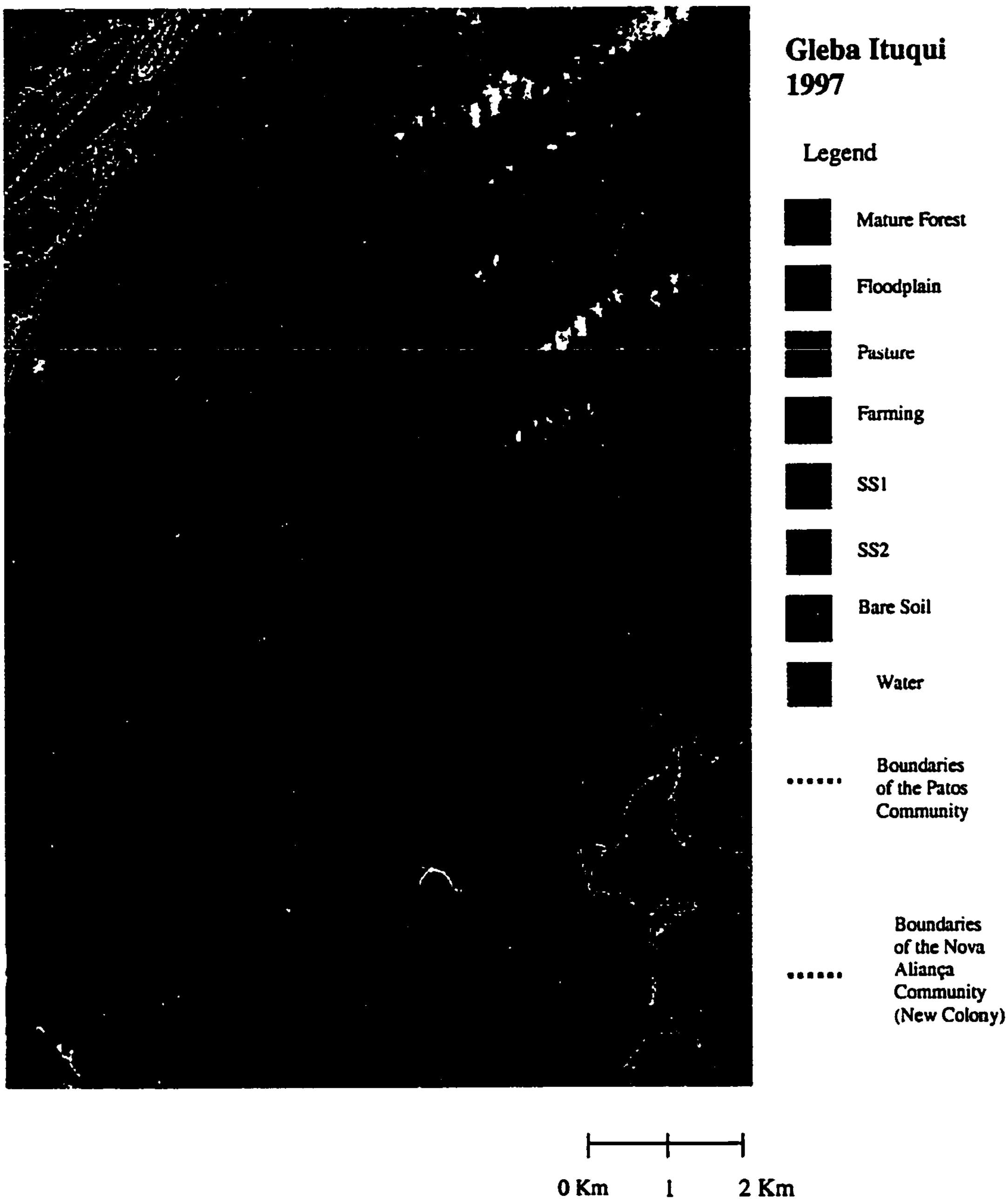

Figure 4.2. Classified Image (TM-1997) and Property Grid of the Gleba Ituqui after Privatization, Depicting Areas of Farming, Pasture, Bare Soil, Secondary Sucession, and Mature Forest

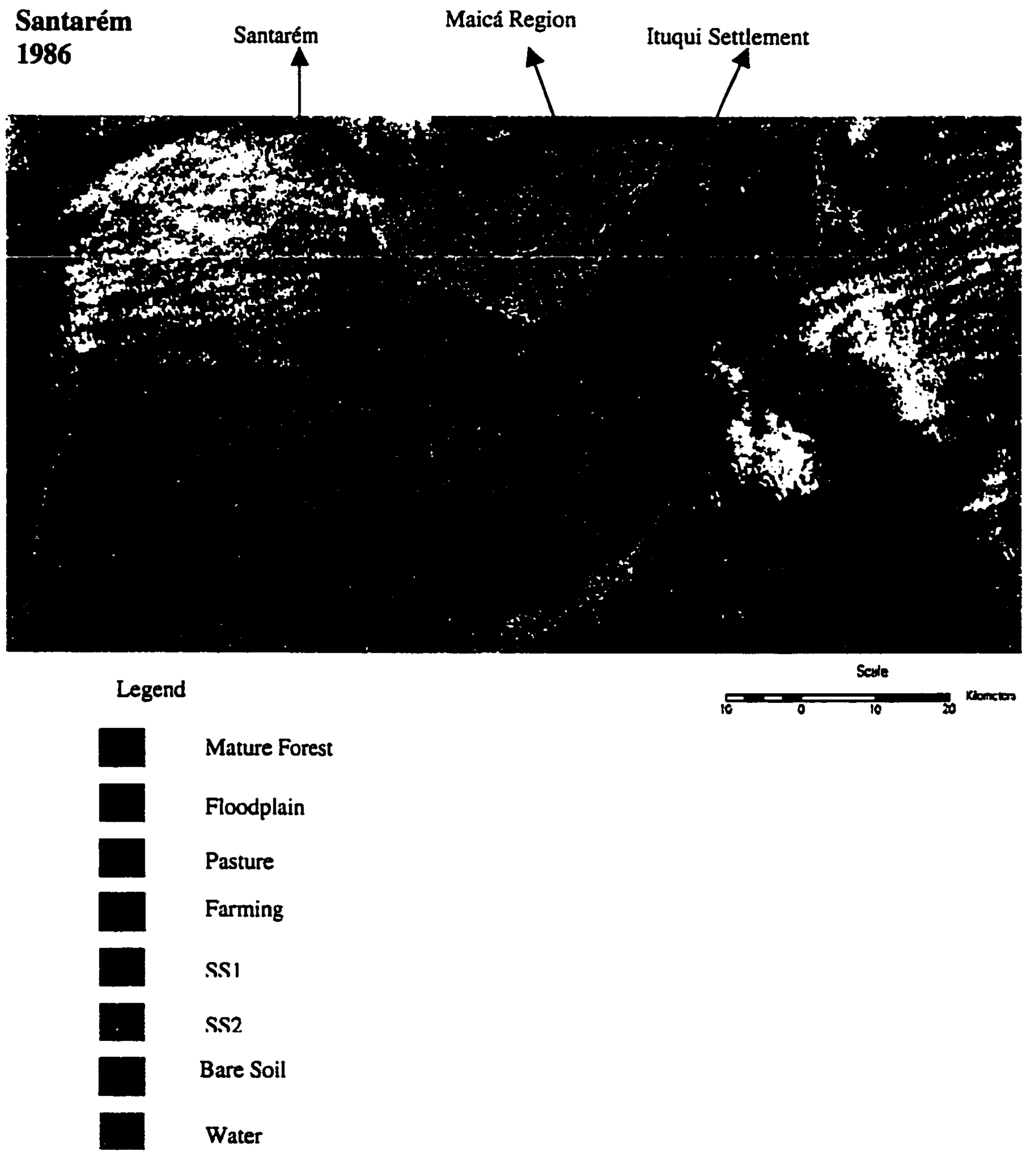

Figure 4.3. Classified Image (TM-1986) before Privatization, Depicting Areas of Farming, Pasture, Secondary Sucessions, and Mature Forest. The image illustrates Santarém urban center, the Gleba Ituqui, and the Maicá Region.

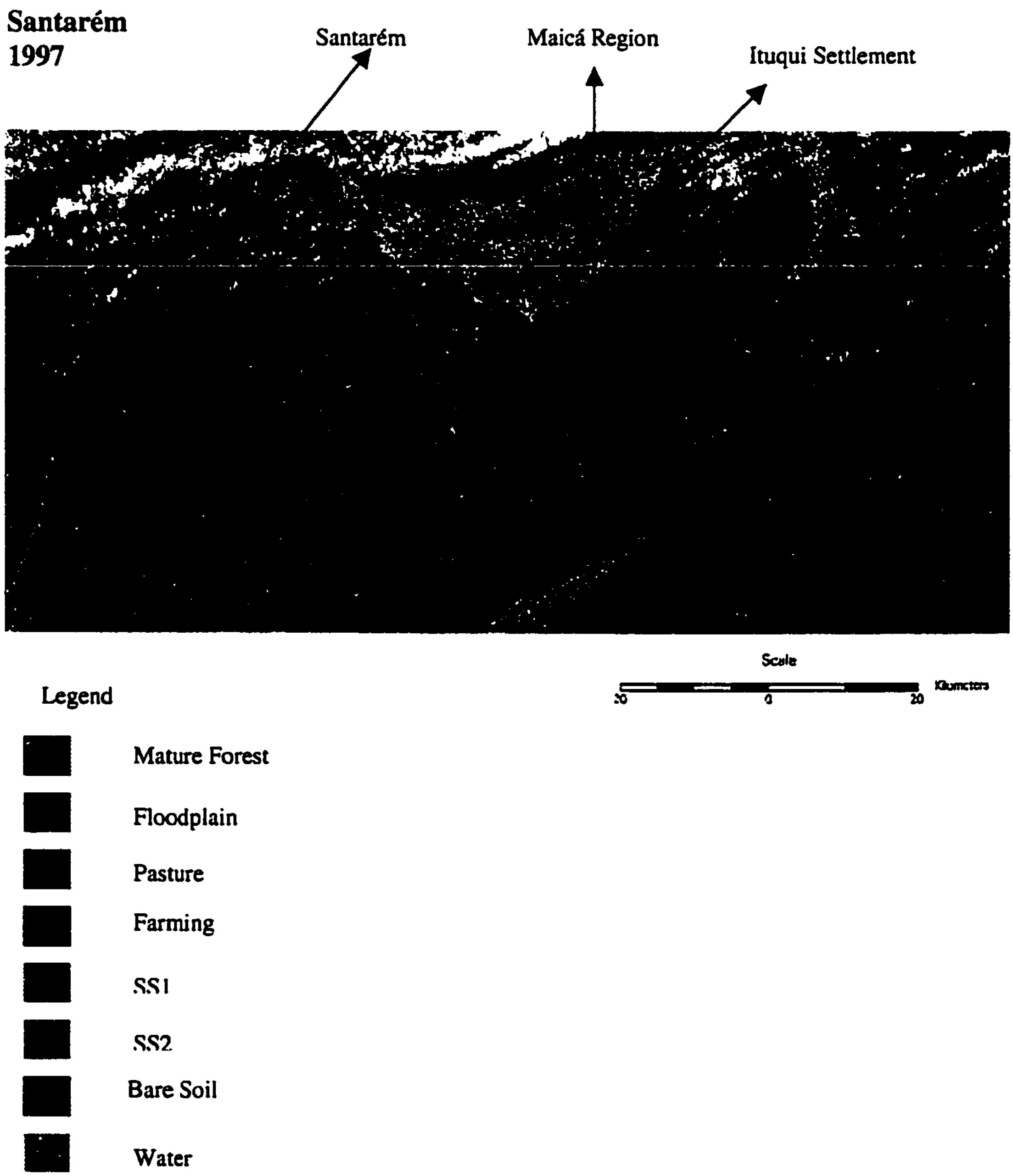

Figure 4.4. Classified Image (TM-1997) after Privatization, Depicting Areas of Farming, Pasture, Secondary Successions, and Mature Forest in Santarém Urban Center, the Gleba Ituqui, and the Maicá Region.

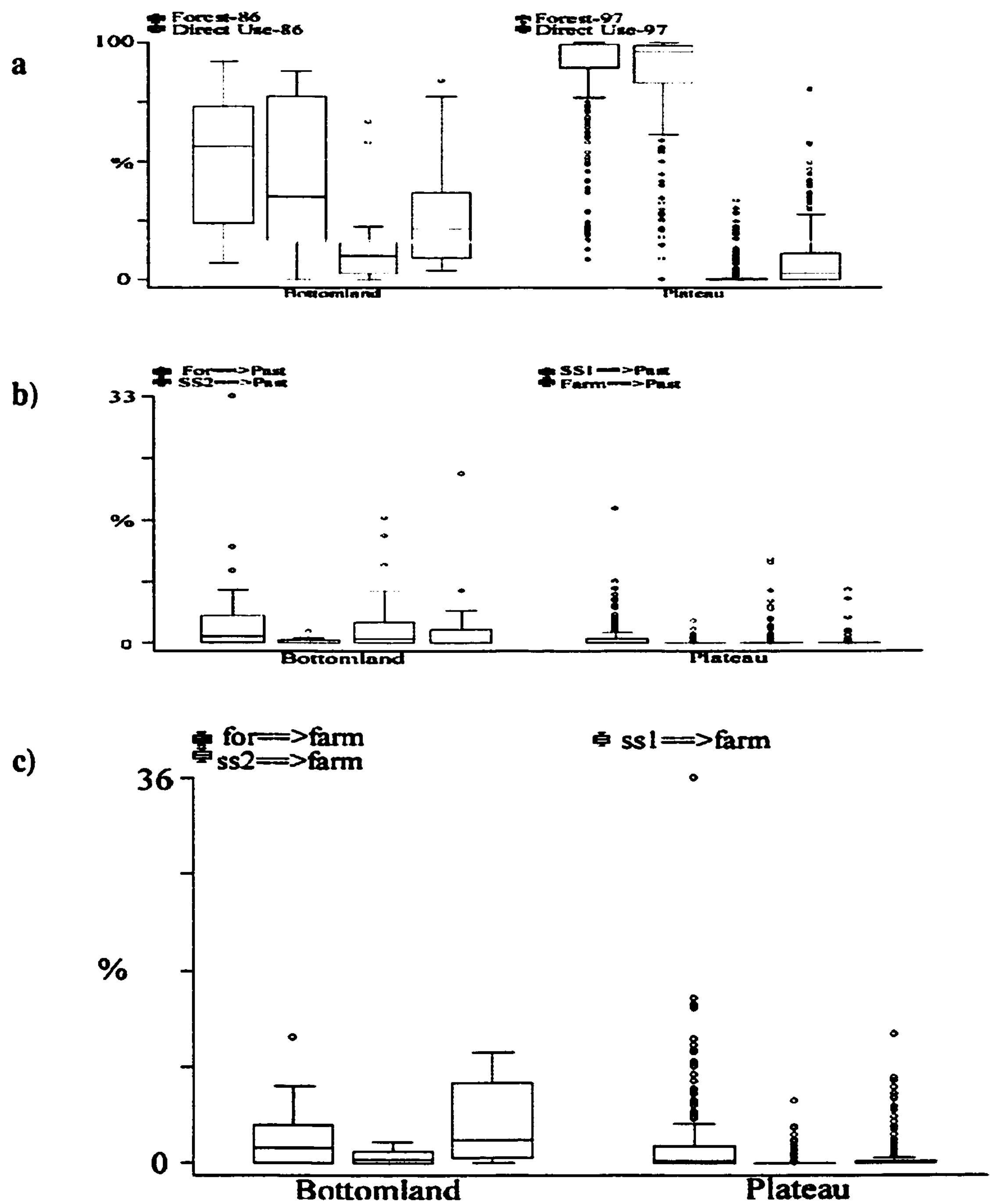

Figure 4.5. Distribution of Average areas (percent per lot) of Mature forest and Direct Use (farming+pasture+SS1) in 1986 and 1997. (a) Transition matrix Analysis indicates the average amount (percent per household) of land cover that was converted into pasture (b) and farming (c) since before privatization up to 1997, comparing areas between bottomland and plateau zones. (n = 282 private lots)

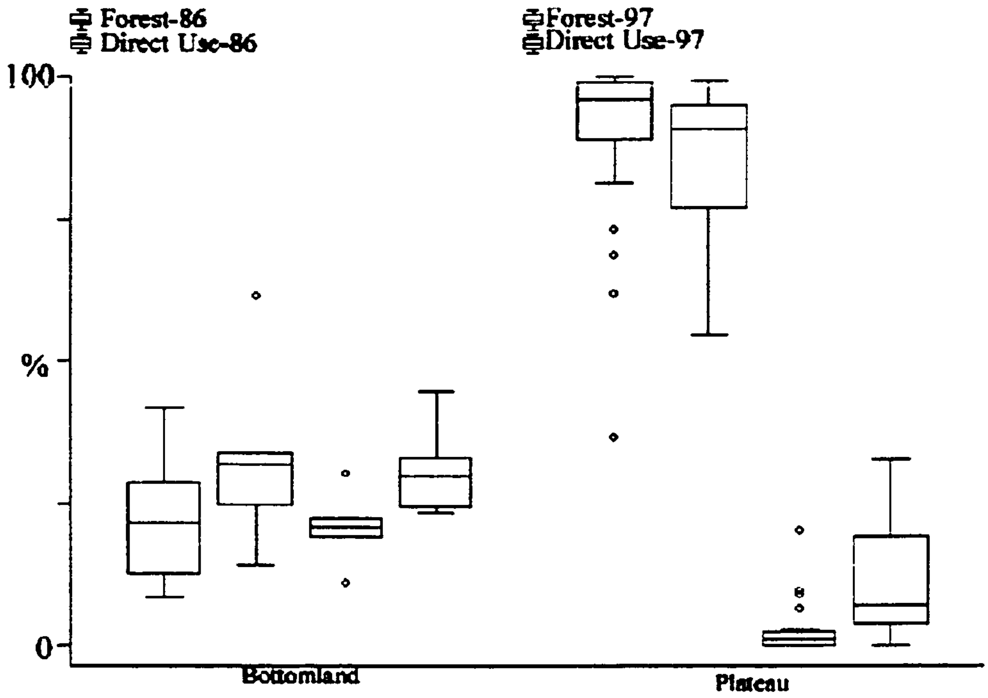

Figure 4.6. Distribution of Average Areas (percent per lot) of Mature Forest and Forms of Direct Use of Land (farming+pasture+ss1) across the Patos Households, Comparing Areas between Bottomland and Plateau Zones (n = 27 private lots)

THE PATOS COMMUNITY

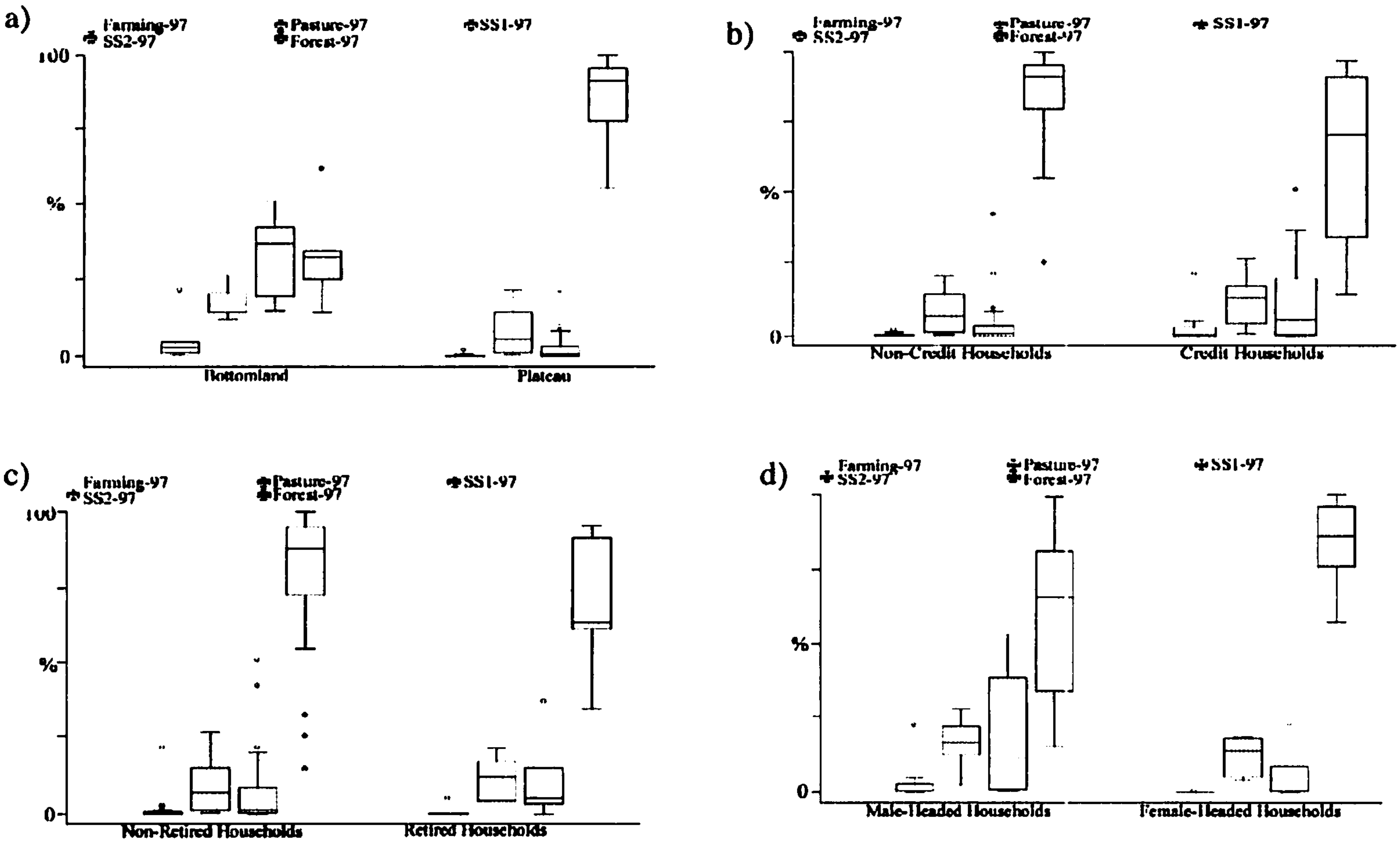

Figure 4.7. Distribution of Average Areas (percent per lot) of Farming, Pasture, Initial Secondary Succession (SS1), Intermediary Secondary Succession (SS2), and Mature Forest during 1997 across Households from the Patos Community According to Ecological Zone (a), Farm Credit (b), Retirement (c), and Gender of the Head of the Household (d) (n = 27 private lots)

Table 4.1. Land-Cover Changes at Settlement Level in Gleba Ituqui, 1986 (before privatization) and 1997 (after privatization)

Land-Cover Class	Percent of Land Cover (average per property)	
	1986	1997
Mature Forest	86.42	83.04
Interm. SS (SS2)	8.04	5.80
Initial SS (SS1)	1.86	4.40
Pasture	.090	1.84
Farming (crop)	1.10	3.20
Bare Soil	0.23	0.80

Table 4.2. Land-Cover Changes at Household-Property Level in the Patos Community: 1986 (before privatization) and 1997 (after privatization)

Land-Cover Class	Percent of Land Cover (average per property)	
	1986	1997
Mature Forest	77.00	76.48
Interm. SS (SS2)	14.59	8.55
Initial SS (SS1)	5.12	9.58
Pasture	0.01	1.33
Farming (crop)	0.91	3.50
Bare Soil	0.12	0.07
Direct Use*	6.14	14.50
Forested Vegetation**	91.59	85.03

* Direct Use (farming + pasture + SS1)
** Forested vegetation (mature forest + SS2)

Chapter 5

MOTIVATION FOR COLLECTIVE ACTION AND ITS ECOLOGICAL EFFECTS ON THE UPLAND FOREST

Introduction

Chapter 4 addressed issues of cooperative behavior among rural producers at the settlement level (the Gleba Ituqui). The present chapter deals with a follow-up collective action that recently took place in a particular community of this region—Patos do Ituqui—that involved local villagers and outsider large-scale ranchers. As mentioned in Chapter 2, the community is located between two ecosystems—floodplain and upland (Figure 2.2). The upland area is now privately owned, and the floodplain area is collectively owned. The present floodplain common property regime is a result of a cooperative effort which involved only one-third of the community. This analysis will answer two questions: (1) Why did only one-third of the households initiate collective action in the floodplain ecosystem? and (2) How did the collective action in the floodplain affect the upland forest after it took place?

Social Heterogeneity and Social Capital

One aspect that was not addressed in the preceding chapter deals with the effects of social heterogeneity and the individual's previous experience with political participation in a collective action. Although individuals are frequently able to organize (Berkes 1989; McKean 1982; Netting 1976; Ostrom 1992; Tang 1992), they face different incentives to collaborate or not. When there is heterogeneity within a group, an individual can face different positive and negative incentives that may make collaboration more difficult. Previous studies argue that homogeneous groups more easily achieve group cooperation than heterogeneous ones, without regard to the community's capacity to overcome internal differences in order to achieve the collective goals (Blair 1996; Cernea 1989, 1988). All too often scholars and policy makers have considered rural peasant communities to be homogeneous social groups either economically, socially, or politically. In fact, one of the causes of failure in development projects in developing countries was probably due to ignoring variability within a community (Durham 1988). That is, assymetric distribution of assets and differential opportunities in gaining personal benefits such as prestige, power, or security affect an individual's response to cooperation.

Several types of attributes may affect cooperative behavior, such as gender, age, material assets (sources of income or material goods, access to retirement, access to farm credit), education (degree of official education), religion, and land tenure (landholder, landless), among others (Ostrom 1999b). Attributes within a community might vary at individual, family and household levels or at any other group level. In Patos' case, households vary in several aspects from composition to structure and economy which appear to affect individual incentives to collaborate.

Varughese and Ostrom forthcoming, in an attempt to verify the effects of heterogeneity on cooperative behavior, analyzed forest users from a number of communities in Nepal. They found that there is no strong association between heterogeneity and success of collective action. Communities that are more homogeneous, have a low level of self-organization and poor forest conditions, whereas others with some heterogeneity present a successful collective action with a moderate to high level of forest preservation. In fact, local forest users in Nepal have developed institutional arrangements that contribute to overcoming those problems of inequality (Varughese and Ostrom forthcoming). Gibson and Koontz (1997) also found that local villagers in southern Indiana are able to overcome divergence within a group through establishing flexible but efficient institutional arrangements, in particular through frequent meetings in order to adjust the community's values according to changes in individuals' choices and preferences. Schlager and Blomquist (1998) focus on how local resource users in their study area can solve internal heterogeneity, either by separating different groups of users, strengthening the group with a strong hierarchical structure, or excluding different groups from having rights to a resource.

In regard to self-governance, it is important to understand how cooperation emerges and how it is maintained. In a cooperative situation, problems of coordination affect the success of collective action. Previous experience with social organization or the existence of some kind of pre-established cooperation helps to build trust among members and increases the likelihood of collaboration (Durston 1998). History of participation in organization and the experience of beneficial outputs are likely to motivate individuals to collective action, as shown by White (1996) in a study on the common property regime in Haiti. He found that membership and some positive output (success) from collaborating in a group, such as adopting soil conservation techniques, are factors that affect the emergence of collective action.

In other words, trust and reciprocity contribute to enhance social structure that strengthens relations among individuals, and thus help to build social capital (Ostrom 1999b). Experiencing collaboration in a group is a learning process of acquiring and exchanging information through a social network that contributes to the coordination skills in that individuals learn or develop commitment, responsibility, and assignment of tasks (Coleman 1987). Social capital takes time and energy to build; indeed, it usually occurs through a process of trial and error (Ostrom 1992), and historical facts can reveal the formation of social capital in a society and uncover the underlying factors behind cooperation (Durston 1998; White and Runge 1994).

The formation of leadership is another form of social capital that has been pointed out by some scholars as an important factor contributing to the emergence of collective action. History of participation in sociopolitical movements and presence of leadership and membership are factors present in Patos that have strengthened its social structure.

Thus, the present chapter addresses issues on the history of the emergence of a collective action which reveals opportunities and constraints faced by different groups of households within the community. On one hand, these different household attributes facilitated the taking of collective action; on the other hand, the differences led to internal conflict and different patterns of natural resource use. Another focus of this chapter is on the effects of collective action on the upland forest.

Floodplain Institutional Arrangement

Up to 1994 the floodplain ecosystem had long been held privately by successive large ranchers with the local population enjoying free access to products such as fruits, timber, and medicinal plants. Floodplain areas that are not held privately have legally been state property since 1934 (Vieira 1992). People have free access to this property as well; these local residents have illegally controlled floodplain areas as common property or private property.

In the early 1990s, the floodplain owner (a large-scale rancher) put the land up for sale and another mid-scale rancher who had just moved to Patos showed interest in buying the land for ranching purposes. Although the prospective owner had interests similar to those of the former rancher, some local residents assumed that the new rancher planned to exclude them from the system. This perception of a threat of loss of access by some local residents led them to organize a group to purchase the land. Although all residents were invited, only one third of the community joined the group (11 households), and each household paid approximately US$250.00 for a share in the 200 hectares of land.[1] By this action, they avoided the loss of the land. Now the floodplain ecosystem is a common property regime but owned by only part of the community.

During the privatization process, two groups of households emerged within the Patos community—Private-Landholder (PL) and Landless (LL). Later, with this more recent collective action, two other groups have arisen—Collective-Private (CP) and Outsider-Rancher (OR). The OR group is composed of only one household that refers to the outsider mid-scale rancher case (see Household Structure section on Chapter 2). The OR household is not categorized as PL group, because the present collective action was in many ways a reaction against this household (discussed further in this chapter). Thus, for the purposes of the present analysis, only the three first groups of households—CP, PL, and LL—will be considered (see Table 5.1). The OR household will be treated as a separate actor given its particular position in the present local political-ecological arena.

The emergent CP group is struggling to solve floodplain ownership problems because they do not legally own the property. Legal recognition of property rights and assignment of land title to an immense floodplain area throughout the Amazon region are two gaps that need to be filled within regional and local institutional structure, but they are two very difficult tasks to be accomplished. Large areas of floodplain have been occupied more than one hundred years by native riverine populations, but their lands are usually not formally owned. In addition, in past years, conflicts over floodplain areas between local communities and outsider ranchers increased in the Amazon. Several large-scale ranchers claim legal rights to those lands by holding land documents from *Sesmaria* time (see Chapter 4 for more details on *sesmaria*). Acknowledging the urgent need to regulate Amazonian floodplain areas as a result of growing competition over its natural resources, by 1998, the Brazilian federal government decided to start regulating these lands through Law No. 9.636 of May 18, 1998 (DPU 1998). According to this law, the Secretariat of Union Patrimony (SPU) is authorized to identify, delimit, record, monitor, and legalize floodplain areas that are already occupied and to promote sustainable utilization of lands that belong to the Union.

At the state and municipal levels, the Department of National Patrimony (DPU) is a federal agency that regulates wetland areas nationwide and is hierarchically below SPU. It has centralized control of these lands. Due to the diversified and changeable environment (spatially and temporally), DPU officials face problems in regulating and monitoring those lands. Setting physical boundaries of a property rights regime to a particular floodplain area is always difficult. Besides, individuals who are living in floodplain areas or using floodplain resources differ in their sociocultural and economic attributes, which makes legal assignment of property rights to each individual an intricate task; i.e., it is hard to reach a consensus among different occupants or users. Under Law No. 9.636, DPU officials can legalize a piece of land if an individual already has a title or some document that proves her/his ownership of the land (e.g., *sesmaria* document) and if an individual's title to the land was recorded before February 15 of 1997 (DPU 1998). Poor people who have lived a long time in floodplain areas can receive rights of usufruct with tax exemption. However, these poor people are usually the riverine native people, such as the Patos residents. Like the Patos case, these areas are usually occupied by a community rather than a sole individual. Since the residents consist of different resource users, such as fishers, farmers, and cattle-raisers, the government is trying to legalize those areas on a community basis, taking into consideration the welfare of the local people and conservation of natural resources. DPU has proposed some pilot projects in some communities of the Ituqui region in Santarém in order to define and assign a property rights system that meets social, economic, and ecological needs[2] (Lopes, DPU's Pará State Chief, pers. comm.). An individual also can purchase from the Union rights to floodplain areas, through a process called "*aforamento*," which gives an individual rights of use, management, exclusion, and alienation (see Ostrom and Schlager 1996 for definition of rights). S/he can pay the entire amount of the value of the property at once or pay monthly up to 120 months (DPU 1998).

Regarding the Patos case, the process of recognition and legalization of floodplain is likely to be slow, considering that DPU is evaluating land disputes and regularizing the land on a case-by-case basis. Besides, to make a petition for regularizing title to the land, an individual needs to go to the DPU's office, which in this case is located in Belém, capital of Pará state. It is practically impossible for small producers to go to Belém, due to its relatively high cost and its distance from areas of origin. In addition, floodplain legislation is complex and it is hard for lay people to understand it; and lack of staff members taking care of these issues throughout the state makes the process even harder to accomplish and local conflicts harder to solve. It is important to make clear that the control over wetlands nationwide is always under state hands. If for any reason the federal government needs to use the land for national security purposes, preservation of ecosystems, or for any development project that meets social or economic demands of the nation, the floodplain owner needs to return the land to the Union (Art. 35, Decree No. 9.760, 1946).

In summary, both upland and floodplain ecosystems were privately held by large landholders until the 1970s, but Patos residents always had free access to both systems. When they felt their access to resources threatened by one outsider, they organized themselves to maintain their rights to access and use of resources. In the upland, their status changed from squatters to private landholders. In the floodplain, an ongoing change is taking place from a single private owner to a collective property. The collective action in the floodplain area attracted only part of the Patos community, which had wholly participated in the previous collective action in the upland area.

The next sections discuss what factors have affected decisions. Three sets of factors have influenced individuals' decisions regarding their participation in collective ownership of the floodplain: (1) source of income; (2) value of floodplain resources; and (3) ecological and social conditions for floodplain resource use.

(Table 5.1 is about here)

Data Collection

Social-Economic and Institutional Data

A household survey was carried out in order to evaluate whether there was a relationship between household attributes and collaborative behavior. Structured interviews related to demography, land use, socioeconomic activities, and institutional arrangements were administered in 33 households between June and August of 1997. The analysis is focused on PL and CP households because they share similar conditions in terms of upland forest ownership and economic opportunities, and these were the households engaged in the first collective action. For purposes of analysis, one case from the PL group will be left out of analysis, despite being interviewed, because this household is an outlier. Its members are outsiders who came to the Patos community recently, in the early 1990s. They have a middle-scale ranch and own a motor boat; the head is a trader, selling all kinds of goods, including *açai* during its season.

In addition to the household survey, officials from governmental and non-governmental organizations were interviewed: the National Institute for Colonization and Agrarian Reform (INCRA), the Department of National Patrimony (DPU), the Brazilian Institute for Renewable Natural Resources and the Environment (IBAMA), the Federation of Agencies for Social Work and Education (FASE), and the Union of Rural Workers of Santarém (STR-Santarém). Also, the two most important ranchers who were involved in the case were interviewed.

Forest Inventory

In the upland ecosystem, a vegetation inventory was conducted to compare forest conditions in terms of woody vegetation between PL and CP groups. To carry out such an analysis to assess the relationship between institutional arrangements and ecological outcomes, the International Forestry Resources and Institutions research program was applied (see Appendix 5.4). A total of ten private parcels (50 hectares each)—five among the CP group and five in the PL group—were randomly chosen. In each parcel, a 200-meter base line with 100 meters on each side was measured in the mature forest and ten plots of 300 m^2 (15 meters x 20 meters) lying to either side of the base line were randomly selected. A total of three hectares (0.01 percent of the total area on the upland forest) distributed in 100 plots were sampled. All trees above 2.5 centimeters of diameter at breast height (dbh) were measured. For the purpose of the present analysis, only those commercially valuable trees above 45 centimeters of dbh were considered. The cut-off value was based on federal Brazilian law, which establishes 45 centimeters of dbh as the minimum size to cut a tree for logging purposes. A study of logging activity in the Eastern Amazon by Uhl and Vieira (1989) found that the smallest tree removed for commercial purposes had a dbh of 48 centimeters.

In the next two sections, characteristics of groups of households and vegetation analysis will be addressed. In addition, remotely sensed analysis contributes to assessment of land coverage and usage of land among PL and CP private parcels (see Chapter 4 for more information on land-use methods and analysis).

Type of Household and Land Tenure

New groups of households were formed after privatization in 1987 and after a purchase of floodplain area in1994, based upon PL, CP, and LL land tenure (tables 5.1 and 5.2).

The CP households are composed of older heads of households (average of 52 years old) and have a larger number of literate individuals than PL and LL households (Table 5.2). The CP group also has on average a larger household size (7.5 members) than the PL and LL households. In addition, material assets such as cattle and wood-walled houses show that CP households are relatively better off economically than the two other groups. Landless households have fewer material assets than the two groups that hold private land and are, on average, younger and less literate. In regard to religious life, there are Catholic and Evangelic followers in all three groups of households; therefore, there is no difference in this regard (Table 5.2).

These groups of households also vary in type and degree of affiliation as members or leaders in regard to religious, political, and recreational institutions. Table 5.3 indicates that, overall, both wives and husbands from the CP groups have held a larger number of political affiliations, particularly leadership, than PL and LL individuals. In regard to previous political engagement, LL individuals have no history of participation in any social-political movement.

(Table 5.1 is about here)

(Table 5.2 is about here)

(Table 5.4 is about here)

The Mature Upland Forest

The upland forest in the Patos community had 1,374 trees of 10 cm or more dbh that were distributed among 213 species in the three hectares sampled. There were 134 genera and 49 families represented (see Appendix 5.1). Unlike the temperate zone, tropical dense forest is not usually characterized by a dominant species, but a few species were abundant in the present case, such as *Jacaranda copaia* (*parapará*), *Protium pallidum* (*breu branco*), and *Miconia micantra*, which have the largest importance value due to their high frequency rates. *Caryocar villosum* (*piquiá*), on the other hand, shows a high importance value due to its absolute dominance measured in basal area (93.20 m^2 ha^{-1}). Considering the number of individual trees, the main families are Burseraceae, Lecythidaceae, Caesalpinaceae, Mimosaceae, Sapotaceae, Moraceae, Myristicaceae, Lauraceae, Violaceae, and Bignoniaceae, which are similar to trees in other upland forests in the Amazon (Carvalho 1992; Gentry 1991; Prance 1991; Rankin-de-Merona et al. 1991). In terms of number of species, Mimosaceae, Caesalpinaceae, Lecythidaceae, Fabaceae, and Sapotaceae are the most representative families. The number of species per hectare in mature upland forest varies a great deal among several studies in the Amazon region, from 38 species ha^{-1} (Salomão et al. 1995) to 94 species ha^{-1} (Boom 1985) (See Table 5.4).

Although logging activity (see Chapter 3) has occurred in past decades in this area, floristic composition and structure of the forest indicate that this forest still possesses most of the initial features of a mature forest. The mean height of the trees of the mature upland dense forest in the Patos community is 16 meters (±6.2 meters) and reach a diameter up to 179 centimeters. There are some emergent trees that reach 30-35 meters, such as *Qualea paraensis* (*mandioqueira*), *Sclerolobium paniculatum* (*tachi pitomba*), and *Vochysia maxima* (*quaruba verdadeira*). The structure of vegetation follows the same patterns of distribution of classes of diameter as other Amazonian upland forests. There is a larger number of smaller trees between 10 and 21.9 centimeters of dbh, and that number steadily decreases as the size of the trees increases (Figure 5.1). The mean basal area for the present upland forest is $27.11 m^2 ha^{-1}$ ($\pm 71.65 m^2 ha^{-1}$). Barros (1986), studying upland mature forest of Curuá-Una Federal Reserve, close to the Patos upland forest, found a basal area of $28.89\ m^2\ ha^{-1}$. This is close to the $29.87\ m^2\ ha^{-1}$ analyzed in the National Forest of Tapajós (FLONA-Tapajós) (Carvalho 1992). Other studies in the Amazon region indicate a basal area that varies between 20 and $30\ m^2\ ha^{-1}$ (Campbell et al. 1986; Uhl and Vieira 1989; Moran et al. 1998).

(Table 5.4 is about here)

(Figure 5.1 is about here)

Certain species are distributed in clusters, as found in other regions of the Lower Amazon (e.g., FLONA-Tapajós). In the Patos forest, some of those important economic trees, such as the Brazil nut tree (*Bertholetia excelsa*) and *uxi* (*Endopleura uchi*), occur in clusters. Economically valuable trees are not uniformly distributed throughout lots. Each lot may have very different species of commercially valuable trees.

This forest is characterized by few epiphyte species and 12 species of lianas with 29 individuals (Appendix 5.2). The most frequent lianas are *Memora flavida* and *Memora magnifica*. Palm trees are very common in the Amazonian forest but not so abundant in the Patos forest; the only two species are *Oenocarpus distichus* (*bacaba*), with five individuals, and *Maximiliana maripa* (*inajá*), with three individuals in a total of 3,000 hectare sampled. Liana forest in the Amazon region has been considered an anthropogenic forest—its existence is the result of human intervention (Balée and Posey 1989)—thus this anthropogenic black soil verifies the human occupation of the area.

In the Patos forest, at least 56 commercial wood species are still present (Appendix 5.3). The most abundant woody species is *Virola michellii* (*ucuúba preta*), with a mean stem area of 181.4 m^2; the second most frequent is *Couratari oblongifolia* (*tauari*), with a lower mean stem area of 25.3 m^2. Although the Patos forest presents similar composition and structure to other Amazonian upland forests, some highly valuable-wood trees, such as *Swietenia macrophylla* (mahogany), *Cedrela odorata* (cedar), *Dinizia excelsa* (*angelim pedra*), *Hymenolobium petraeum* (*angelim da mata*), and *Aniba duckei* (*pau rosa*), are wiped out. Some have practically disappeared from this area, including *Tabebuia serratifolia* (*pau d'arco*) and *Bertholletia excelsa* (Brazil nut). There are a number that are still present such as *Jacaranda copaia* (*parapará*), *Goupia glabra* (*cupiúba*), *Clarisia racemosa* (*guariúba*), *Qualea paraense* (*quaruba*), *Manilkara huberi* (*maçaranduba*), *Simaruba amara* (*marupá*), *Couratari oblongifolia* (*tauari*), *Virola michelii* (*ucuúba preta*), and *Sclerolobium paniculatum* (*tachi pitomba*). The main purpose of this vegetation analysis is to compare the logging effects on forest land held by two groups of households within the Patos community. To do so, floristic composition and the structure of both forests are compared (see Ecological Effects of Collective Action on the Upland Forest).

Factors behind Collective Action: Social and Ecological

In order to analyze how individuals decided to join the collective action in the floodplain, it is assumed that a household takes into account the expected costs and benefits of obtaining and investing cash to cooperate with the group. Figure 5.2 presents the hypothetical decision-making tree. Because the collective action was based on the land purchase, is expected that income influenced the decision. This explains why individuals from the LL group did not participate (Figure 5.2a). Because this group held no parcels in the upland ecosystem, they had neither access to farm credit nor timber to sell. Assuming the same level of income for both groups, is expected that the way each household measures the economic importance of the floodplain would determine their interest in joining the collective action (Figure 5.2b). In this case, those PL households that did not value the floodplain resources (e.g., natural grassland for grazing) were not expected to collaborate. Finally, even if a resource has potential value, ecological and social factors may constrain households from exploiting the potential resources of the floodplain ecosystem. Thus, households that face more favorable ecological and social conditions for using resources are the ones geared toward collective action (Figure 5.2c).

(Figure 5.2 is about here)

Sources of Income

Collective-Private and PL households have three main sources of income: farm credit (bank loan), retirement income, and timber sales.

Since 1989, the State Bank of the Amazon (BASA) has provided farm credit for agropastoral activities (see Chapter 4 for more information on farm credit line). All local residents who hold parcels in the Ituqui settlement are eligible to apply for credit (INCRA 1994; BASA 1997). It is expected that a larger number of CP households than PL households have borrowed money to invest in cattle and/or to buy a floodplain share. Although there is a weak relationship between access to credit and participation in collective action (tau = 0.31), a larger number of the CP households withdrew farm credit (45 percent) in comparison to only 18 percent among PL households (Table 5.5).

With regard to retirement income, women older than 60 and men older than 65 received a monthly salary of about US$120.00. This contributes a great deal to the household economy in comparison to a salary of US$60.00/month for an elementary school teacher, which is a highly valued profession in the region (Oliveira et al. 1994). Results show that a larger number of CP households (64 percent) than PL households (27 percent) have at least one member who is retired and thus receives a regular income, which indicates that availability of retirement salary is moderately associated with cooperative behavior (tau = 0.38).

Finally, both PL and CP households have access to woody trees in the upland forest. The local population in the region has long been involved in timber activity (Oliveira et al. 1995). The price paid per tree is about the same among all households (mean of US$10/tree), giving them a similar profit return from trading. Thus, it is expected that the parcels held by the CP group have fewer trees and lower basal areas among woody species than parcels held by the PL group. Almost 100 percent of both CP and PL groups have sold wood (Table 5.5); however, this fact does not reveal the number of logs removed. Such information can be derived from the forest inventory, which suggests that CP households have removed more trees for timber than PL households. Considering only trees above 45 centimeters of dbh, the parcels of PL households have, on average, a larger number of commercially valuable species (PL forest = 1.41 species/plot) and tree individuals (PL forest = 1.48 trees/plot) in comparison to those of CP households (CP forest = 1.04 species/plot and 1.09 trees/plot). Taking into account only data on trade wood, income from timber sales is weakly associated with the decision to cooperate in a group (tau = 0.19) (Table 5.5).

In general, although sources of income are positively but weakly to moderately associated with cooperative behavior toward the floodplain, they reveal why LL households could not afford to join a collective action, and chose not to participate. But these variables do not explain why PL households did not cooperate as the CP group did once they had all or some of these sources available at hand. Probably, the fact that some PL households did not cooperate may be related to the way they value floodplain resources. In order to address this question, three main floodplain products will be analyzed in the next section: *açai* fruit, natural grassland, and land access.

(Table 5.5 is about here)

Value of Floodplain Resources

It is assumed that local residents take into consideration the economic value of each product—*açai* fruit, natural grassland, and land access—in the household economy (subsistence or cash income) when deciding whether or not to participate in a collective effort.

Açai is an important subsistence and cash product from the floodplain in Santarém county and other parts of the Amazon region (Oliveira et al. 1994; Anderson 1990; Brondízio and Siqueira 1997). It can be promptly sold in the local market. Additionally, *açai* is a low-cost extractive activity, thus increasing the interest among all households to collect it (see Chapter 3 for more information about Patos *açai* production). Since the establishment of the collective property of the floodplain, *açai* harvest has become an issue of conflict between the CP and the PL groups. The CP group has stripped the PL group of their previous free access. In the first year of the collective ownership, during 1993-94, only CP members were allowed to harvest. The present data show that there is a moderate strength of association between *açai* and cooperative behavior (tau = 0.60) in that 55 percent of CP households harvested *açai* for commercial purposes while no household among the PL group did (Table 5.5). The PL and LL members could harvest only for subsistence but not for sale. This created strong resentment among residents. By the second year, after harsh conflict, CP members stopped monitoring so rigidly and they allowed everyone to harvest *açai* for both subsistence and commercial purposes (see Social Consequences of Collective Action: The *Açai* Case).

The second product, natural grassland, is directly related to cattle raising. Cattle are raised in the upland during the flood season and in the floodplain during the dry season. Cattle are used as draft animals or as monetary investments. For draft animals, the household has one or two cows to pull carts, and a small patch of grass (usually in the garden) is enough to feed them. For monetary goals, a larger number of cattle are raised (between 10 and 15 heads) and, in turn, a larger area for pasture is necessary (see Chapter 4 for more information on cattle production). Thus, it is expected that the CP households will: (1) be more involved in cattle raising than the PL households because they would value grassland as a grazing area, and (2) have more impact on plateau forest due to the opening of the pasture. Results show that raising cattle is moderately related to decisions on collaborating with collective action (tau = 0.54), since four CP households (45 percent) raise cattle for monetary investment with a total of 61 heads (Table 5.2) whereas only one PL household (8 percent) does with six heads (Table 5.5).

Finally, due to the history of threats to land access, the interest in maintaining access to the land prompted local leaders to initiate a collective action. In this case, the presence of leadership is a proxy for security of access to the land. Currently, these leaders are four residents who have a history of political participation and leadership roles in the upland movement. They are in their 60s, Catholic, and belong to traditional families with strong kinship ties (see Chapter 3). They have contributed and are still fulfilling functions within the Patos political structure such as coordinator, promoter, the union's representative, and the Rural Producers Association of the Gleba Ituqui's (ACACI) representative (see Chapter 3). Thus, the CP group is expected to have more leaders than the PL group. The results show that 45 percent of CP households have a leader as opposed to none among the PL group (Table 5.5), indicating moderate relationship between presence of leader and participative behavior (tau = 0.54).

In general, the value assigned to floodplain resources by Patos' residents is positively associated with group cooperation. The economic importance of floodplain products does not fully explain why PL households did not collaborate. The next section attempts to analyze another set of variables that dissuades the PL group from cooperating.

Conditions for Floodplain Resource Use

The exploitation of consumptive products in the floodplain may depend upon the opportunities and constraints that are related to conditions for using them. While harvesting palm fruit is a low-cost extractive activity, cattle ranching may depend upon a set of ecological and social variables being in place.

The bottomland presents a more favorable environment for cattle raising because it is close to the river and is dominated by secondary forest (see Chapter 4 for more information on patterns of land use). The former offers easier access to water for raising cattle, whereas the latter implies a lower cost of opening pasture in terms of time and labor (Figure 2.2). In contrast, the plateau zone of the upland ecosystem offers two main constraints for cattle ranching. First, it is dominated by mature forest that imparts a high cost of labor and time allocation to establish a pasture. Second, it is located in an elevated area that has poor access to water. Easy access to water in the bottomland or upland attracts individuals to invest in cattle in these areas as opposed to areas that have poor access to water. Therefore, individuals whose parcels are in the upland area—where the access to water is difficult—face more limitations to raising cattle and thus to participating in a collective action. So, it is expected that the CP households that hold parcels in the bottomland area would invest more in cattle than the PL group. Results confirm that more CP households (36 percent) holding pasture in the bottomland zone are involved in cattle activity than PL households (none). This result indicates a moderate strength of association of both access to water (tau = 0.61) and access to upland (tau = 0.36) with participation in the collective action (Table 5.5).

As described in Chapter 3 (see Household Economy), cattle raising is typically a male activity in the Amazon region (Hecht 1993). Thus, availability of a male labor force plays a key role in a household's decision to engage in cattle ranching. For purposes of the present analysis, an "active" male is defined as a male between 15 and 55 years old. It is expected that the CP households would have more male labor than the PL households. Although availability of labor is moderately related to collaboration with such a collective effort (tau = 0.41), results show that a larger portion of the CP group (45 percent) does have more available males than the PL group (9 percent) (Table 5.5). Table 5.6 clearly demonstrates the distribution of males among the CP and the PL households: four out of 11 CP households have at least three active male members compared with only one PL household out of 11.

In sum, conditions for using floodplain resources in terms of labor force, access to water, and access to upland pasture are positively and moderately associated with cooperative behavior (Table 5.5). Therefore, less favorable conditions for exploiting the floodplain resources faced by the PL households help to explain why they did not participate in the collective effort as opposed to the CP households that did join a group.

Table 5.7 arrays the attributes discussed above in one table. This array enables one to examine the distribution of households that did engage in collectively purchasing of the floodplain land as contrasted with the households that did not. Each variable is given a score of zero if it is not present. For all variables except male labor and cattle, a one means that the variable is present. Thus, household 1 (hh1) receives retirement income, has a credit line, engages in trade for *açai*, has upland pasture land and has access to water. Household 1 does not trade wood and does not have someone who participated in a leadership role in the earlier effort to secure private rights. For male labor, each household is coded as a zero if there is no male labor, a one if there are one or two male laborers, and a two if there are three or more male laborers. Thus, household 1 has three or more male laborers. For cattle, each household is coded zero if it has no cattle, coded one if there are one or two heads of cattle, and coded two if it has three or more heads of cattle. Thus, household 1 has three or more heads of cattle. The coded values were then summed to provide a rough indication of the overall presence in a household of attributes that are potentially conducive to economic use of the floodplain land. As one can see, the households who jointly purchased the floodplain land do have higher scores than those who did not jointly purchase the floodplain land with some interesting exceptions. The sum of attributes ranged from 9 to 4 for the households who jointly purchased land and from 3 to 1 with the exception of household 12. Household 12 joined the CP group initially but dropped its membership months later due to disagreements with other members of the CP group. However, this household has a total of 10 active individuals, who produce manioc flour on a commercial basis and own two cows, adding up to a higher score than the remaining PL households.

The LL group presents the lowest scores, from 0 to 2, with the exception of household 23. In that household, the head individual betrayed the upland land movement by working for the large-scale rancher, and as a result of his non-cooperative behavior, the household received no private lot. But this household has a work force of seven, and the head receives a monthly retirement salary, providing the household with a stable source of income. All these positive attributes give household 23 case a higher score than the rest of the LL group. Nevertheless, households that participated in the collective action present a more positive relation to each variable than PL and LL households, which means higher material assets among the CP group. In sum, the higher the score, the higher the chances for cooperating.

As mentioned before, *açai* has been a cause of harsh internal conflict. The next section will analyze these social consequences of the collective action on local residents, focusing on the *açai* resource.

(Table 5.5 is about here)

(Table 5.6 is about here)

(Table 5.7 is about here)

The Floodplain Collective Property and Its Effects on *Açai* Resource

As discussed before, the floodplain ecosystem was once a type of "open access" regime and turned into a collective form of appropriation. At the beginning, members of the CP group established who would have access to a resource (boundary rules) and how much of a resource a user could extract from a system (authority rules). Only CP households who paid for their share had full rights of access and withdrawal, in that s/he could enter the system and harvest/use any resources from the floodplain (e.g., graze cattle on natural grasses and harvest *açai*). However, as internal conflicts emerged, rules changed in order to accommodate different interests among households, as will be discussed further.

Because natural grassland is important only for those households that own cattle and need a place to graze them—cases of CP households as discussed before—no conflicts have happened with respect to restricting access to grassland. The PL and the LL households are not allowed to bring their cattle to graze in the floodplain grasses. Even though these rules are very strict, they have not been changed, in contrast to the *açai* resource.

Açai is a more complex case than grassland, and changes in rules are still taking place. At first, both the PL and LL households could harvest *açai* for consumption, but this rule was not clear regarding harvesting for sale. In the first year (1994 to1995) after they bought the land, the group did not allow anyone who had not contributed to harvest *açai* either for subsistence or for market. However, strong internal conflict between those who had bought and those who did not led to the establishment of a more flexible rule for the next harvesting season. Hence, in the second year, the CP group changed the rule and gave non-members (PL and LL households) rights to harvest, but only for consumption. This did not, however, dissolve the internal conflict because the non-members wanted to harvest for commercial purposes. In fact, they believed that the CP group had no de jure rights to control floodplain resources. During the third and fourth harvesting seasons (coinciding with fieldwork periods), the boundary rule was unclear and several non-members started to harvest and sell *açai* as they had before.

Açai is also the main cause of battles in some other surrounding communities with large areas of *açai* forest such as Tiningú, Muru-Muru, and Ipau-Pixuna. These communities, located in the Maicá region, harvest and sell large amounts of this product every year between May and October. An observable trend is that some local villagers are trying to privatize *açai* forests to which the whole community always has had access and to harvest it for both subsistence and the market. Such privatization is intended to define rights to a household, thereby allowing only household members exclusive rights to harvest, consume, and sell *açai*, thus excluding other members of the community from having rights to it. Usually, the area of *açai* claimed by each household refers to an area located exactly in front of a household; it is a continuing piece of the upland lot. There are cases in which individuals who claim to own a section of *açai* forest have threatened to shoot if someone else enters their forest. It is worth mentioning that all of these communities are more than 100 years old, and villagers are local native peasant people who have lived in the same land tenure situation as Patos residents with respect to both floodplain and upland areas. In other words, they previously had access to all of the resources but not control over them.

It is interesting to observe that this process of individual appropriation has taken place since INCRA's privatization of the upland forest at the end of the 1980s and in the 1990s, in that they have learned the process of individual appropriation of a natural system and/or a resource. The plan to privatize has been discussed among Patos villagers also, following the same patterns as in the neighboring communities. Although such a change in property rights to *açai* is taking place in order to minimize resentments within the community, they are trying to respond in a more friendly manner, by allowing all households (including PL and LL households) from the community to harvest for their own consumption and/or plant *açai* for market-oriented purposes.

Despite those conflicts over valuable native fruit, results of *açai* density indicates 444 to 548 clumps and 1,120 stems per hectare, figures similar to other areas of the Amazon (Hiraoka 1999; Jardim and Kageyama 1994). That is, Patos *açai* forests apparently present a low degree of human disturbance. In fact, exploitation for commercial purposes does not mean depletion; instead, production can even be improved through a management system, as shown by Brondízio (1996) in his work with *açai* producers in the Amazonian estuary. Through a management of *açaizal*[3] (a forest of *açai*), local producers were obtaining higher density of both clumps (800 per hectare) and stems per clump (3,000 per hectare), which meant higher production of fruits per area. Patos residents have never managed *açai* areas, even before they purchased them.

Ecological Effects of Collective Action on the Upland Ecosystem

Although collective action took place in the floodplain ecosystem, it also affected the upland ecosystem in two major ways: (1) demand for pasture in the upland, and (2) extraction of timber to raise money to invest in cattle ranching and to contribute to the purchase of floodplain shares. Vegetation composition analysis and land-use analysis confirm these effects. To assess these effects a comparative analysis between PL forest lots and CP forest lots was conducted.

Vegetation Analysis

Considering that the current collective action occurred between 1994 and 1995 and that incentives to buy cattle started in 1993 (the first official farm loan), it is assumed that timbering activity occurred more intensively three to four years before this forest inventory was carried out in 1997. To assess effects on upland forest trees, the following parameters will be analyzed: floristic composition (number and types of species), forest structure (density and basal area), and forest regeneration.

Floristic Composition

Using the Shannon-Weiner index of diversity for all species and individuals (trees, saplings, and seedlings), both PL and CP forest lots present similar index rates of 4.8 and 4.9, respectively. Uhl and Murphy (1981) found similar indexes for tropical upland forest in Venezuela (i.e., from 4.8 to 5.4). These rates indicate high biodiversity in both forests. But the forest areas held by PL households present a smaller number of tree species (144 or 96 species ha^{-1}) of 10 centimeters or more of dbh than CP lots, which have 176 species or 117 species ha^{-1}. Some studies show that after logging activity, the numbers of species and individuals increases rather than decrease, especially among light-demanding and pioneer species (Carvalho 1992).

Carvalho (1992) carried out comparative and time sequence changes in logged and unlogged vegetation in the FLONA-Tapajós. In areas where trees of 45 centimeters or more of dbh were cut, the number of trees per hectare increased from 211 to 215, and where 55 centimeters was the cutoff, the number increased from 217 to 222 (Carvalho 1992). The unlogged areas presented the same number in the first five years, with a small decrease from 226 to 219 species. Current results show that PL forest areas present a slightly smaller number of trees than CP forests. Likewise, PL lots have a smaller number of species than CP lots at a 0.1 level of significance (Table 5.8). These results suggest that CP individuals have probably removed a larger number of trees, thus opening larger or more gaps than PL individuals, favoring the rapid growth of light-demanding species or pioneer species such as *Vismia caynensis*, *Cecropia sciadophyla*, *Jaracaranda copaia*, and *Talisia carinata*.

Considering only commercial woody species of 45 centimeters or more dbh, among PL forest lots, a larger number of species (19) are present than in CP lots (12). All of the species found among CP lots are also present among PL lots. There are 205 trees left among CP lots in comparison to 261 among PL (Table 5.8). The trees with the largest dbh in PL lots are *Caryocar villosum* (mean of 197.5 centimeters), *Clarisia racemosa* (99 centimeters) and *Tetragastris panamensis* (92 centimeters). Among CP lots, the largest trees are *Caryocar villosum*, with a mean of 179.4 centimeters; *Pithecellobium pedicellare*, with 99.9 centimeters; and *Vochysia maxima*, with 90.5 centimeters. Valuable wood species such as *Simaruba amara* (*marupá*), *Manilkara huberi* (*maçaranduba*) and *Clarisia racemosa* (*guariúba*) were either not found or were below 45 centimeters dbh in forests held by the CP group. Thus, at the present time, the incentives at stake seem to lead CP households to use the upland forest more intensively than PL households.

In order to evaluate with more accuracy the effects of both groups on the Patos' forest, the structure of both PL and CP forest lots will be analyzed in the next section.

(Table 5.8 is about here)

Structure of Forest

Changes in structure can be observed by taking into account dominance and abundance of species. The mean basal area among PL forest lots (32.40 m^2ha^{-1}) is statistically larger than CP lots (23.72 m^2ha^{-1}) (Table 5.8). Several studies show a reduction of basal area after logging. Uhl and Vieira (1989), studying a forest in the

Eastern Amazon, found a basal area of 20-30 m^2ha^{-1}; Jonhs's (1988) findings in West Malaysia indicate a basal area of 10-18 m^2ha^{-1}; and Lopes et al. (1984) found that the basal area changed from 34.15 m^2ha^{-1} before logging to 25.24 m^2ha^{-1} after logging; that is a reduction of 8.66 m^2ha^{-1} in forest of the FLONA-Tapajós. Thus, while the PL forest displays a basal area similar to unlogged areas, CP forest lots present traits more similar to logged ones. To more accurately assess these figures, the number of stumps left in the forest lot could have been counted.

The distribution of trees along classes of diameter indicates slight differences in frequency among different classes between PL and CP lots (Figure 5.2). Similar to the number of species, PL lots present a smaller number (622 or 13.88 per plot) of trees of 10-25.9 centimeters than CP lots (747 or 14.42 per plot), but this difference is not statistically significant (Table 5.8). However, this pattern changes above 26 centimeters dbh, in that PL lots have more trees than CP lots. This suggests that there are a larger number of young trees among CP lots due to regeneration processes than in PL lots. Lopes et al. (1984) observed that all the classes of diameters suffered reduction in density of trees after logging activity. In other words, not only large trees are removed but also smaller ones due to treefall. Uhl and Vieira (1989) also observed a great amount of damage to non-timber trees in logged areas. A larger presence of young trees brings us to discuss regeneration processes in order to understand forest changes, particularly in regard to the effects of logging.

Regeneration of Forest. Regeneration in logged and unlogged forest can be measured by considering sapling and seedling populations. The community of sapling species among both PL and CP lots is quite similar: 105 and 108 species, respectively. Abundance of species is also very similar for both PL (1,056 ind ha^{-1}) and CP (1,120 ind ha^{-1}) lots. The distribution of abundance of species among classes of dbh is also similar between PL and CP lots (Figure 5.3). Ground cover shows a slightly richer species composition of seedlings among CP lots (128) than PL (112). The abundance, however, is larger among PL (73,400 ind ha^{-1}) than CP (71,200 ind ha^{-1}) lots. Regeneration does not explain much difference between these groups in order to assess logging impact.

More recent studies on treefall gaps have greatly contributed to understanding processes of regeneration after disturbances (Brokaw 1982). Brokaw's results from tropical forest in Barro Colorado, Panamá, indicate that pioneer sapling species are more common in old forests than in young ones. Besides the emergence of pioneer species, woody species are also another indicator of types of land use. Logged areas are expected to have a greater number of woody species than land used for agriculture or pasture, due to complete removal of non-grass vegetation in the latter. A larger number of woody species is expected among unlogged areas than logged ones. Several woody tree species are observed among sapling and seedling strata in both PL and CP plots. The same number (19) of sapling woody species was found in PL and CP lots; however, PL lots present a larger number of seedling woody species than CP lots: 21 and 14, respectively.

(Figure 5.3 is about here)

Another method for evaluating the effects of PL and CP household actions on forest lots is the assessment of patterns of land use through remotely sensed analysis (see next section).

Land-Use Analysis

One of the reasons why the CP group was formed was cattle ranching. It is expected that CP households have been opening a larger area for pasture in the bottomland area, close to the water source. Both CP and PL households started raising cattle after 1994, i.e., when the collective action began in the floodplain. This time period also coincides with the first farm loans from the Amazon Bank to farmers living in areas of agrarian reform. In fact, results show that the former group has not only opened larger areas of pasture but also larger farming areas than the PL group; consequently, they have a smaller area of mature forest and secondary vegetation (Figure 5.4). The LL households are associated with both PL and CP households in order to use land for farming. Data show that 100 percent of LL households grow manioc and corn on land owned by someone from Patos in order to meet their subsistence needs.

(Figure 5.4 is about here)

Discussion

Patos has experienced two collective actions in less than 20 years that were similar in some aspects but which have had different outcomes. Both cases involved a group of people who perceived a threat to their access to resources. The upland conflict ended with privatization of the land, and the floodplain situation led local residents to purchase the land and convert it into collective property. Concerning the upland conflict, the entire community cooperated as a group, and their access was maintained without any monetary cost, but with considerable time and effort. In the floodplain ecosystem, only part of the community participated in the collective effort, and group access was maintained by land purchase (see Chapter 6 for rights to floodplain resources). Therefore, cooperation that occurred in the upland ecosystem demanded mainly political participation, whereas, in the floodplain, it demanded direct economic investment as well as political participation.[4]

The decision of some households to participate in the purchase of the floodplain area is related to the limits and opportunities that each household faces. In the past, the local population had access to upland and floodplain, but both systems were formally held privately by one owner. In upland areas, the local population cultivated subsistence crops close to their houses and had free access to forest resources. The development of a more elaborate system of appropriation was not necessary until their rights to use the upland and, more importantly, to live in the area, were threatened. The new picture that emerged from this process changed the structure of social opportunities leading to the formation of social capital. Their legal property rights to the upland provided new sources of money (timber and farm credit) and control over land use, creating incentives for local residents to engage in long-term investments, such as cattle ranching.

Cattle ranching is a traditional activity that has increased in the Amazon due to tax incentives introduced by the Brazilian government between the 1970s and late 1980s (Hecht 1993; Moran 1981; Uhl et al. 1988). The local population considers cattle a measure of wealth. In the Amazon region, smallholders are increasingly turning to ranching activity due to the low labor demand and the low cost of pasture in comparison to other activities such as perennial crops (Hecht 1993). In the floodplain, landholders who engage in cattle ranching may face a tradeoff between ecological opportunities and household constraints. In Patos, for example, easy access to both floodplain and upland provides an ecological and institutional opportunity to develop cattle ranching. This trait explains why almost all cattle raisers from Patos decided to cooperate in a group when access to the floodplain was threatened (see Floodplain Institutional Arrangement).[5]

However, easy access does not explain why some households with similar opportunities did not join in purchasing the floodplain. In this case, household structure seems to have played an important role in discouraging them from collaborating. Because cattle ranching is carried out by male members, household analysis provides information that helps to explain decisions for or against group participation by uncovering the differential distribution of endowments among residents in terms of labor force (Table 5.6). Thus, the CP group faced an opportunity structure that motivated them to cooperate in a group as opposed to PL and LL groups, who confronted some constraints—no source of income, low economic importance of floodplain products, lack of male labor force, and less favorable ecological conditions—that discouraged them from investing in a collective effort.

Despite the importance of cattle ranching in motivating households to participate, a few households in the CP group have no cattle (n= 4). But, they may eventually plan on owning cattle. These individuals are mostly the leaders who played a key role in the origin of the collective action. The fact that the same persons who led the upland conflict were the ones who organized the collective action in the floodplain seven to eight years later reveals a continuing form of social capital that was created out of long-term community-based life (see Chapter 3 for characterization of community and household) with the support of several external organizations in the past (see Chapter 4). Some scholars consider leadership an important element in collective action, particularly in regard to its origin and coordination (Frohlich et al.1971).

The Catholic church also developed a leadership system in the 1960s among floodplain communities. De Castro (2000) describes the Santarém region, in which 85 percent of 95 communities studied had some form of leadership. There are several organizations that are supported by the Catholic Church (see Chapter 4); in particular, the Catechist Group performs an important function among local residents. In the Santarém region, 90 percent of 102 communities in the flooodplain communities have a Catechist Group (de Castro 2000). In addition to their religious tasks, catechists also play an important political role among residents because they are respected individuals within a community, as mentioned in Chapter 3 and previously in this chapter.

Singh and Ballabh (1994) show that leadership plays a strong role in several functions, such as the generation of ideas, the motivation of a group, the mobilization of resources, and the development of management systems. In a Guatemalan village, Durston (1998) found that leaders were important actors for facilitating negotiation and creating cooperation. In the present case, leaders initiated the collective movement and encouraged other village members to participate through providing information about the floodplain.

The question of what motivates these individuals to lead the group may be explained by two factors. First, these leaders mentioned their plan to convert part of their crop field into cultivated pasture in the near future. Second, they may have interest in gaining control over the floodplain area in order to prevent outsiders from appropriating it. Both incentives may be correlated, because control over the land would ensure access to the grassland and other floodplain resources in the future. Although it is unclear if leadership affects individuals' cooperation, it seems to have been an important factor in the success of the collective action. Therefore, building social capital in terms of organization and leadership allowed local residents to initiate and coordinate their group (see chapters 3 and 4).

Previous experience in group cooperation and success of previous collective action (e.g., gained access and control over upland forest) contributed to the Patos residents' willingness to initiate the collective action that occurred in the floodplain ecosystem. The whole process of coordinating the floodplain collective group is a case in point where group tasks and assignment of responsibility have built social capital (Ostrom 1990). Similar cooperation was observed by White and Runge (1994) among local people in Haiti where a successful history of past cooperation contributed to a more efficient community-based watershed management.

Durston (1998) suggests that peasant communities present some kind of cultural precursors of social capital which can be the basis for group learning processes. The Patos community exemplifies a social organization basis, such as kinship relations and a church-sponsored political structure, which sets the stage for building trust and mutual reciprocity. As in other Amazonian floodplain areas, peasant people exchange labor, food, and any other products or even share land among kin households (Lima-Ayres 1992; Futemma 1995).

The present floodplain collective group (CP) is self-organized, but it is still in its early phase of organization. The head of the group was responsible for purchasing the land, including regulation and definite title of floodplain land. There is also an informal committee that participates in discussions and the decision-making process. They meet irregularly, and members are currently trying to define land tenure status and to structure their organization in order to regularize their usufruct rights of access and use of floodplain resources.

Final Considerations

Cooperation in the collective action for the floodplain depended upon the constraints and opportunities that individuals met, which can essentially be defined as push-and-pull factors. Cattle was the main driving force behind those factors that led local residents to organize.

A contextualization of the decision-making process into three levels—capability to buy the share, potential value of the resource, and capability to exploit the resource—enabled one to uncover the major factors that motivated individuals to participate in collective property of a floodplain area in the Lower Amazon. In short, the decision process consists of opportunity factors (access to grassland) that pushed individuals to join a collective action (one-third of Patos community) rather than constraint factors (lack of a money source for LL households and lack of labor force for PL households) which held back two-thirds of Patos households. In addition, leadership was a push factor that helped in the formation of the CP group, reducing costs of organization due to previous experience in three areas: (1) how to get organized; (2) how to utilize external assistance to get information; and (3), how to gain bargaining power with local government agencies. Therefore, social capital appears to be an important factor in promoting group cooperation.

The present study shows that because cattle ranching implies the use of the floodplain during the dry season and the upland during the flood season, this activity has effects on both ecological systems. Despite the relatively low rate of deforestation for pasture (0.80 hectare per capita), if incentives for cattle raising are to be continued, this figure may rapidly increase. Furthermore, timbering will likely continue for two reasons. First, the logged areas facilitate agro-pastoral tasks in that they lower the cost of opening areas for farming and pasture. Once trees are removed, local farmers save money in terms of labor, time, and energy to clear the area for farming and pasture; logging companies also open roads that facilitate the transport of farm products from field to house or market. Second, logging provides cash and/or other services that subsidize cattle. Several families reported that they sold lumber to logging companies two to three years ago in exchange for opening roads within the Patos community.

Although it appears that cooperation is leading to a higher rate of forest disturbance, the important point here is that local people appear to be able to organize in order to achieve their goals. If they perceive the importance to adopt more appropriate management techniques that require group cooperation in order to maintain their natural assets, they would be able to do so.

Endnotes

[1] The group is formed by sixteen households, twelve from Patos and four from Pau D'Arco. The Pau D'Arco members are not included in the present analysis but they participated with US$ 4,000.00. In fact, partners paid their shares gradually not only in cash but also in goods.

[2] Lopes, Daniel, Pará State Chief for DPU, conversation with author, December 3, 1998.

[3] Management of an *açai* forest involves activities such as clearing old stems and clearing understory surrounding *açai* trees to increase production of only healthy and young *açai* stems (see more details in Brondízio 1996).

[3] Political participation is an economical investment in the sense that time spent in political action affects the time allocated among other economic activities (Olson 1965; Udehn 1993). In addition, risks taken in such activities also raise the long-term economic cost. The floodplain case involves a short-term investment in floodplain area through payment in cash in order to maintain their access and use of resources.

[4] As discussed earlier, the only cattle rancher who did not join the collective property was the rancher who was willing to buy the floodplain system on his own (see Floodplain Institutional Arrangement).

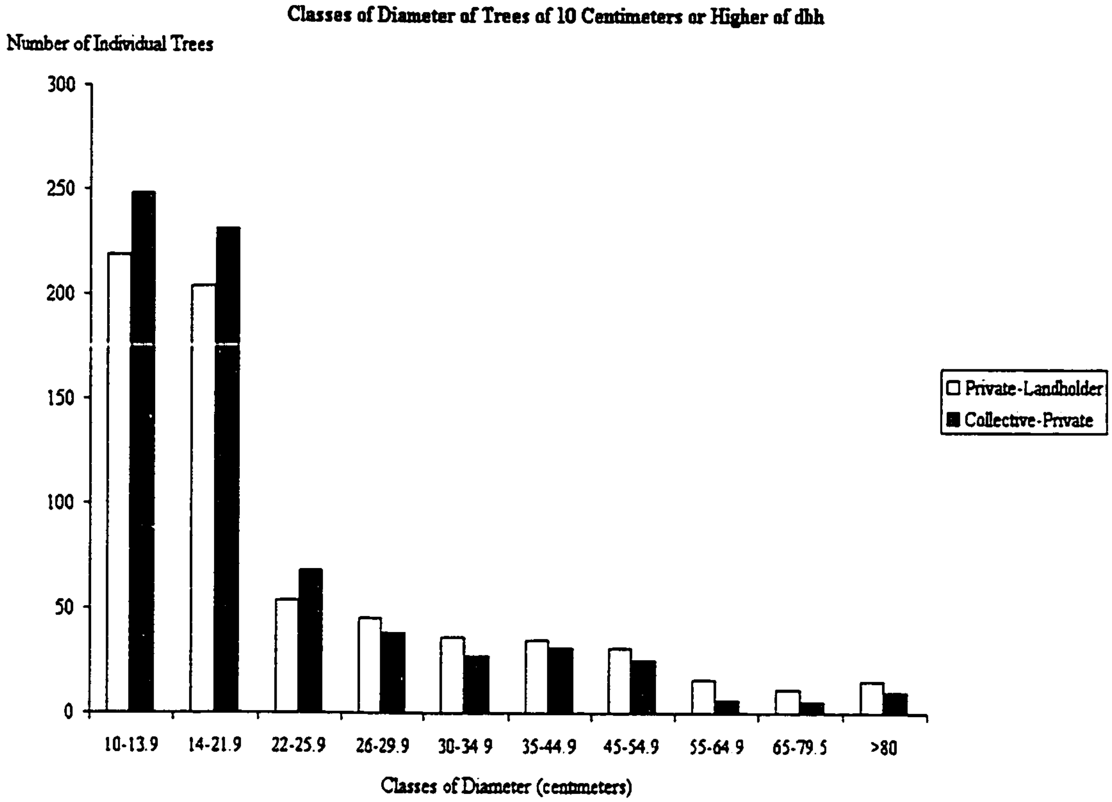

Figure 5.1. Distribution of Individual Trees According to Their Diameter, Comparing Forest Plots and Held by Private-Landholder (n = 50) and Collective-Private (n = 50) Households in the Patos Community

DECISION-MAKING TREE

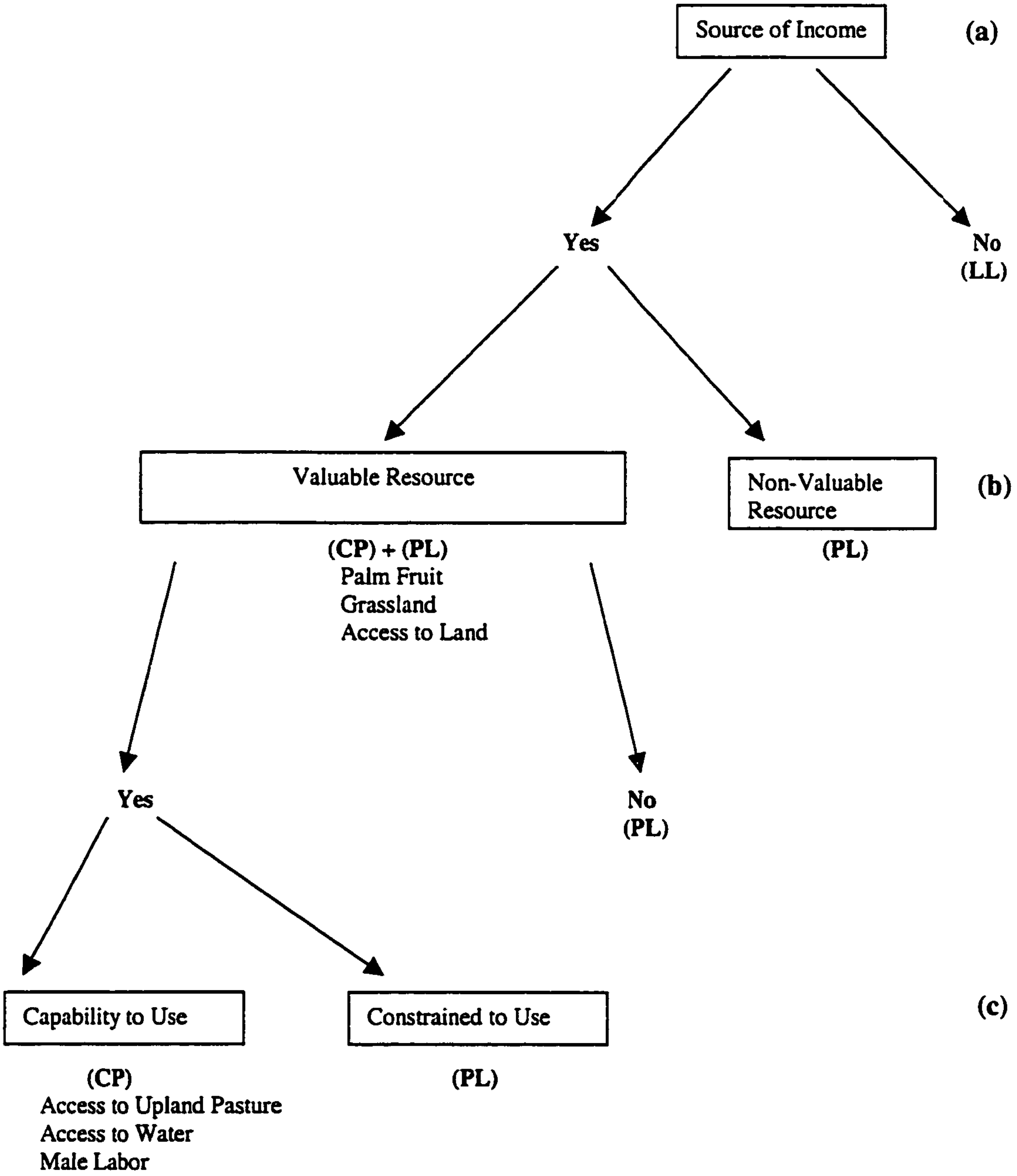

Figure 5.2. Hypothetical Decision-Making Tree for Participating in the Common Property of the Floodplain, Involving Three Groups of Households: Collective-Private (CP), Private-Landholder (PL), Landless (LL)

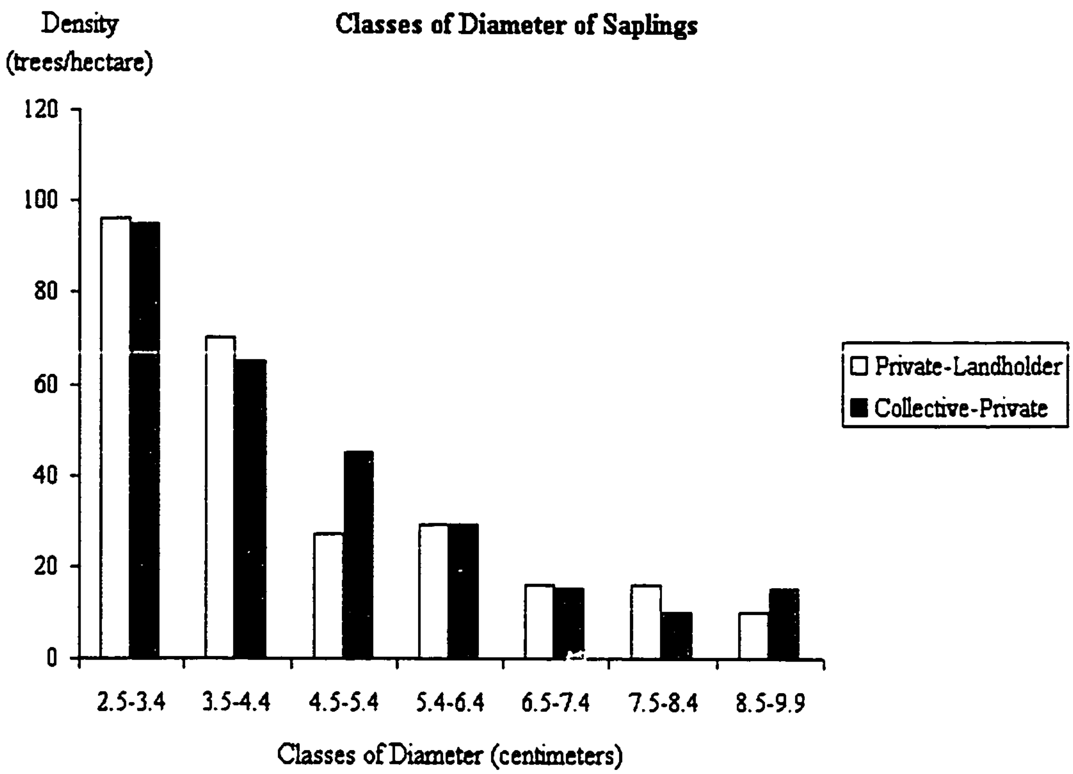

Figure 5.3. Distribution of Individual Saplings per Hectare According to Diameter, Comparing Plots between Private-Landoholder (n = 50) and Collective-Private (n = 50) Households in the Patos Community

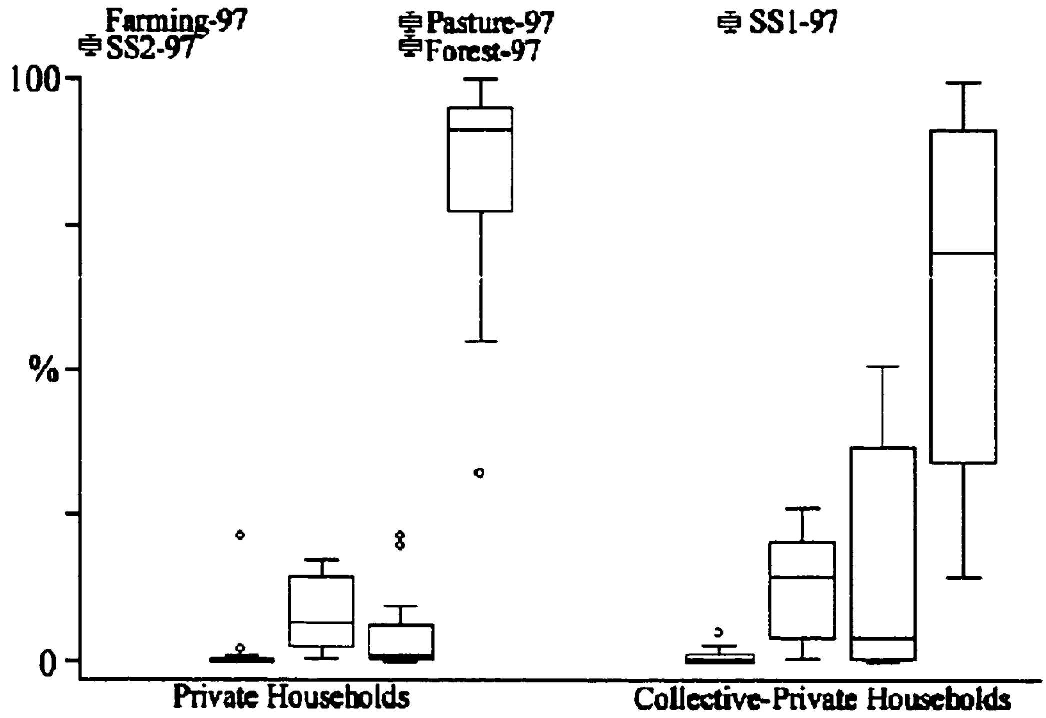

Figure 5.4. Comparison of Directed Land Use (farming and pasture) and Forested Vegetation (mature forest, intermediary secondary succession [SS2], and initial secondary succession [SS1]) between Private-Landholder and Collective-Private Forest Plots (1997)

Table 5.1. Distribution of Households in the Patos Community According to Land Ownership: Collective-Private (CP), Private-Landholder (PL), and Landless (LL)

Category of Household	Land Tenure	Frequency of Households
LL	None	10
PL	Upland parcel	11
CP	Upland parcel + Floodplain share	11
Total		32

Table 5.2. Sociocultural Comparison among Different Groups of Households in the Patos Community According to Land Tenure: Private-Landholder (PL), Collective-Private (CP), and Landless (LL)

Attributes	Groups of Households			Community
	PL	CP	LL	
Number of Households	11	11	10	32
Number of Female-Headed Households	5	0	2	7
Number of Male-Headed Households	0	1	1	2
Number of Double-Headed Households	6	10	7	23
Average Age of Heads	47 (± 16)	50 (± 15)	39 (±18)	46 (± 17)
Number of Literate Individuals	47	55	37	139
Average Size of Household	7.2 (± 4.6)	7.6 (± 2.9)	4.3 (±2.4)	5.6 (±3.5)
Number of Female Adults	28	24	12	64
Number of Female Children	24	17	11	52
Number of Male Adults	14	26	15	55
Number of Male Children	20	11	8	39
Total	86	78	46	210
Number of Catholic Heads	9	10	9	28
Number of Evangelic Heads	1	1	1	3
Number of Evangelic and Catholic Heads	1	0	0	1
Number of Cattle	2	61	6	69
Number of Horses	3	6	0	9
Number of Poultry	220	250	150	620
Number of Wood-Walled Houses	5	10	6	21
Number of Leaf-Walled Houses	4	0	3	7
Number of Mud-Walled Houses	2	1	1	4
Wooden Cart Pulled by Bull	1	3	1	5
Manioc Flour House	3	4	1	8

Table 5.3. Comparison of Members' Affiliations among Collective-Private (CP), Private-Landholder (PL), and Landless (LL) Households from the Patos Community

Variables		Frequency of Individuals					
Entity	Affiliation	CP		PL		LL	
		Husband (n = 11)	Wife (n = 11)	Husband (n = 6)	Wife (n = 11)	Husband (n = 9)	Wife (n= 9)
Catholic	Membership	10	9	5	8	7	8
	Leadership	-	1	-	1	1	0
Evangelic	Membership	1	1	0	2	1	1
	Leadership	-	-	1	-	0	-
STR	Membership	9	7	6	4	3	3
	Leadership	2	-	0	-	-	-
Mothers' Club	Membership	-	2	-	3	-	2
	Leadership	-	1	-	-	-	-
Soccer Club	Membership	2	-	3	-	4	-
	Leadership	3	-	1	-	0	-
MEB-FASE	Supporter	-	-	-	-	-	-
	Leadership	2	-	-	1	-	-
Upland Land Movement	Supporter	2	3	1	1	1	1
	Organizer	7	1	2	1	-	-

Table 5.4. Comparison between the Patos Upland Forests and Other Upland Tropical Forest from Other Region in Terms of Number of Trees Equal to or Larger Than 10 cm dbh (diameter at breast height), Number of Species, Number of Genera, Number of Families, and Basal Area

Author	Area of Study	Area Sampled (hectare)	Min dbh (cm)	Frequency of Trees (per ha)	Frequency of Species (per ha)	Frequency of Genera	Frequency of Families	Basal Area (m^2/ha)
Black et al. (1950)	Belem, Brazil	1	10	423	87	65	31	
Boom (1985)	Alto Ivon, Bolivia	1	10	649	94	61	28	
Cain et al. (1956)	Belem, Brazil	2	10	448	77	100	39	
Campbell et al. (1986)	Rio Xingú Region	3	10	473	88	127	39	28.7-32.1
Carvalho (1992)	FLONA-Tapajós	15	45		211		45	31.65
Carvalho (1992)	FLONA-Tapajós	15	55		217		45	31.82
Carvalho (1992)	FLONA-Tapajós	15	5	101	257	151	49	29.87
Lopes et al. (1984)	FLONA-Tapajós	3	5					34.15
Lopes et al. (1984)	FLONA-Tapajós	3	5					25.49
Lopes et al. (1984)	FLONA-Tapajós	3	5					32.32
Lopes et al. (1984)	FLONA-Tapajós	3	5					25.96
Barros (1986)	Curuá-Una (SUDAM)	5	5	99	49	127	48	28.89
Dantas and Muller (1979)	Transamazônica	1	9.55	578	101	77	30	
Dantas et al. (1980)	Capitão Poço, Brazil	1	9.55	504	120	79	39	
FUTEMMA (current)	**Santarém, Lower Amazon**	**3**	**10**	**458**	**71**	**134**	**49**	**27.11**
Gentry (1991)	Central America-La Selva	3-4	10		30 to 44			
Gentry (1991)	Manaus	1	15		179			
Hartshorn (1980)	Manu Park, Peru	1	10	584	153			
Hubbell and Foster (1983)	Barro Colorado Island (BCI)	50	20	102	186			
Johns (1988)	Sungai Tekam Forestry	2.08	9.5	548	87	53		
Lechthaler (1956)	Manaus, Brazil	1	8	735				
Pires (1966)	Breves, Brazil	1	10	516	157		36	
Pires et al. (1953)	Castanhal, Brazil	3.5	10	423	51	130	47	
Prance (1991)	Central Amazonia	1	15		825		96	
Prance et al. (1979)	Manaus, Brazil	1	15	350	179	115	45	
Rodrigues (1963)	Amapá, Brazil	1.1	15	315	36	84	63	
Rodrigues (1963)	Amapá, Brazil	1.5	15	204	64	70	37	
Uhl et al. (1988)	Eastern Amazon, Brazil		10					30
Uhl and Murphy (1981)	Amazon Basin, Venezuela	1	10		83			27.8
Uhl and Vieira (1989)	Eastern Amazon, Brazil	6.8	10		100			20 to 30

Table 5.5. The Effect of Social and Ecological Variables on Collective-Private (CP) and Private-Landholder (PL) Households of the Patos Community and the Association between Those Variables and Collective Action (n = 11 for each, CP and PL)

Category	Variables	CP (%)	PL (%)	Strength of Association (Tau-b)
Source of Income	Withdrawal of Credit Line	64	18	0.31
	Withdrawal of Retirement Income	64	27	0.38
	Trade Wood	100	91	0.19
Value of Floodplain	*Açai* (Harvest or Not Harvest)	55	0	0.60
	Cattle (Have or Do Not Have)	45	8	0.54
	Access (Leader or Non-Leader)	45	0	0.54
Conditions for Floodplain Resource Uses	Access to Water	55	0	0.61
	Access to Upland Pasture	36	0	0.47
	Male Labor	45	9	0.41

Note: One household from the Patos Community is not included in the present analysis because the head is an outsider rancher. He is the rancher who wanted to buy the floodplain area in the early 1990s. He holds more than 50 heads and opened more than 16 hectares for pasture area in the bottomland zone, and he uses both family and paid labor. In fact, this case falls into a fourth category of household—Outsider-Rancher (OR).

Table 5.6. Distribution of Male Labor Force in the Patos Community between Collective-Private (CP) Households (n = 11) and Private-Landholder (PL) Households (n = 11)

Number of Male Labor per Household	CP (%)	PL (%)
0	30	38
1 to 2	30	54
3 to 4	30	8
5 or More	10	0

Table 5.7. Matrix Displaying the Attributes[1] of Each Household of the Collective-Private (CP), Private-Landholder (PL), and Landless (LL) Groups (n = 32)

ID	Retirement Income	Credit Line	Trade Wood	Trade *Açai*	Leadership	Male Labor	Upland Pasture	Access Water	Cattle	Total
Collective-Private										
hh1	1	1	0	1	0	2	1	1	2	9
hh2	1	1	0	1	0	2	1	1	2	9
hh3	1	1	0	0	0	2	1	1	2	8
hh4	0	1	1	1	0	2	0	1	2	8
hh5	0	0	1	1	1	2	0	0	2	7
hh6	1	1	1	1	1	1	0	1	0	7
hh7	1	1	1	0	1	1	0	0	1	6
hh8	1	1	1	0	1	0	0	0	0	4
hh9	0	1	1	1	0	1	0	0	0	4
hh10	0	1	1	1	0	1	0	0	0	4
hh11	0	1	1	1	0	1	0	0	1	5
Private-Landholder										
hh12	0	1	1	0	0	1	0	0	1	4[2]
hh13	1	0	0	0	1	0	0	1	0	3
hh14	1	0	1	0	0	1	0	0	0	3
hh15	0	0	1	0	0	2	0	0	0	3
hh16	1	0	1	0	0	0	0	0	0	2
hh17	0	0	1	0	0	1	0	0	0	2
hh18	1	0	1	0	0	0	0	0	0	2
hh19	0	0	1	0	0	1	0	0	0	2
hh20	0	0	1	0	0	1	0	0	0	2
hh21	0	0	1	0	0	1	0	0	0	2
hh22	0	0	1	0	0	0	0	0	0	1
Landless										
hh23	1	0	0	1	0	2	0	0	0	4[3]
hh24	0	0	0	1	0	1	0	0	0	2
hh25	0	0	0	1	0	1	0	0	0	2
hh26	0	0	0	1	0	1	0	0	0	2
hh27	0	0	0	1	0	1	0	0	0	2
hh28	0	0	0	0	0	1	0	0	0	1
hh29	0	0	0	0	0	1	0	0	0	1
hh30	0	0	0	0	0	1	0	0	0	1
hh31	0	0	0	0	0	0	0	0	0	0
hh32	0	0	0	0	0	0	0	0	0	0

[1] Except for male labor and cattle, 1 means "yes" and 0 means "no." For male labor, 0 means "no labor", 1 = 1-2 male labor, and 2 = 3 or more male labor. For cattle, 0 means "no head," 1 means "from 1 to 2 heads, and 2 means "more than 3 heads."

[2] The 12th household joined the floodplain collective endeavor but dropped months later. They had their share (money) returned. They own two cows but they invested heavily in a cash crop rather than cattle.

[3] The 23rd household's head is considered a betrayer because he helped a large-scale rancher rather than support the upland social movement. The head now receives a retirement salary, which provides a household economy with stable monthly income.

Table 5.8. Effects of Collective Action on Tree Species of 10 centimeter or More dbh by Comparing Forests Held by Collective-Private (CP) and Private-Landholder (PL) Households in the Patos Community

Parameter (per plot)	CP ($n = 49$) Mean (SD)	PL ($n = 49$) Mean (SD)	T-Test
Number of Trees	14.42 (4.64)	13.88 (3.52)	1.68
Number of Species	12.43 (3.97)	11.68 (2.38)	1.68*
Total Basal Area ($m^{1/2}$/ha)	26.61 (18.88)	33.91 (21.81)	1.68**

* $p < 0.1$
** $p < 0.05$

Appendix 5.1

Stand Inventory Table Displaying All Tree Species of 10 cm or More dbh That Were Sampled in the Patos Upland Forest, Distributed According to Their Ecological Parameters of Density, Frequency, Dominance, and Importance Value.

FAMILY NAME	SPECIES NAME	LOCAL NAME	Absolute Density (ind/ha)	Relative Density (ind/ha)	Absolute Frequency	Relative Frequency	Absolute Dominance (m^2/ha)	Relative Dominance (m^2/ha)	Importance Value
Mimosaceae	Abarema jupumba (willd)britton & killip var.jupumba	ingarana	0.003	7.25	0.01	0.084	0.000	0.05	7.35
	Acrocomia sclerocarpa mart.	mucaja	0.003	7.25	0.01	0.084	0.000	0.07	7.35
Mimosaceae	Acacia multipinnata ducke	rabo de cameleao	0.003	7.25	0.01	0.084	0.001	0.23	7.41
Apocynaceae	Ambelania acida aubl.	pepino do mato	0.003	7.25	0.01	0.084	0.000	0.06	7.35
Annonaceae	Anaxagorea prinoides (dunal) st.hil		0.003	7.25	0.01	0.084	0.001	0.13	7.37
Lauraceae	Aniba hostmanmana mez	louro capitiu	0.003	7.25	0.07	0.588	0.007	1.21	8.24
Annonaceae	Annona ambotay aubl.		0.003	7.25	0.01	0.084	0.001	0.12	7.37
Caesalpinaceae	Apulia molaris spruce	amarelao	0.003	7.25	0.02	0.168	0.003	0.49	7.58
Apocynaceae	Aspidosperma nitidum bth.	carapanauba	0.004	9.06	0.04	0.336	0.018	3.05	10.41
Anacardiaceae	Astronium gracile engl.	muiracatiara	0.003	7.25	0.01	0.084	0.010	1.75	7.91
Caesalpinaceae	Bauhinia macrostachya bth.		0.007	14.49	0.01	0.084	0.001	0.10	14.61
Melastomataceae	Bellucia grossularioides (l.) trian.	goiabarana	0.003	7.25	0.01	0.084	0.000	0.05	7.35
Lecythidaceae	Bertholletia excelsa hbk	castanha do para	0.003	7.25	0.01	0.084	0.001	0.19	7.39
Bombacaceae	Bombax longipedicellatum ducke	mamourana da terra firme	0.003	7.25	0.02	0.168	0.003	0.44	7.56
Fabaceae	Bowdichia nitida spruce & benth.	sucupira amarela	0.003	7.25	0.01	0.084	0.001	0.11	7.37
Moraceae	Brosimum acutifolium huber	murure	0.003	7.25	0.06	0.504	0.002	0.31	7.85
Moraceae	Brosimum amplicoma ducke	amargoso	0.003	7.25	0.05	0.420	0.001	0.19	7.73
Moraceae	Brosimum guianense (aubl.) huber	janita	0.004	7.91	0.11	0.924	0.001	0.20	8.90
Moraceae	Brosimum lactescens (s. moore) c.c.berg.	amapai	0.003	7.25	0.01	0.084	0.003	0.46	7.48
Combretaceae	Buchenavia grandes ducke	irarana, cuiarana	0.003	7.25	0.03	0.252	0.010	1.69	8.06
Malpighiaceae	Byrsonima aerugo sagot.	muruci branca	0.003	7.25	0.03	0.252	0.002	0.28	7.59
Malpighiaceae	Byrsonima densa (poiv) dc	muruci da mata	0.003	7.25	0.08	0.672	0.002	0.41	8.06
Meliaceae	Carapa guianensis aublet	andiroba	0.003	7.25	0.02	0.168	0.006	1.10	7.78
Lecythidaceae	Cariniana rubra ducke	tauari cachimbo	0.003	7.25	0.01	0.084	0.001	0.11	7.37
Caryocaceae	Caryocar villosum (aublet) c.h.person	piquia	0.003	7.25	0.02	0.168	0.093	16.06	12.77
Flacourtiaceae	Casearia decandra jacq.		0.003	7.25	0.01	0.084	0.000	0.06	7.35
Flacourtiaceae	Casearia javitensis		0.003	7.25	0.02	0.168	0.000	0.06	7.44
Moraceae	Castilla ulei warb.	caucho	0.003	7.25	0.01	0.084	0.001	0.23	7.41
Moraceae	Cecropia obtusa trecul.	embauba branca	0.003	7.25	0.04	0.336	0.001	0.10	7.62
Moraceae	Cecropia sciadophylla mart.	embauba da mata	0.003	6.39	0.17	1.427	0.001	0.18	7.88
Caesalpinaceae	Cenostigma tocantinum ducke	coracao de negro	0.005	9.82	0.31	2.603	0.004	0.70	12.65
Olacaceae	Chaunochiton kappleri (sagotex engl.) ducke	lacrao da mata	0.003	7.25	0.07	0.588	0.002	0.29	7.93
Rubiaceae	Chimarrhis turbinata dc	pau de remo	0.003	7.25	0.16	1.343	0.003	0.59	8.79
Moraceae	Clarisia racemosa ruiz and pavon	guariuba	0.003	7.25	0.03	0.252	0.010	1.77	8.09
Euphorbiaceae	Conceveiba guianensis aubl.	Arraceira	0.003	7.25	0.03	0.252	0.000	0.07	7.52
Connaraceae	Connarus perottetii(dc)planch.var.angustifolius		0.003	7.25	0.01	0.084	0.001	0.17	7.39
Caesalpinaceae	Copaifera reticulata ducke	copaiba	0.003	7.25	0.02	0.168	0.001	0.23	7.49
Boraginaceae	Cordia bicolor a.dc	freijo branco	0.003	7.25	0.03	0.252	0.003	0.54	7.68
Boraginaceae	Cordia escabrifolia a.dc	freijo	0.003	7.25	0.03	0.252	0.006	1.07	7.85
Boraginaceae	Cordia exaltata lam.	chapeu de sol	0.003	7.25	0.06	0.504	0.000	0.07	7.77
Boraginaceae	Cordia goeldiana huber	freijo cinza	0.003	7.25	0.01	0.084	0.001	0.12	7.37
Boraginaceae	Cordia tetandra	freijo folha peluda	0.003	7.25	0.01	0.084	0.001	0.22	7.40

FAMILY NAME	SPECIES NAME	LOCAL NAME	Absolute Density (ind/ha)	Relative Density (ind/ha)	Absolute Frequency	Relative Frequency	Absolute Dominance (m^2/ha)	Relative Dominance (m^2/ha)	Importance Value
Apocynaceae	Couma macrocarpa (gard.)miers ou barb.	sorva preta	0.003	7.25	0.01	0.084	0.000	0.06	7.35
Lecythidaceae	Couratari guianensis aubl.	tauari de folha grande	0.004	8.05	0.09	0.756	0.001	0.12	8.85
Lecythidaceae	Couratari oblongifolia ducke	tauari	0.004	9.66	0.12	1.008	0.003	0.50	10.84
Euphorbiaceae	Croton matourensis		0.003	7.25	0.01	0.084	0.003	0.56	7.52
Sapindaceae	Cupania escrobiculata l.c. rich.		0.003	7.25	0.01	0.084	0.002	0.33	7.44
Caesalpinaceae	Cynometra hostmaniana tul.	jutairana	0.003	7.25	0.01	0.084	0.000	0.07	7.35
Fabaceae	Derris spruciana		0.003	7.25	0.01	0.084	0.006	1.04	7.68
Caesalpinaceae	Diallium guianensis aubl.	jutai pororoca	0.004	8.45	0.06	0.504	0.002	0.26	9.05
Ebenaceae	Diospyros melinnoni (hiern) a.c.sm.	caqui preto	0.003	7.25	0.01	0.084	0.003	0.53	7.51
Fabaceae	Diplotropis pupurea (rich) arres.	sucupira preta	0.003	7.25	0.01	0.084	0.001	0.09	7.36
Fabaceae	Dipteryx odorata aubl.	cumaru	0.003	7.25	0.01	0.084	0.003	0.60	7.53
Annonaceae	Duguetia cadaverica huber	enviracana	0.003	7.25	0.01	0.084	0.001	0.16	7.38
Annonaceae	Duguetia quitarensis benth	envireira	0.003	7.25	0.02	0.168	0.001	0.10	7.45
Annonaceae	Duguetia sp.	envira preta	0.003	7.25	0.01	0.084	0.001	0.10	7.36
Sapotaceae	Ecclineura ramiflora mart.	abiu peludo	0.003	7.25	0.01	0.084	0.001	0.16	7.38
Humiricaceae	Endopleura uchi huber	uxi	0.003	7.25	0.06	0.504	0.001	0.16	7.80
Araliaceae	Eschefflera morototoni (aubl.)dc & planch	morototo	0.003	7.25	0.05	0.420	0.008	1.41	8.13
Lecythidaceae	Eschweilera amazonica r.kunth.	matamata vermelho	0.004	8.28	0.07	0.588	0.001	0.14	8.92
Lecythidaceae	Eschweilera coriacea (a.p.dc) mart. ex.berg	matamata branco	0.004	9.45	0.46	3.862	0.001	0.13	13.36
Lecythidaceae	Eschweilera grandiflora (aubl.) sandw.	matamata preto	0.003	7.25	0.14	1.175	0.001	0.13	8.47
Myrtaceae	Eugenia patrisii vahl	pitombarana	0.004	8.45	0.12	1.008	0.001	0.09	9.49
Moraceae	Ficus insipida (willd.) var. insipida	caxiruba	0.003	7.25	0.01	0.084	0.001	0.20	7.40
Sapotaceae	Franchetella gongripii (eyma) aubrae	abiurana branca	0.004	7.94	0.21	1.763	0.001	0.19	9.76
Apocynaceae	Geissospermum sericeum (sajot)bth.	quiinarana	0.003	7.25	0.03	0.252	0.001	0.24	7.58
Apocynaceae	Geissospermum villosii allen	quiinarana	0.003	7.25	0.03	0.252	0.002	0.41	7.63
Celastraceae	Goupia glabra aubl.	cupiuba	0.004	8.28	0.07	0.588	0.001	0.15	8.92
Meliaceae	Guarea guidonia (l.) sleumer	andirobarana	0.003	7.25	0.05	0.420	0.010	1.76	8.25
Meliaceae	Guarea kunthiana a.juss.	andirobarana	0.003	7.25	0.02	0.168	0.001	0.19	7.48
Annonaceae	Guatteria poeppigiana mart.	envira preta	0.003	7.25	0.11	0.924	0.001	0.23	8.25
Lecythidaceae	Gustavia poeppigiana berg.	jeniparana	0.004	9.66	0.09	0.756	0.004	0.65	10.63
Moraceae	Helicostylis pedunculata ben.	muiratinga, moracea chocolate	0.003	7.25	0.09	0.756	0.000	0.06	8.02
Moraceae	Helicostylis tomentosa (poepp. and endl) rusby	moracea chocolate	0.003	7.25	0.02	0.168	0.001	0.20	7.48
Flacourtiaceae	Homalium guianensis (aubl) oken		0.003	7.25	0.01	0.084	0.000	0.07	7.35
Caesalpinaceae	Hymenea courbaril l.	jatoba	0.003	7.25	0.04	0.336	0.001	0.12	7.62
Caesalpinaceae	Hymenea parvifolia huber	jutai mirim	0.003	7.25	0.03	0.252	0.001	0.10	7.53
Fabaceae	Hymenolobium excelsum ducke	angelim da mata	0.003	7.25	0.02	0.168	0.009	1.57	7.94
Mimosaceae	Inga alba (sw.) willd.	inga vermelha	0.004	8.80	0.14	1.175	0.001	0.23	10.05
Mimosaceae	Inga auristellae harms.	inga	0.003	7.25	0.01	0.084	0.002	0.27	7.42
Mimosaceae	Inga cinnamomea sp. ex benth	inga acu	0.003	7.25	0.04	0.336	0.000	0.05	7.60
Mimosaceae	Inga edulis mart.	inga cipo	0.003	7.25	0.07	0.588	0.000	0.07	7.86
Mimosaceae	Inga gracilifolia ducke	inga duro	0.004	8.21	0.15	1.259	0.001	0.16	9.52
Mimosaceae	Inga heterophylla willd.	inga xixica	0.003	7.25	0.03	0.252	0.001	0.21	7.57
Mimosaceae	Inga nitida willd.	inga	0.004	7.97	0.1	0.840	0.002	0.27	8.90
Mimosaceae	Inga rubiginosa	inga peludo	0.003	7.25	0.03	0.252	0.001	0.17	7.55
Mimosaceae	Inga sp.		0.003	7.25	0.01	0.084	0.001	0.16	7.39
Mimosaceae	Inga thibaudiana dc.	inga pintado	0.003	7.25	0.05	0.420	0.001	0.09	7.69
Mimosaceae	Inga velutina	inga folha peluda	0.003	7.25	0.01	0.084	0.000	0.08	7.36
Myristicaceae	Iryanthera juruensis warb.	ucuubarana	0.003	7.25	0.01	0.084	0.000	0.06	7.35
Myristicaceae	Iryanthera paraense	ucuubarana	0.003	7.25	0.01	0.084	0.001	0.09	7.36

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Myristicaceae	Iryanthera sagotiana (benth) warb.	ucuubarana	0.003	7.25	0.03	0.252	0.000	0.07	7.52
Rubiaceae	Isertia longifolia rich.		0.003	7.25	0.01	0.084	0.000	0.08	7.36
Bignoniaceae	Jacaranda copaia (aubl.) d.don	parapara	0.007	14.49	0.17	1.427	0.001	0.15	15.97
Caricaceae	Jacaratia espinosa a.dc	mamui	0.006	12.08	0.03	0.252	0.004	0.63	12.54
Apocynaceae	Lacmelia aculeata (duck) monach.	pau de colher	0.003	7.25	0.06	0.504	0.001	0.09	7.78
Flacourtiaceae	Laetia procera (poepp et endl) eichl.	pau jacare	0.003	7.25	0.06	0.504	0.000	0.07	7.77
Lecythidaceae	Lecythis idatimon aubl.	jatereua	0.003	7.25	0.08	0.672	0.004	0.61	8.12
Lecythidaceae	Lecythis lurida (miers) mori	jarana, morejarana	0.004	8.28	0.14	1.175	0.001	0.13	9.50
Lecythidaceae	Lecythis pisonis cambs.	sapucaia	0.003	7.25	0.03	0.252	0.005	0.84	7.78
Lecythidaceae	Lecythis sp.		0.003	7.25	0.01	0.084	0.013	2.32	8.10
Violaceae	Leonia guianensis		0.003	7.25	0.01	0.084	0.000	0.08	7.36
Crysobalanaceae	Licania apetala (e.meyer) fritsch.	cariperana	0.003	7.25	0.02	0.168	0.000	0.05	7.43
Crysobalanaceae	Licania canescens r. ben.	cariperana	0.003	7.25	0.01	0.084	0.000	0.08	7.36
Crysobalanaceae	Licania heteromorpha benth.	macucu	0.003	7.25	0.1	0.840	0.000	0.06	8.11
Flacourtiaceae	Lindackeria paraensis kuhl.		0.004	9.06	0.04	0.336	0.001	0.13	9.44
Tilliaceae	Luehea speciosa willd.	acoita cavalo	0.003	7.25	0.01	0.084	0.001	0.11	7.37
Sapotaceae	Manilkara huberi (ducke) chew.	macaranduba	0.003	7.25	0.01	0.084	0.001	0.09	7.36
Moraceae	Maquira guianensis aubl.	muiratinga folha miuda	0.004	8.36	0.13	1.092	0.010	1.66	10.00
Moraceae	Maquira heterophylla	muiratinga folha grande	0.003	7.25	0.01	0.084	0.001	0.09	7.36
Moraceae	Maquira sclerophylla ducke	muiratinga folha grande	0.003	7.25	0.03	0.252	0.000	0.05	7.51
Mimosaceae	Marmoroxylon racemosum (ducke) killip.	faveira amarela	0.005	10.87	0.02	0.168	0.005	0.78	11.30
Palmae	Maximiliana maripa (mart.) drude	inaja	0.003	7.25	0.03	0.252	0.000	0.05	7.52
Celastraceae	Maynetus myrcinoides reissek	xixua	0.003	7.25	0.01	0.084	0.003	0.51	7.50
Bignoniaceae	Memora flavida (dc) bur&k.schum.			0.00		0.000	0.000	0.00	0.00
Rutaceae	Metrodorea flavida krause	limaozinho	0.003	7.25	0.01	0.084	0.000	0.00	7.33
Lauraceae	Mezilaurus itauba (meiss) taub.	itauba	0.003	7.25	0.07	0.588	0.000	0.05	7.85
Melastomataceae	Miconia minutiflora (boupl) dc	tinteiro	0.005	11.59	0.05	0.420	0.002	0.39	12.14
Melastomataceae	Miconia myriantra benth.		0.007	14.49	0.01	0.084	0.001	0.20	14.64
Melastomataceae	Miconia poeppigii triana		0.003	7.25	0.01	0.084	0.000	0.06	7.35
Melastomataceae	Miconia pubipetala miq.		0.003	7.25	0.01	0.084	0.000	0.08	7.36
Melastomataceae	Miconia surinamensis gleason		0.005	9.88	0.11	0.924	0.003	0.47	10.96
Melastomataceae	Miconia tomentoss (l.c.rich) d.don.		0.003	7.25	0.01	0.084	0.001	0.15	7.38
Sapotaceae	Microphyllis venulosa (m & e) pierre	abiu folha fina	0.003	7.25	0.02	0.168	0.000	0.07	7.44
Olacaceae	Minquartia guianensis aubl.	aquariquara	0.003	7.25	0.02	0.168	0.001	0.11	7.45
Melastomataceae	Mouriri duckeana morley	mirauba	0.003	7.25	0.02	0.168	0.005	0.78	7.67
Myrtaceae	Myrciara floribunda (west. ex willd.) berg.	goiabarana	0.003	7.25	0.03	0.252	0.000	0.06	7.52
Lauraceae	Nectandra cuspidata (mart. ex. nees) nees	louro preto	0.004	8.70	0.05	0.420	0.003	0.53	9.29
Nyctaginaceae	Neea floribunda poepp. & endl.	joao mole	0.003	7.25	0.02	0.168	0.001	0.11	7.45
Nyctaginaceae	Neea glomerulifera heimert.	joao mole	0.003	7.25	0.01	0.084	0.002	0.33	7.44
Nyctaginaceae	Neea oppositifolia r. and p.	joao mole	0.003	7.25	0.16	1.343	0.000	0.07	8.61
Lauraceae	Ocotea copaifera	louro	0.003	7.25	0.01	0.084	0.001	0.15	7.38
Lauraceae	Ocotea costulatum (nees) mez.	louro amarelo	0.004	7.70	0.16	1.343	0.001	0.16	9.10
Lauraceae	Ocotea glomerata (nees) mez.	louro branco	0.004	8.70	0.1	0.840	0.004	0.69	9.76
Palmae	Oenocarpus distichus mart.	bacaba	0.003	7.25	0.05	0.420	0.003	0.44	7.81
Fabaceae	Ormosia coutinoi ducke	buiucu	0.003	7.25	0.01	0.084	0.001	0.18	7.39
Fabaceae	Ormosia paraensis ducke	tento	0.003	7.25	0.02	0.168	0.001	0.09	7.44
Myristicaceae	Ostheophloeum platispermun (a.dc.) warb.	ucuuba chorona	0.003	7.25	0.01	0.084	0.005	0.84	7.61
Annonaceae	Oxandra sp.	amandireira	0.003	7.25	0.01	0.084	0.000	0.06	7.35
Rubiaceae	Palicourea guianensis aubl.		0.003	7.25	0.01	0.084	0.000	0.06	7.35
Mimosaceae	Parkia nitida	faveira dura	0.003	7.25	0.02	0.168	0.001	0.12	7.45

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Mimosaceae	Parkia velutina r. benoist.	faveira folha peluda	0.003	7.25	0.06	0.504	0.001	0.18	7.81
Violaceae	Paypayrola grandiflora tul.		0.003	7.25	0.11	0.924	0.002	0.40	8.30
Mimosaceae	Piptadenia psylostachya (dc) bth.	timborana da folha grande	0.003	7.25	0.05	0.420	0.001	0.11	7.70
Mimosaceae	Piptadenia suaveolens miq.	timborana	0.004	7.76	0.14	1.175	0.001	0.12	8.98
Mimosaceae	Pithecellobium marmoxylon (ducke) killip	angelim rajado	0.003	7.25	0.02	0.168	0.005	0.85	7.70
Mimosaceae	Pithecellobium pedicellare (dc) bth.	mupucixi vermelha	0.003	7.25	0.01	0.084	0.003	0.52	7.50
Fabaceae	Poecilanthe effusa	gema de ovo	0.004	8.21	0.15	1.259	0.030	5.10	11.17
Euphorbiaceae	Pogonophora schomburgkiana miers ex. benth.	aracapuri	0.003	7.25	0.01	0.084	0.000	0.07	7.35
Moraceae	Pouroma guianensis aubl.	mapatirana	0.003	7.25	0.09	0.756	0.001	0.09	8.03
Sapotaceae	Pouteria caimito (r. and p.) radlk	abiu, abiurana vermelha	0.004	7.97	0.1	0.840	0.003	0.44	8.96
Sapotaceae	Pouteria laurifolia gomes	abiu seco	0.004	7.65	0.18	1.511	0.001	0.15	9.21
Sapotaceae	Pouteria sp.	goiabao	0.003	7.25	0.01	0.084	0.001	0.19	7.39
Burseraceae	Protium heptaphyllum (aubl) march.	breu	0.003	7.25	0.01	0.084	0.001	0.17	7.39
Burseraceae	Protium insignis (tr. and pl) engl.	breu preto	0.003	7.25	0.08	0.672	0.001	0.17	7.98
Burseraceae	Protium pallidum cuatr.	breu branco	0.005	10.71	0.46	3.862	0.003	0.45	14.72
Burseraceae	Protium paraense cuatr.	breu amesclado	0.004	9.66	0.03	0.252	0.001	0.16	9.97
Burseraceae	Protium pernervatum cuatr.	breu vermelho	0.005	9.79	0.37	3.107	0.001	0.23	12.97
Burseraceae	Protium robustum (swartz) poster	breu de folha grande	0.004	8.94	0.3	2.519	0.001	0.22	11.53
Burseraceae	Protium sagotiana	breu	0.003	7.25	0.01	0.084	0.001	0.12	7.37
Fabaceae	Pterocarpus rohrii vahl.	mututi duro	0.003	7.25	0.01	0.084	0.001	0.13	7.37
Vochysiaceae	Qualea paraensis ducke	mandioqueira	0.004	9.22	0.11	0.924	0.012	2.09	10.84
Sapotaceae	Richardella macrophylla	abiu cutiti	0.004	8.70	0.3	2.519	0.006	1.11	11.58
Violaceae	Rinorea flavescens (aubl) kunth.	canela de jacamim	0.003	7.25	0.02	0.168	0.001	0.13	7.46
Violaceae	Rinorea guianensis aubl.	quariquarana	0.004	8.63	0.21	1.763	0.000	0.06	10.41
Violaceae	Rinorea passoura (dc) kantz	canela de velha	0.003	7.25	0.02	0.168	0.001	0.13	7.46
Humiricaceae	Saccoglotis guianensis bth.	uchirana	0.003	7.25	0.02	0.168	0.001	0.12	7.45
Euphorbiaceae	Sapium marmiere huber	burra leiteira	0.003	7.25	0.01	0.084	0.000	0.00	7.33
Caesalpinaceae	Sclerolobium guianensis		0.003	7.25	0.01	0.084	0.001	0.09	7.36
Caesalpinaceae	Sclerolobium paniculatum vog.	tachi pitomba	0.004	8.77	0.19	1.595	0.001	0.12	10.41
Caesalpinaceae	Sclerolobium paraense hub.	tachi branco	0.003	7.25	0.1	0.840	0.004	0.69	8.32
Simarubaceae	Simaruba amara aubl.	marupa	0.004	8.70	0.05	0.420	0.004	0.61	9.32
Monimiaceae	Siparuna guianensis aubl.	capitiu	0.003	7.25	0.01	0.084	0.002	0.43	7.47
Elaeocarpaceae	Sloanea grandis ducke	urucurana folha grande	0.003	7.25	0.02	0.168	0.001	0.12	7.46
Elaeocarpaceae	Sloanea guianensis (aubl) beroth	urucurana	0.003	7.25	0.05	0.420	0.001	0.13	7.71
Sterculiaceae	Sterculia pilosa ducke	axixa	0.003	7.25	0.01	0.084	0.003	0.48	7.49
Sterculiaceae	Sterculia pruriens (aubl) schum.	tacacazeiro	0.003	7.25	0.07	0.588	0.003	0.59	8.03
Mimosaceae	Stryphnodendro paniculata poepp. and endl.	tachirana	0.003	7.25	0.03	0.252	0.003	0.47	7.66
Mimosaceae	Stryphnodendro pulcherrimum (willd) hochr.	paricazinho	0.003	7.25	0.02	0.168	0.002	0.43	7.56
Caesalpinaceae	Swartzia arborescens (aubl) pittier	pitaica	0.003	7.25	0.04	0.336	0.002	0.33	7.69
Caesalpinaceae	Swartzia laurifolia benth.		0.003	7.25	0.01	0.084	0.001	0.10	7.36
Caesalpinaceae	Swartzia racemosa benth.	pitaica	0.003	7.25	0.01	0.084	0.023	3.90	8.63
Guttiferae	Symphonia globulifera l.f.	anani	0.004	8.45	0.06	0.504	0.001	0.15	9.01
Sapotaceae	Syzygiopsis pachycarpa pires	abiu casca grossa	0.004	9.32	0.07	0.588	0.001	0.16	9.96
Caesalpinaceae	Tachigalia myrmecophila (ducke) ducke	tachi preto	0.004	9.51	0.16	1.343	0.003	0.47	11.01
Sapindaceae	Talisia carinata radlk.		0.003	7.25	0.02	0.168	0.002	0.31	7.52
Anacardiaceae	Tapirira guianensis aubl.	tapiririca	0.004	7.91	0.11	0.924	0.001	0.12	8.87
Dichapetalaceae	Tapura amazonica poepp. and endl.	pau de bicho	0.003	7.25	0.03	0.252	0.002	0.35	7.62
Dichapetalaceae	Tapura guianensis		0.003	7.25	0.01	0.084	0.002	0.38	7.46
Burseraceae	Tetragastris altissima (aubl.) swartz	breu manga	0.003	7.25	0.01	0.084	0.001	0.22	7.40
Burseraceae	Tetragastris panamensis (engl.) o.k.	breu areiu areiu	0.003	7.25	0.03	0.252	0.005	0.82	7.77

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Burseraceae	Tetragastris trifoliolatum (engl.) cuatr.	breu amesclinha	0.004	8.36	0.13	1.092	0.010	1.67	10.01
Sterculiaceae	Theobroma speciosum willd. ex. spring.	cacau da mata	0.004	7.91	0.11	0.924	0.000	0.08	8.85
Anacardiaceae	Thyrsodium paraense huber	amaparana	0.003	7.25	0.06	0.504	0.000	0.07	7.77
Quiinaceae	Tourolia guianensis aubl.	papo de mutum	0.003	7.25	0.01	0.084	0.000	0.07	7.35
Burseraceae	Trattinickia burserifolia mart.	breu	0.003	7.25	0.01	0.084	0.000	0.08	7.36
Burseraceae	Trattinickia rhoifolia (engl.) cuatr.	breu sucuruba	0.003	7.25	0.02	0.168	0.001	0.21	7.48
Meliaceae	Trichilia lecointei ducke	caxua	0.004	7.85	0.12	1.008	0.001	0.09	8.89
Humiricaceae	Vantanea parviflora lan.	achua	0.003	7.25	0.01	0.084	0.009	1.52	7.84
Fabaceae	Vatairea guianensis aubl.	fava amargoso	0.003	7.25	0.02	0.168	0.007	1.13	7.79
Myristicaceae	Virola calophylla warb.	ucuuba	0.003	7.25	0.01	0.084	0.001	0.13	7.37
Merysticaceae	Virola elongata (bth) warb.	ucuuba	0.003	7.25	0.05	0.420	0.001	0.18	7.73
Myristicaceae	Virola michellii hackel	ucuuba preta	0.005	10.18	0.42	3.526	0.003	0.50	13.87
Myristicaceae	Virola sebifera aubl.	ucuuba folha peluda	0.003	7.25	0.13	1.092	0.001	0.15	8.39
Guttiferae	Vismia guianensis (aubl) choisy	lacre	0.003	7.25	0.01	0.084	0.000	0.05	7.35
Verbenaceae	Vitex triflora vahl.	taruma	0.003	7.25	0.02	0.168	0.000	0.07	7.44
Vochysiaceae	Vochysia guianensis aubl.	quarubatinga	0.003	7.25	0.03	0.252	0.003	0.50	7.66
Vochysiaceae	Vochysia inundata ducke	quaruba cedro	0.003	7.25	0.02	0.168	0.001	0.19	7.48
Vochysiaceae	Vochysia maxima ducke	quaruba verdadeiro	0.003	7.25	0.11	0.924	0.011	1.89	8.80
Annonaceae	Xylopia nitida dun.	envira branca	0.003	7.25	0.04	0.336	0.003	0.47	7.74
Rutaceae	Zanthoxyllum rhoifolium engl.	tamanqueira	0.003	7.25	0.01	0.084	0.000	0.08	7.36
Rhamnaceae	Zizyphus itacaiunensis froes	maria preta	0.003	7.25	0.01	0.084	0.004	0.75	7.58
	Unknown 10.1		0.003	7.25	0.01	0.084	0.001	0.09	7.36
TOTAL			0.751	1633.19	11.92	100.084	0.580	100.00	1766.61

Appendix 5.2

List of Lianas That Are Found in the Patos Upland Forest

Scientific Name	Common Name	Frequency
Abuta grandiflora (Mart.) Sandw.		2
Bauhinia guianensis Aubl.	Escada de jabuti	2
Clitoria guianensis		1
Clusia grandiflora Splitg.	Cebola brava	1
Coccoloba guianensis		1
Coccoloba sphaerocarpa Lindl.		1
Combretum rotundifolium Rich.		2
Cydista aequatorialis (L.) Miers		2
Davilla kunthii St. Hil	Cipó de fogo	1
Dioclea guianensis Benth.	Cipó	1
Memora consaguina (Bur & K.) Schum.		1
Memora flavida (DC.) Bur & K. Schum.	Graxama	7
Memora magnifica (Mart. ex DC.) Bur.		7
Salacia insignis A.C. SM.		1

Appendix 5.3

List of 56 Woody Tree Species That Are Found in the Patos Upland Forest (1997)

Scientific Name	Common Name	Scientific Name	Common Name
Astronium gracile engl.	Muiracatiara	Minquartia guianensis aubl.	Aquariquara
Bertholletia excelsa hbk	castanha do para	Mouriri duckeana morley	Mirauba
Bowdichia nitida spruce & benth.	sucupira amarela	Ocotea costulatum (nees) mez.	louro amarelo
Brosimum acutifolium huber	Murure	Oenocarpus distichus mart.	Bacaba
Brosimum amplicoma ducke	Amargoso	Ormosia coutinoi ducke	Buiucu
Brosimum guianense (aubl.) huber	Janita	Ostheophloeum platispermun (a.dc.) warb.	ucuuba chorona
Brosimum lactescens (s. moore) c.c.berg.	Amapai	Parkia velutina r. benoist.	faveira folha peluda
Buchenavia grandes ducke	irarana, cuiarana	Paypayrola grandiflora tul.	
Carapa guianensis aublet	Andiroba	Piptadenia psylostachya (dc) bth.	timborana da folha grande
Caryocar villosum (aublet) c.h.person	Piquia	Piptadenia suaveolens miq.	Timborana
Casearia decandra jacq.		Pithecellobium marmoxylon (ducke) killip	angelim rajado
Casearia javitensis		Pithecellobium pedicellare (dc) bth.	mupucixi vermelha
Castilla ulei warb.	Caucho	Qualea paraensis ducke	Mandioqueira
Clarisia racemosa ruiz and pavon	Guariuba	Sclerolobium paniculatum vog.	tachi pitomba
Copaifera reticulata ducke	Copaiba	Sclerolobium paraense hub.	tachi branco
Cordia bicolor a.dc	freijo branco	Simaruba amara aubl.	Marupa
Couratari guianensis aubl.	tauari de folha grande	Stryphnodendro pulcherrimum (willd) hochr.	Paricazinho
Couratari oblongifolia ducke	Tauari	Tetragastris altissima (aubl.) swartz	breu manga
Cynometra hostmaniana tul.	Jutairana	Tetragastris panamensis (engl.) o.k.	breu areiu areiu
Diplotropis pupurea (rich) arres.	sucupira preta	Trattinickia burserifolia mart.	Breu
Endopleura uchi huber	Uxi	Trattinickia rhoifolia (engl.) cuatr.	breu sucuruba
Eschefflera morototoni (aubl.)dc & planch	Morototo	Vantanea parviflora lan.	Achua
Goupia glabra aubl.	Cupiuba	Virola michellii hackel	ucuuba preta
Guarea kunthiana a.juss.	Andirobarana	Virola sebifera aubl.	ucuuba folha peluda
Hymenea courbaril l.	Jatoba	Vochysia guianensis aubl.	Quarubatinga
Hymenea parvifolia huber	jutai mirim	Vochysia inundata ducke	quaruba cedro
Hymenolobium excelsum ducke	angelim da mata	Vochysia maxima ducke	quaruba verdadeiro
Jacaranda copaia (aubl.) d.don	Parapara		
Manilkara huberi (ducke) chew.	Macaranduba		
Mezilaurus itauba (meiss) taub.	Itauba		
Microphyllis venulosa (m & e) Pierre	abiu folha fina		

Appendix 5.4

The IFRI Research Program

The International Forestry Resources and Institutions (IFRI) research program provides instruments to analyze the effects of institutions on forest conditions in terms of structure and composition. The program was developed by scholars at the Workshop in Political Theory and Policy Analysis at Indiana University (Ostrom and Wertime 1994; see also Gibson et al. 2000 for study cases using IFRI tools).

The IFRI allowed me to identify the resource users (or forest users) within and outside the community, the forest institutional boundaries, the relations between users and non-users in regard to use and control of natural resources, and the working rules (maintenance, harvesting, monitoring, and sanctioning rules). In addition, the impact of users on the upland forest was assessed by analyzing changes in the forest in terms of forest structure (such as height of trees, basal area, and density) and composition (number of species and types of species). Forest inventory involves the measurement at plot level, registering for each individual plant: height, diameter at breast height (dbh), and species identification.

Chapter 6

FOREST AND RESOURCE GOVERNANCE AT THE HOUSEHOLD LEVEL

Introduction

The previous two chapters dealt with cooperative situations in which residents from the Patos community were the main actors. While Chapter 5 is concerned with cooperation toward the floodplain system, Chapter 4 focuses on appropriation of the upland forest system through privatization. However, Chapter 4 did not cover how these landholders—Collective-Private (CP) and Private-Landholder (PL) households—are governing the upland forest after privatization, considering the emergence of the Landless (LL) households and the presence of differential spatial distribution of forest resources. In order to understand how rules are developed and executed at the household level, two factors are considered in the present case: social ties and economic reliance on a forest resource (see Chapter 3 for social bonds and exploitation of natural resources). The Patos residents are related through strong social ties, primarily kinship, and secondarily co-parenthood and friendship. These people are also very dependent on forest resources for their livelihood such as soil for planting manioc and corn crops. Rules based upon these two criteria apparently are contributing to reduce problems of unequal distribution of resources among the Patos households in order to guarantee each household its survivorship.

Institutional Analysis

Although community-based management has been a sound approach for conservation issues, privatization of forest has been the main type of property right throughout the Brazilian Amazon region (May 1992). Usually, privatization of land means that each family or household holds a piece of forestland and controls it. Several studies have addressed types of governance at the community level; in other words, how rights and duties have been successfully created by the community members (Berkes 1989; Bromley 1992; McCay and Acheson 1987; McKean 1982; Ostrom 1992; Tang 1992).

Ostrom (1990) argues that development of rules is a difficult, time-consuming, and trial-and-error process—no matter which types of institutional arrangements are sought, whether private, common, or public. This view is opposed to assumptions that private property can be crafted at low cost and can be easily enforced. Individuals must overcome provision and appropriation problems in order to design any institutional arrangement (Ostrom et al. 1994) at the community level or at any other group level, such as the household.

As in community life, the decision-making process within a household in regard to natural resources is affected by a number of factors embedded in a particular cultural setting. Various local peasant villages in the Amazon are composed of households within which an individual livelihood takes place (Chibnik 1994; Futemma 1995; Lima-Ayres 1992; McCracken et al. 1999; Siqueira 1997). Thus, household analysis may be necessary in order to look at an individual's choices and how decisions are made at this microlevel.

In an attempt to understand under which situation an individual makes decisions in regard to natural resources, colleagues at the Workshop in Political Theory and Policy Analysis have developed an analytical tool, the Institutional Analysis and Development (IAD) framework, that allows one to consider biophysical and cultural aspects and working rules of a particular setting (Ostrom et al. 1994).

The goal of this chapter is to analyze whether rights to forest resources differ among households, depending upon: (1) household economic reliance upon a resource, and (2) social ties within and between households.

Data Collection

In order to collect data on patterns of use and systems of regulation of forest resources at the household level, all 32 households from the Patos community, including Private-Landholder (PL), Collective-Private (CP), and Landless (LL) were interviewed. For purposes of the present analysis, the fourth group composed of the outsider mid-scale rancher household (see chapters 2 and 5) will be analyzed because some other members of Patos used this household's private lot. Therefore, the present analysis deals with 33 households. Structured interviews were administered in order to ask each household questions on decision making regarding forest use and access and to identify forest users, transmission of material assets, and economic roles of forest resources for their livelihood. When possible, both wives and husbands were present during interviews as well as older children (over 18 years old). Besides an individual interview with each household, group-based meetings were conducted to check information and to gather any other information at a collective level.

Analytical Instruments

Sociocultural and Biophysical Attributes

The main theoretical tool used in the present analysis is the IAD framework, which offers tools to analyze cultural aspects, biophysical conditions, and the working rules[1] in which decision making takes place (Ostrom et al. 1994). In the Patos case, biophysical and sociocultural factors affect decision making among households, and, as a result, affect types of rules in use.

The reasons why households in Patos are using lands that belong to other people are the differential spatial distribution of resources and the presence of landless people. The distribution of forest resources across lots is not uniform in that some resources are clustered while others are more scattered (see Chapter 2 for information on types of upland forest resources). Hence, each lot varies in types of fruit, game, timber, soil, and so forth. Some lots are located in the bottomland and others are up on the plateau. As described in Chapter 3, the bottomland area has a long history of land use which has contributed to a dominance of secondary forest with no more valuable timber, no more fruits such as *piquiá*, and decreasing game. In this case, households that hold private lots in the bottomland need to obtain these resources from someone else's lot that is located in the mature upland forest (plateau zone).

In addition, 10 households have no forest to provide them with their own subsistence or cash products. They are the LL households within the Patos community, and it is a heterogeneous group. Twenty percent are married children whose parents hold a private lot and twenty percent are siblings whose brother owns a piece of land. Twenty percent are households composed of relatives who came into the community accompanying their children (daughter or son) who married residents of Patos. One household is a parent who holds no land, but whose children do. One case refers to a household whose head did not participate in the land movement, and, thus, did not receive a piece of land, but his son did (see Chapter 4). Finally, there is one household whose head is an outsider, and has no kin ties with any other household in Patos, but he keeps friendly relationships with other Patos residents.

Sociocultural and Economic Criteria

Two factors affect a household's decision regarding the system of rights to forest resources: social ties and degree of dependence on a resource.

The degree of social ties among households differs within the community (see Chapter 3). Variation in kinship, co-parenthood, and friendship ties among households affect the patterns of resource uses and systems of control over them. In this case, kin-members are categorized into two groups: (1) first degree of consanguinity (parents, children, and siblings) and (2) second degree of consanguinity (in-laws, nephews, nieces, grandparents, grandchildren, aunts, and uncles). In regard to kinship, households related through the first degree of consanguinity have a stronger connection than households of the second degree of consanguinity. Some households are simply acquainted but eventually collaborate with each other in labor division, exchange of products, or help in emergency situations. Co-parents present weaker ties than kinfolks but stronger than acquaintances or friends; yet, both non-kin attachments provide some strength of relationship between households.

Local residents rely heavily upon the upland forest for both food and cash income. Because households use forestland primarily for food production and, secondarily, as a source of income, rules vary according to degree of reliance on a particular resource. Among a large number of forest products available in the Patos upland forest, four main products were identified, from more subsistence-oriented to strongly market-oriented ones: *piquiá* native fruit, timber, soil for cropping, and soil for pasture.

Despite *piquiá* being considered a kind of delicacy among local residents, it is not an essential subsistence product nor it is a highly valuable commodity (see section on Other Secondary Activities in Chapter 3). In contrast, timber is highly valued as a commodity in the local market (see Chapter 2) and it is easy to trade—logging companies cut and transport timber from the forest community (see description of logging activity in Chapter 3). Timber also serves for subsistence purposes such as building houses. Besides timber, other woody products—poles, firewood, and sticks—are also used for household consumption. Farming production is an important source of the households' staple food, manioc flour. It is also the main source of cash for the household economy (see Farming Production in Chapter 3). Cattle are strongly related to market, hence it is a highly valuable commodity but it is not an essential subsistence product. Only in cases in which cows serve to pull carts do cows serve for subsistence purposes, and each household has only one or two cows and does not need a pasture area; animals graze in the garden area surrounding a house. When cows are needed for commercial purposes, each household raises more than two heads, and needs land for cultivated pasture (see discussion on cattle production in Chapter 3).

Thus, this analysis focuses on four main consumptive products from the forest—a native fruit (*piquiá*), timber, land for agriculture, and land for pasture—in order to understand how rights have been established thus far. Rights are affected by both the degree of social ties among resource users and the degree of reliance on a resource. The four levels of relations within the Patos social structure are: Level 1—first degree of consanguinity; Level 2—second degree of consanguinity; Level 3—co-parents, and Level 4—acquaintances or friend. Reliance on a resource is categorized in three classes depending upon purposes of use: subsistence, market, or subsistence and market simultaneously. Subsistence-oriented purposes refer to cases when households use a particular resource only for consumption as opposed to market goals that are geared exclusively toward raising cash income. When a household uses a product for both local consumption and for sale, a product serves for both subsistence and market purposes.

Household-Level Governance

Despite a recent history of land-tenure changes, during the past 13 years (see Chapter 4), the CP and the PL households have been trying to create some informal and unwritten rules in order to regulate different forest products. This arrangement has been developing as long as CP and PL households have experienced situations that require some norm of conduct in that they have to establish ways of regulating residents' behavior with regard to use of distinct natural resources.

Developing a System of Rights to Forest Resources

In an attempt to regulate their own private forest lots, both CP and PL households have defined rights to different forest resources. Although each household makes its own decision, a pattern of rights systems can be observed across both CP and PL households—they have adopted the same types of criteria in order to specify a right to a particular resource.

In order to understand the Patos self-governance of upland forest resources, Ostrom and Schlager's (1996:131 to132) analysis of property rights to natural resources—rights of access, rights of withdrawal, rights of exclusion, rights of management, and rights of alienation—is analyzed.

The CP and PL households have specified who can enter a forest lot (rights of access) as well as how much a user can harvest of a particular resource (rights of withdrawal). They also make decisions on forms of using or managing a particular resource (rights of management). In fact, there are some cases in which the landless children participate along with their landholder parents in determining patterns of forest use, defining who can use and how s/he can use a resource. Finally, these groups of households have specified who may sell, rent or in any way transfer of a particular resource (rights of alienation).

In order to restrict someone else's action, CP and PL households have established a type of verbal permission that assigns a household without a resource right to a certain product. Asking for permission, even if informal and unwritten, is a local meaningful request that conveys respect of one individual toward another. It is part of a local moral code that has been incorporated into the customary system of rights to forest products, which distinguishes the rights of a certain household with respect to a certain product (see below).

In order to understand how the Patos households are creating and exercising these rights to forest products, the next section focuses on the rights to four consumptive forest products, considering social bonds and economic dependency on a resource. Further, it discusses the monitoring and sanctioning systems.

Patterns of Using Forest Resoures and Customary Rules

Rights to Forest Resources

Overall, CP, PL, and LL households are allowed to harvest *piquiá* for both consumption and for trading. Kinfolks (levels 1 and 2) may harvest without asking permission, in which case a household has free access as opposed to non-relatives (levels 3 and 4) who must ask for permission from either CP or PS household (Table 6.1).

When each household (CP, PL, and LL) was asked which forest lot they have collected *piquiá* from, 64 percent of respondents answered that they collected from their own lots while the remaining 36 percent collected from someone else's lot, either from a relative's or an acquaintance's lot (Table 6.2). Households that used a lot that belongs to an acquaintance household collected *piquiá* only for consumption, whereas households that collected from their own lots or relatives' lots, collected for both subsistence and market purposes (Table 6.2). These results from Table 6.2 indicate that regulations regarding *piquiá* harvesting are less restrictive (flexible).

If timber is for subsistence purposes, such as building houses or fences, relatives of first and second degrees (levels 1 and 2) may harvest wood and poles, but they must ask for permission (Table 6.1). Only children, parents, or siblings (Level 1) may harvest for selling if they need cash, but they still must ask permission from the landholder. More restricted, kinfolks of second degree (Level 2), co-parents (Level 3), and acquaintances (Level 4) are not allowed to cut timber for market purposes. In fact, if co-parents or acquaintances need timber for subsistence purposes, they must either buy it or negotiate with the landholder; it is not as simple as the transaction for kinfolks.

Asking each household (CP, PL, and LL) whether they cut timber and from which lot they have cut it yielded. Table 6.2, which indicates that 81 percent cut from their own lot and 19 percent cut timber from lots that belong to their relatives of first degree (Level 1). The remaining households have never cut timber from anyone's lot; they usually have to buy it. In fact, the latter have cut poles, firewood, and sticks from private lots that belong to either relatives of second degree (Level 2) or acquaintances (Level 4). Only households that cut timber from their own lots or lots belonging to their first-degree kin cut timber for supplying both subsistence and cash needs (Table 6.2). Overall, timber is controlled by more restricted and more exclusive rights (less flexible) than *piquiá*.

(Table 6.1 is about here)

(Table 6.2 is about here)

The access and use of forest land for farming purposes are less restrictive (more flexible) among all levels of social relations (from Level 1 through Level 4). However, everyone must ask for permission in order to clear a forest and cultivate the land (Table 6.1). While parents, children, and siblings (Level 1) may grow perennial crops, other households (levels 2, 3, and 4) may cultivate only annual crops such as manioc and corn, because permission is temporary rather than permanent. Every household is also allowed to grow for commercial purposes. In many cases they are sharecroppers, i.e., a landholder lends a piece of land to an LL household, which in turn, cultivates it. The LL household usually pays the CP or PL household in goods (e.g., manioc flour) rather than cash in exchange for using the land.

Asking each household (CP, PL, and LL) which lot they used to grow crops yielded Table 6.2, which shows that 67 percent used their own lot, whereas 33 percent used someone else's lot—relatives (levels 1 and 2), co-parents (Level 3), or acquaintances (Level 4). In any of these cases, whether a household uses a relative's, a co-parent's, or an acquaintance's lot, soil can be used for both subsistence and commercial goals (Table 6.2), indicating the key economic role of agricultural products, manioc flour in particular, to their livelihood. Thus, rights to farm a piece of land are less restrictive and less exclusive than rights to timber and pasture (see below).

In regard to cattle, only relatives of the first degree of consaguinity (Level 1) may open pasture, but with permission (Table 6.1). Kinfolks of second degree (Level 2) either ask for permission to open pasture or they form a partnership. Formation of a partnership is also frequent among co-parent households (Level 3). More restricted, acquaintances (Level 4) only have access through rental transactions.

When each household (CP, PL, and LL) was asked whether they have opened a pasture and in which lot they have opened it, 12 households (36 percent of the community) answered that they have cleared a forest and have cultivated a pasture. Table 6.2 indicates that out of these 12 households, 67 percent have used their own lot to raise cattle for commercial ends (fattening system). Twenty percent (three households) have created partnerships with second-degree kin households (Level 2) and used their partner's lot. The remaining 13 percent (two households) rented a pasture area from an acquaintance (Level 4). Besides cattle being mainly a commercial-oriented activity, opening a pasture implies a mid- to long-term use of the land. In this regard, using land for pasture purposes has led to a development of more restricted rights to land.

It is worth mentioning that the mid-scale rancher who lives in the Patos community and owns a private lot in the bottomland (see Chapter 5) has been trying to establish closer connections with Patos residents through forming partnerships or even loaning land (sharecropping) to some of the LL households. This outsider household falls into the category of an acquaintance type of social bond.

In regard to rights of management, usually decisions over forms of use and management of the forest products are made only among members from the same household. However, as mentioned earlier, there are cases where kinmembers of first degree (Level 1) help their landholder relatives in defining those rights to forest products. These cases refer to a few families of married children who take care of their parents' forest lots (especially in cases of an elder female head of household). Thus, children act as actual landholders by making decisions regarding forest governance or at least play an active role in influencing their parents in terms of how to use and control the lot. In these cases, children who belongs to CP, PL, or LL households hold rights of exclusion by making decisions regarding who may enter a forest and use a resource (rights of access) and the amount s/he may harvest (rights of withdrawal).

The fifth type of right is concerned with transference of rights to land to members of the same household or different households (rights of alienation). Transmission of assets such as forest land is similar between men and women; that is, both daughters and sons may receive any material assets. It is almost unanimous among CP and PL households as to what the criteria are regarding who has rights to receive land as an heir. The land will be transferred to those children who work on the land (in this case, either for raising cattle or growing crops). In other words, if a married female or male child is farming the land s/he will probably receive a piece of land. Inheritance of land conveys criteria that are based upon the right of usufruct, in that those children who are using the land are those who have the rights to it. In a case where there are no blooded-related children, a *filho de criação*—female or male adopted child (see Chapter 3 for more details on *filhos de criação* and *caboclo* societies)—has rights as an heir to receive land or any other material assets from her/his adoptive parents. There are two cases of female adopted children from different families who have received pieces of private land from their adoptive parents.

In sum, from this analysis, two types of rules can be identified among the Patos households: boundary and authority rules. Taking into account the strength of social ties among households, PL and CP households, and some LL households (married children), determine who may have rights of access to and rights of harvesting a forest product (boundary rule). The amount of a resource that can be harvested or used is based upon dependency on a resource, whether for subsistence or market purposes (authority rules).

Table 6.3 shows that the boundaries of a user group will be more permeable (less exclusive) when it deals with subsistence-oriented products (levels 1, 2, 3, and 4). In contrast, market-oriented products will be related to a less permeable (more exclusive) user group, composed mostly of household members, and, in some cases, other kin-related members (Level 1 and eventually Level 2, but not Level 3 or Level 4).

(Table 6.3 is about here)

Monitoring and Sanctioning System

Empirical evidence shows that in cases where well-defined boundary and authority rules exist, as well as effective monitoring of rules and a strong sanctioning system, successful institutional design and better outcomes are observed (Ostrom et al. 1994). In the Patos case, there are no such well-defined monitoring and sanctioning systems. They rely chiefly upon social sanctions in order to prevent users from breaking rules.

Besides the degree of reliance on one product and the degree of social ties criteria, physical attributes of a resource affect monitoring activities among the Patos households. Schlager et al. (1994: 308—309) have classified resources into two types according to their physical characteristics: stationarity and storage.[2] Although *piquiá* fruit is stationary, the cost of monitoring it is high because anyone who passes by a tree can simply pick the fruit from the ground and eat it behind the landowner's back. Similar to fruit, game is difficult to monitor because it is a mobile resource which crosses forest borders, and thus, is hard to follow.

Because of the high cost of monitoring game and enforcing rules, there are no restrictions on hunting at the household level; anyone may hunt in any lot. They mostly hunt for consumption; if they sell, it is to community members who do not hunt. However, in regard to the formal system, game is similar to timber. It is mandatory to have a license for commercial purposes, but one is totally exempt for subsistence (Cód. 3017, IBAMA 2000). The lack of a clear rule for hunting in the upland forest and fishing in the floodplain is similar to cases in which users have designed rules related to resource facility for non-stationary resources rather than the amount that one can withdraw

(Schlager et al. 1994). In cases of mobile resources, users might define which types of technology and/or equipment can be used in order to limit harvesting (Ostrom et al. 1994).

Clearance for farming or pasture or even the cutting of timber is easier to monitor and enforce. The noise of falling timber and the transport of logs from the forest lot are easier to observe and check, but it is even easier to catch someone using land for farming and pasture. Thus, rules can be more restrictive and infractors are more easily caught. Further, these levels of social bonds between households through trust and mutual commitment contribute to monitoring activities; that is, households look after each other's lots.

Nevertheless, empirical evidence shows that graduated sanctions within a village work more efficiently than the use of strong punishment such as fines or bringing a case to court (Ostrom 1992; Ostrom et al. 1994). Despite ambiguities in the monitoring and enforcement of rules, one can observe the existence of some form of graduated sanctions in the Patos community. If someone breaks a rule, s/he first receives a verbal warning to not break it again. If s/he commits a second infraction, s/he might receive a second verbal warning with a threat of losing rights of access to and rights of withdrawal of a resource. After a third infraction, s/he is likely to lose her/his rights to a product temporarily or permanently, depending upon the degree of the infraction.

Formal Rules

Despite local and informal rules and/or norms that were created by the Patos households, there are two governmental agencies at the federal level that are in charge of policy making and management: the Brazilian Institute for Renewable Natural Resources (IBAMA) which deals with environmental policy, and the National Institute for Colonization and Agrarian Reform (INCRA), which handles tenure policy for upland areas.

In regard to land, the Patos landholders are classified as proprietors, because they may use the land and decide on forms of using land as well as who may have access to and use of the land (see Ostrom and Schlager 1996). Each landholder holds an authorization of occupation until they receive the legal and definitive title of land (INCRA, Decree No. 806/87). Thus, they are not owners and may not transfer (sell) the land (rights of alienation), until they hold the title. INCRA's functions are to regulate land tenure, enforce those regulations, monitor them, and punish any infractors (INCRA 1994).

The Brazilian environmental policy went through major changes with the new constitution in 1988 (see Machado 1989 for more information on federal constitution and environmental policies). Forest regulation at the national level is based on Forest Policy 1965 but is currently going through a process of reformulation of rules (IBAMA 2000; ISA 2000). IBAMA is the Brazilian agency responsible for all renewable natural resources within the Brazilian territory. It is in charge of implementing environmental policies, enforcing the rules, monitoring them, and punishing any rule breakers (Machado 1989, IBAMA 2000).

Discussion

Customary Rules versus Formal Rules

Because environmental policy regulates resources at federal, state, and municipal levels, the existence of informal household governance contributes to fulfilling lacunae left by the general system of law. In addition, these de facto rules are more suited for ecological and social-cultural contexts and are more flexible to adjustment if changes occur. Thus, these rules crafted at the local level are more diversified than de jure rules established by the government in order to accommodate social and ecological diversities (Agrawal 1996; Ostrom et al. 1994; Tang 1992).

As Ostrom (1990) points out, the institution is a nesting of rules, in that rules are related to deeper-level rules at operational, collective-choice, and constitutional levels. Although de facto rules usually do not contradict de jure rules established at the constitutional level, a more diversified set of operational and collective-choice rules are observed. Similar diversity of rules at the local level was observed by other scholars (Agrawal 1996; Ostrom et al. 1994; Tang 1992).

In regard to some non-timber forest products, such as vines, roots, and fruits, there are no federal rules restricting either their consumption or their trade; therefore, they are exempt from license, authorization, or permission.[3] Timber harvesting is more restricted than that of non-timer. An individual must have a license from IBAMA (Decrees 302/88, 011/89, and 732/91) to sell timber, but extraction of timber for subsistence and/or artisanal activities is fully exempt. Thus, timber has more restricted rules in both formal and customary arrangements (Table 6.1).

To cut any type of tree in the Amazon region (this falls into IBAMA's category of deforestation), an individual must have an authorization if clearing reaches up to 20 hectares per year (Decree 449/87). The government has control over deforestation in general, but it does not distinguish types of clearings, whether for annual crops, permanent crops, pasture, or agroforestry purposes. Local residents create different regulations depending on whether the soil is for cultivation or for pasture due to time of occupation that each land use requires. Pasture presents a more long-term occupation than an annual field crop, which has a short-term land-use pattern.

Besides similarities and differences between formal and informal (customary) rights to forest products, privatization of a forest ecosystem underlies other aspects, such as unequal distribution of resources among potential users, that will be addressed in the next section.

Implications of Privatization of a Forest

Assigning a private piece of forest to an individual, family, or household becomes a puzzle with both positive and negative side effects. From the perspective of a recipient (CP or PL), private property means autonomy in terms of land-use decision making and guaranteed land on which to produce and to transfer to heirs or children. But from the perspective of a non-recipient (LL), privatization generates inequality of assets. From the ecological perspective, it causes fragmentation (see Bierregaard et al. 1992; Lovejoy and Bierregaard 1990; Lovejoy 1981; Lovejoy and Oren 1981; Lovejoy and Rankin 1981; and others), which in turn may cause differential distribution of resources among individuals within the same community.

In addition to availability of labor and economic inequality, cases from around the world show that governments have been imposing privatization upon existing customary land tenure. Such an imposition, in turn, has been causing social-economic and institutional problems, as in the cases of Kenya (Ensminger 1996) and Bolivia (Vallejos 1995), where land has historically been held communally. In the Patos case, privatization of land was an external decision (federal government), but a local movement for gaining rights to this land occurred and lasted almost 15 years (see Futemma et al. 1998). For Patos residents, gaining private rights means security of land which might have triggered CP and PL households to create some rules in order to defend their own pieces of land.

Despite all landholder households enjoying their private rights, dividing up a forest into pieces and passing them on to individual families, it has caused inequality of resources among the Patos households, thus causing differential provision of food and income. Again, the development or adoption of some regulations is an attempt to minimize this present unequal availability of forest resources to all residents.

More recently, several scholars have been trying to understand the effects of dividing up the forest into pieces (fragmentation of forest ecosystem), which may impede animal transit, affect reproduction systems of plants (e.g., seed dispersion by animals), among other ecological damages. But detailed fragmentation analysis is beyond the scope of the present dissertation.

Final Considerations

Customary institutional arrangements have been created through trial and error. Despite there having been less than 15 years of privatization of the Patos upland forest, crafting local institutional rules is still an ongoing process, but it has helped to lessen some effects of privatization. The Patos households have developed different rights to different forest products taking into account consumptive dependency on a resource and the degrees of social ties among resource users—in this case, Collective-Private, Private-Landholder, and Landless households. Familial ties among households assure less restrictive access to forest resources as well as participation in making decisions regarding forest use and management than those with non-kinship ties. While a kinhousehold may exploit a large amount of a resource to obtain cash income, acquaintances or friends may usually extract for subsistence purposes only, or they have to purchase a product from a landholder. For instance, a son/daughter may sell timber from his/her parent's private forest lot in order to earn some cash, as opposed to a nephew/niece who has to negotiate with his/her uncle/aunt, or a friend to buy the timber.

In addition, customary rules appear to be more appropriate on a social basis than formal rules in that they take into account sociocultural and ecological factors. For future studies, it will be important to conduct fragmentation analysis of the forest in order to assess the effects of this local property rights system on the forest ecosystem as a whole.

Endnotes

[1] Definition of rule, as borrowed from S. Crawford and Ostrom (1993): "Rules are prescriptions that define what actions are required, prohibited, permitted, and the sanctions authorized if the rules are not followed." Ostrom et al. (1996:38): "Rules provide information about the actions an actor 'must' perform (obligation), 'must not' perform (prohibition), or 'may' perform (permission) if the actor is to avoid the possibility of sanctions being imposed."

[2] Stationarity is related to those resource units that "remain spatially confined prior to harvest, or at least travel so slowly as to be fixed for all practical short-term purposes" (Schlager et al. 1994:308), for instance, forest products, grasses, fish. Storage is related to the "existing physical capacity of a resource to collect and hold resource units" (ibid.: 309). Instances of resources that are more difficult to keep stored are forest products, but not timber nor grazing areas (ibid.: 309).

[3] License: This is an individual's right to execute (at the operational level) a particular activity under certain conditions that s/he must meet. Permission: This is an individual's right to execute an activity on behalf of a public service or rights of use of a particular public good. Authorization: This is legal approval for an individual to carry out a particular activity. Authorization differs from license: in the latter, an individual receives a legal right to carry out an activity; in the former, s/he does not (Machado 1989:368—369).

Table 6.1. Rights of Access and Rights of Withdrawal among Households in the Patos Community According to Degree of Social Ties and Economic Use of Forest Product. (n = 33 households)

Forest Resources	Degree of Social Relations[1]	Use for Subsistence	Use for Market
Piquiá (Fruit)	Level 1	Free Access	Free Access
	Level 2	Free Access	Free Access
	Level 3	Permission Requested[2]	Permission Requested
	Level 4	Permission Requested	Permission Requested
Timber	Level 1	Permission Requested	Permission Requested
	Level 2	Permission Requested	Not Allowed
	Level 3	Purchase/Permission Requested	Not Allowed
	Level 4	Purchase[3]	Not Allowed
Land Farming	Level 1	Permission Requested	Permission Requested
	Level 2	Permission Requested	Permission Requested
	Level 3	Permission Requested	Permission Requested
	Level 4	Permission Requested	Permission Requested
Land Pasture	Level 1	Permission Requested	Permission Requested
	Level 2	Partnership[4]	Partnership
	Level 3	Partnership	Partnership
	Level 4	Rent[5]	Rent

[1] Level 1: first degree of consanguinity (parents and children). Level 2: second degree of consanguinity (nephews, nieces, grandparents, aunts, uncles, in-laws). Level 3: co-parents (co-fathers and co-mothers). Level 4: acquaintances/friends.

[2] Verbal permission (informal and unwritten).

[3] Users who belong to Level 4 group can either purchase or try to negotiate with the landholder.

[4] Users who belong to Level 2 and Level 3 groups can form partnerships with the landholder in order to have access to and use pasture areas.

[5] Users who belong to Level 4 group can only have access to and use pasture areas through a rental transaction, or can try to negotiate with the landholder to create a partnership instead.

Table 6.2. Distribution of Households According to Patterns of Use of Four Consumptive Forest Products (*piquiá* fruit, timber, land for farming, and land for pasture), Taking into Account the Economic Use of Each Resource (for subsistence, for market only, or for both) and from Which Forest Lot Household Users Harvest These Resources (from their own forest, from a household's first degree of consanguinity, from a household's second degree of consaguinity, from a co-parent household, or from an acquaintance) (n = 33 households)

Source of a Resource (Upland Private Forest Lot)	Economic Use of a Resource	Relative Frequency of Households (%)			
		Piquiá Fruit	Timber	Land for Farming	Land for Pasture
Own Forest	Subsistence	47	-	12	20
Own Forest	Market	-	-	-	40
Own Forest	Subsistence + Market	17	81	55	7
Forest from First-Degree Relative	Subsistence	10	14	-	-
Forest from First-Degree Relative	Subsistence + Market	3	5	12	-
Forest from Second-Degree Relative	Subsistence	-	-	-	-
Forest from Second-Degree Relative	Subsistence + Market	-	-	6	-
Forest from Second-Degree Relative	Subsistence + Market (Partnership)	-	-	-	20
Forest from Co-parent	Subsistence	-	-	3	-
Forest from Co-parent	Subsistence-Market	-	-	3	-
Forest from Acquaintance	Subsistence	23	-	3	-
Forest from Acquaintance	Subsistence + Market	-	-	6	-
Forest from Acquaintance	Subsistence + Market (Rent)	-	-	-	13
TOTAL		100	100	100	100

Table 6.3. The Boundaries of User Groups within the Patos Community According to the System of Rights to Forest Resources (n = 33 households)

Economic Use of Forest Resources

Degree of Social Ties		
	Subsistence-Level 1* VERY PERMEABLE BOUNDARIES	Market-Level 1 PERMEABLE BOUNDARIES
	Subsistence-Level 2 PERMEABLE BOUNDARIES	Market-Level 2 LESS PERMEABLE BOUNDARIES
	Subsistence-Level 3 LESS PERMEABLE BOUNDARIES	Market-Level 3 STRICT BOUNDARIES
	Subsistence-Level 4 LESS PERMEABLE BOUNDARIES	Market-Level 4 VERY STRICT BOUNDARIES

* Level 1: first degree of consanguinity (parents and children). Level 2: second degree of consanguinity (nephews, nieces, grandparents, aunts, uncles, in-laws). Level 3: co-parents (co-fathers and co-mothers). Level 4: acquaintances.

Chapter 7

CONCLUSION

Introduction

The present study deals mainly with issues of appropriation of natural resources and its relationships with household decision-making and local organization in a small village of native peasant people—*caboclo*—and the implications for ecological outcomes and patterns of resource use and distribution among these villagers. Historical facts reveal two situations of collective action whose goals were to secure rights to natural resources and combat threats of losing them. Four main actors play important roles in the social structure of the collective actions: local small producers, ranchers, governmental agencies, and non-governmental organizations.

The first collective action occurred in the mid-1970s and 1980s and involved residents from the Ituqui settlement (the Gleba Ituqui) in a land dispute. They joined efforts in order to keep their rights to upland forest resources. As a result of such collective effort, through agrarian reform, the upland forest was legally privatized by a federal agency. Land reform has led to changes in patterns of land use, with cattle as the key component in the new sociopolitical and ecological context (see further in this chapter).

The second collective action took place approximately six to eight years later, but it involved only residents from the Patos community. In fact, only one-third (10 households) have cooperated. The main goal of this joint effort, was to guarantee their rights to floodplain resources. Unlike the upland case, there was no direct external support, such as non-governmental agents. Rather, formation of social capital unveiled the capabilities of self-organization. Despite the absence of governmental intervention, households who cooperated in the collective action decided to appropriate floodplain resources, such as *açai* and natural grassland, on a collective basis. Underlying cooperation, Patos has been a stage where competition over these natural resources from both upland forest and floodplain ecosystems took place. Two types of conflicts can be identified in this case: locals versus locals and locals versus ranchers (see Expansion of a Production System: Competition over Resources section).

As a result of the collective action in the Patos community, three groups of households emerged (see Chapter 5): Private-Landholder (PL), Collective-Private (CP), and Landless (LL). Finally, change in property rights played an important role in changing land-use patterns of both floodplain and upland ecosystems. These cases illustrate how an action that occurred in one ecosystem (upland forest) affected another (floodplain), which, in turn, affected the first one (upland forest). Therefore, we find that anthropic and ecological factors function in interactive or systemic ways (see Resource-Use and Ecosystem Analysis: Across Time and Space).

Empirical Findings and Theoretical Contributions

This study reveals a number of empirical findings related to the questions that were the basis for this dissertation: (1) the relationship between change in property rights regime and patterns of resource use and distribution, (2) the reasons and conditions to initiate and participate in a collective action and factors affecting whether or not a household to cooperates; and (3) the land-use and ecological outcomes as a result of change in property rights.

First, change in property rights regime did change land-use patterns at landscape level but not at household-property level. At household-property level, other factors such as sources of income, gender, and physical characteristics of land affect decisions of a smallholder household about how to use the land or not to use it at all. In addition, privatization of upland forest has created a landless group, but familial ties played an important role in alleviating unequal distribution of natural resources among community members.

Second, the main reason local residents from the Gleba Ituqui and the Patos community cooperated as groups was to assure their rights to natural resources. However, not every resident has contributed to the collective effort, because an individual (in this case a household) must have the means, such as social capital and material assets (e.g., source of income and labor), to participate. Regarding participation, women have been more involved in membership and in leadership roles at community and regional levels in the past three decades. Moreover, social conflicts due to competition over natural resources have taken place.

Third, cattle played a key role in changing land-use patterns of both the upland and floodplain ecosystems simultaneously. This study shows the importance of considering a more systemic approach in studying the impact of human action on natural systems.

Resource-Use and Ecosystem Analysis: Across Space and Time

A multi-scale analysis allows us to assess patterns of use of natural resources and forest coverage across time and space. It is a key instrument for identifying factors that are affecting small producers' decisions at the household level, and how those decisions modify natural systems.

The Ituqui and Patos cases demonstrate the importance of considering an ecosystem approach (see Bennett 1976; Ellen 1982; Moran 1990, 1979) for discussion on system analysis applied to human ecology), because human action that takes place in one ecosystem affects another one. Legal privatization of the upland forest opened up more opportunities for local residents to use forest for pasture and timber goals. In turn, the collective appropriation that occurred in the floodplain has affected the ecology of the upland forest as a result of increasing area in pasture and logging.

The combination of remote sensing techniques with forest plot-level analysis provided me with tools for assessing the effects of cattle on the upland forest ecosystem—which is an indirect measurement of the collective action outcome. Through remotely sensed data, I could assess forest coverage changes across time (before and after land reform). Massive data on the history of land use and training samples contributed to distinguish pasture areas from crop field and bare soil. Hence, results indicate the occurrence of pasture area only after the privatization, with the removal of both mature and secondary succession forests (tables 4.1 and 4.2). However, average size of pasture among small producers is still small, averaging the size of 1.84 hectares per lot in the Gleba Ituqui and 1.33 hectares per lot in Patos. Annual crop fields have increased but at low rates (tables 4.1 and 4.2).

In contrast to what I expected, not all smallholder households in Patos have invested in agriculture (either crop field or pasture) and, thus, use the land. Image analysis indicates that some households are using their private forest lots very little, or, sometimes, not at all—a process called deintensification by Guillet (1987). A recent development of grid-level analysis (see Brondízio et al. in press; McCracken et al. 1999; Moran et al. in press) allowed me to conduct household-property analysis by combining remote sensing and Geographic Information Systems (GIS) techniques. Results suggest that the gender of the head of household, credit line availability, retirement salary received, and water availability on the property all affect household decisions regarding use of land. Households that are not using their lands, or using them at very low rates, are those headed by females, those that did not have farming loans, those with no retirement salary, and those distant from a year-round water source (Figure 4.7).

As shown in Chapter 5, the main purpose of timber sales was to purchase cattle and pay for the floodplain share of its purchase. In this case, available remote sensing techniques do not offer enough spatial resolution to distinguish logged from unlogged forest. Thus, to evaluate whether CP households extracted more trees than the PL group, analysis of forest structure and composition at plot level was conducted. Results indicate that the CP group has less tree wood of 45 centimeters or higher diameter at breast height (dbh) than the PL group (Table 5.7).

Using similar theoretical and methodological tools for this dissertation, studies conducted in temperate forests in the state of Indiana in the United States show that institutional structure plays an important but not a determinant role in defining patterns of land use and land cover (Koontz et al. 1997; McCracken et al. 1997; Schweik and Green 1999). Indiana forests are regulated under private-, public-, and common-property rights regimes. Studying southern Indiana private forests, Koontz et al. (1997) concluded that physical characteristics of land and previous experience with land use were strongly affecting landowners' decisions. In historical perspectives, McCracken et al. (1997) observed that forest was mostly removed by the beginning of the twentieth century as a result of economic incentives to agricultural expansion and timber extraction. However, between 1920 and the mid-1990s this trend reversed with urbanization, modernization of agriculture and drop in valuable native timber, allowing forests to regrow. They observed that these processes of forest removal and regrowth occurred mostly in the hilly Southern region as opposed to flat areas of north-central Indiana where land has been more intensively used (McCracken et al.1997). Therefore, as Koontz et al. (1997) observed, physical attributes of an environment contribute to patterns of land use throughout the state.

The assessment of forest disturbances is complex to measure, because there are several factors at stake affecting its structure, function, and composition at the ecosystem level. There are also several ecological parameters that have to be considered at species, population, and ecosystem level. Moreover, time frame is another variable that needs to be taken into account as shown by studies conducted by McCracken et al. (1999, 1997), Brondízio et al. (in press), and Schweik and Green (1999). In other words, the lag between the time an action takes place and has its effects on the ecosystem and the time an analysis is done may not be appropriate to measure the degree and intensity of disturbances. Short-term or one-shot measurement is probably not enough to understand both actions of local forest users taken at follow-up periods (they might change rules if forest resources are threatened to extinction) and forest regeneration processes through forest recovery (degree of resilience). The International Forestry Resources and Institutions (IFRI) Research Program points out the importance of a cross-time study of both institutions and forest conditions so that changes can be monitored (Ostrom and Wertime 1994).

Assurance of Rights to Natural Resources: Inter- and Intra-Village Long-Term Social Ties and Building Social Capital

As described in chapters 2 and 3, local small producers from the Ituqui settlement, including the Patos community, rely heavily on natural resources for their livelihood. Therefore, assurance of rights to enter and use a resource becomes vital to the local population, because being excluded from rights of access to a product means being excluded from well-being. Thus, threat of losing rights to upland areas has led an entire population of the Gleba Ituqui to initiate and sustain the land movement until the final outcome: land reform. Similarly, competition over floodplain resources has driven some residents from Patos to initiate collective action and try to maintain follow-up efforts.

It is worth mentioning that communities at the Gleba Ituqui—Patos do Ituqui, Pau D'Arco, Santana do Ituqui, Cabeceira do Marajá, and Serra Grande—maintain friendly and supportive relationships with one another, an explanation of the group's cohesion during the land movement. They also help each other through exchange of products and information and even building familial ties through inter-community marriages.

Household analysis reveals socioeconomic inequalities across the Patos households as a result of land ownership (see Chapter 4). This differential distribution of assets contributes to the explanation of why some individuals join the group and others do not. Results show that holding private forest land provides households with a cash source from timber sales and agricultural credit loans (Table 5.5). These two sources of cash have allowed these households to invest in cattle and, further, to invest in purchasing the floodplain area (see Chapter 5). Besides economic factors, labor availability is another important variable within a household, considering that cattle activity is mainly male oriented. Therefore, households that did not have sufficient active male labor to carry out cattle-raising tasks did not collaborate in the second collective action (Table 5.6), even though they might have had money to purchase both cattle and the floodplain share.

Despite differences in household structure and economy within Patos, the existence of social bonds, such as kinship, co-parenthood, and even acquaintance relationships, contributes to overcome divergent interests and leads people to cooperate. Living together, undergoing the same hardships, and helping one another has reinforced relations based upon reciprocity and commitment (see Ostrom 1999b). In other words, they have contributed to build a form of social capital that enhances coordination capabilities and communication skills in order to work together and reach a mutual understanding.

Moreover, historical accounts unveil that past political experience, such as the upland social movement (the first collective action) and local social organization, contributed to the emergence of the second collective action. Exercising cooperation enhances an individual's capabilities of organization and group coordination (Durston 1998; Ostrom 1999a, 1994; White 1996). In the Patos community, leadership and membership appeared to be important components in the formation of the collective action. Households that have politically participated either in leading roles or in supporting the land reform, are the ones that initiated and are maintaining this collective endeavor. In this case, leadership involved more than one leader; that is, at least four individuals within the Patos community played leading roles in the local political arena. The fact that there is a group of leaders who can monitor each other's attitudes contributes to create a less favorable situation in which to cheat or to maximize her/his own benefit (Frohlich et al. 1971).

Results also demonstrate important political engagement of the Patos female residents, beyond the domestic sphere. Throughout Brazil, in particular in the Amazon region, women have occupied key roles as leaders and supporters of the rural workers' movement for rights to land as well as rural workers' welfare (Caldeira 1990; Campbell 1996; Deere and Léon 1999, 1987). As discussed in Chapter 4, several of these women are more educated than women were one to two decades ago and have been important individuals in fulfilling positions within the community as accountants and secretaries, e.g., writing reports and keeping budget books, in most grassroot organizations. Thus, rural women have been supporting political and religious activities in leadership and membership roles at household, community, and county levels—e.g., president of the Union of Rural Workers in Santarém (the regional union that includes Gleba Ituqui). Therefore, it is important to disaggregate analysis of collective action by gender.

The process of building social capital has also involved external support from several organizations, such as the Federation of Agencies for Social Work and Education (FASE), the Brazilian Movement for National Education (MEB), the Union of Rural Workers of Santarém (STR-Santarém), and the Land Pastoral Commission (CPT). As discussed in chapters 4 and 5, all these external agents have provided means of enhancing cooperative behavior among local actors. FASE and MEB have focused more on empowering issues (Brandão 1991; Leroy 1992) by raising political consciousness regarding local residents' rights as citizens, whereas STR-Santarém and CPT have contributed to social movement with respect to issues on rights of rural workers, including rights to land (Leroy 1992). In addition, STR-Santarém helped them hire a lawyer in order to defend the case.

In the Amazon region, the number and engagement of grassroot organizations have increased in the past decades. In the Lower Amazon region, the fishers' organization (Colônia dos Pescadores) has been strongly involved in the fishers' movement for regulating fishing activities in lakes and rivers. In this case, the grassroot organizations have joined with researchers, practitioners, and policy makers to define rules for subsistence and commercial fishing (see de Castro 2000; McGrath et al. 1999, 1996; Rufino 1999 for fishing accords, fishing conflicts, and local organization). Another instance of co-management is illustrated by the Extractive Reserve (projects of management of forest resources) in which grassroot organizations that represent the rubber tapper communities are sitting down with researchers, practitioners, and policy makers again to define an institutional arrangement for harvesting forest resources (Weigang and de Paula 1998). A case of co-management in nearby Manaus has also been documented (Mamirauá 1999).

However, Ostrom (1999b) points out that external support is not enough to solidify and sustain social capital. Rather, local people must build it by themselves through a process of self-governance. Designing their own institutional arrangement provides means of forming actual foundations for a long-term cooperation and solving problems of collective action. The Patos households have developed rights to different forest resources, taking into account social ties and degree of reliance on a resource in order to guarantee every resident access to, at least, basic resources for their livelihood (see Chapter 6). In doing so, unequal distribution of natural assets between smallholder and landless households is alleviated. The CP households as a group are also trying to develop rules to govern both natural grassland and *açai* forest. Unlike upland resources, exclusion of some households from harvesting *açai* fruit has been a cause of internal conflict. Even though the Patos residents try to avoid disagreements, conflicts involving different actors have occurred and are still ongoing (see next section and Chapter 5).

Expansion of a Production System: Implications to Competition over Resources

Analysis of use and distribution of natural resources also uncovers problems of competition over these resources (social conflict). While internal conflicts over *açai* involved local actors who belong to different groups of households, conflicts over land for pasture area involved locals and ranchers.

While cooperation tied CP households together, competition over *açai* fruit created a fissure with PL and LL households (see Chapter 3 for *açai* harvesting and Chapter 5 for social conflict). Hence, collaboration among one-third of the Patos households led them to try to secure their rights to its resources. However, exclusion of the other two-thirds of the households led to conflict between the collaborators and the non-collaborators. Fortunately, they were able to resolve their differences, and, during my last visit for field work (1998), the conflict appeared to have been mitigated. The collective group decided to allow everyone from the community to harvest *açai* and sell it in order to avoid more resentment toward maintaining a community-based social life that goes beyond the household domain.

In contrast, relations between Patos residents and some ranchers have been more competitive. Locals and ranchers have competed first for rights to upland forest, then for rights to the floodplain. The Gleba Ituqui is completely surrounded by large landholdings. Since cattle became a valuable commodity in the market, areas of natural grassland in the floodplain have been an arena for conflict. Competition over both natural grassland and fish has caused harsh, sometimes violent, conflict among artisanal fishers, commercial fishers, and ranchers (de Castro 2000; Schönenberg 1994). However, relationships between locals and ranchers are not always antagonistic. There are some neighbor ranchers with whom Patos residents try to keep the relationship friendly. As observed, cattle have been an attractive economic activity among small- and large-scale producers. After privatization, smallholders from the Gleba Ituqui and the Patos communities started to open pasture area in the upland ecosystem as well as using the natural grassland in an integrated system as discussed earlier.

Natural grassland and *açai* are not the main resources across the Ituqui communities. Residents from the Santana do Ituqui and Cabeceira do Marajá communities dedicate their time more to fishing activity. Patterns of natural resource use across the Ituqui communities suggest a relationship with physical characteristics of the land. Santana do Ituqui and Cabeceira do Marajá invest chiefly on fishing for both subsistence and cash income due to their closeness and easy access to lakes and rivers. Private lots that belong to Santana residents are all located in plateau areas very distant from their houses, which makes agricultural work very costly. Soils found across private lots in the Cabeceira do Marajá community are very poor, according to local residents, which makes it hard to cultivate any annual or perennial crop. In contrast, the Serra

Grande community is located in the plateau area, away from the rivers and lakes, leading them to invest more time in cattle and cropping activities rather than fishing. They do not fish for subsistence either; they usually buy fish from other communities or trade fish for manioc flour. Aside from this community, fishing is a very important activity in the entire Lower Amazon region, providing local populations with both income and protein (see de Castro 2000; McGrath et al. 1999, 1996, 1993a; Rufino 1999; Rufino and Isaac 1994).

Since the 1960s and 1970s, fishing has become one of the main sources of income among riparian communities (McGrath et al. 1993a; de Castro 2000), besides being the main source of protein in the local population diet (Murrieta 1998). Because of expansion of fishing in both number of fishers and number of fish caught for commercial purposes, competition over fish increased, and social conflicts increased as well, as previously mentioned, between artisanal and commercial fishers, fishers from different communities, and fishers from the same community. Because of such harsh conflict and escalating competition, during the past decade, the grassroot Fishers' Union along with some government agencies have been trying to regulate fishing activity through written agreement—the fishing accords (see de Castro 2000 for in-depth analysis of fishing accords). Following regional trend, the Patos residents tried to reach an agreement to fish only for consumption. There are arguments between some households that are fishing oriented (two households) and those that are more farming oriented. If the Patos households were to decide to fish more intensively for cash income, competition would probably increase not only among its own residents but also with other neighbor and fishing-oriented communities such as Santana do Ituqui. However, co-management of fishing activities in the region seems promising in terms of keeping fish stock and intensifying production. For instance, one of the communities—Ilha de São Miguel—analyzed by de Castro (2000) illustrates a successful case of community-based fishing management. Ilha de São Miguel residents are allowed to fish for commercial purposes only during certain months of the year with specific fishing gear, thus cash-oriented fishing is prohibited for the remaining year. While fish size has been increased or maintained among the Ilha de São Miguel lakes, fish caught in the lakes surrounding the Aracampina community are smaller. Aracampina is another riverine community that has failed to manage their surrounding lakes as a result of unequal access to resources—socioeconomic differences—and imbalance of power at community level to reach a common interest (de Castro 2000). Therefore, fishing has the potential to expand among the Patos residents and to become another source of income. However, to do so, residents must first organize in order to solve collective problems such as free-ride and reach an agreement as Ilha de São Miguel residents did (de Castro 2000). If the Patos residents decide to invest more in fishing activity, chances are that pressure of cattle on both floodplain and upland ecosystems will be reduced.

Governmental Policies' Weaknesses and Their Implications for Small Producers' Livelihood

Currently, some federal policies are leading to more environmental harm and social injustice than welfare. First, agricultural credit policies are not creating enough incentives for small producers to invest more intensively or productively in the land. Second, due to inconsistent policies between land tenure/land use and environmental conservation (Alston et al. 1999), social conflicts—locals vs. locals and locals vs. ranchers—are frequent and are leading to more deforestation. In addition, unstable and inconsistent governmental policies are probably contributing to increasing rural exodus; that is, emigration of adult children, including abandonment of private forest lots. Finally, despite land distribution, the number of LL households is increasing.

Credit Loan Flaws

As discussed in Chapter 4, a farmer must be affiliated with a local association of rural producers in order to have access to a formal agricultural credit loan. Despite being an appropriate strategy adopted by INCRA and the official banks to control farm production and credit debts, the present structure and organization of the association has some flaws, as in the case of ACACI (Rural Producers Association of the Gleba Ituqui). The role of an association is mainly to transmit information between the official banks and the farmers, monitor farmers' production, and maintain control over debtors. However, the monitoring system is not working properly; there is no such group to perform these tasks. Therefore, the committee should participate in the process of decision making along with officials from INCRA and the banks (BASA and BB), agronomists, and forest ecologists.

More recently, agricultural credit policies (BASA 1997) and technical assistance agencies (EMATER and CEPLAC) are trying to encourage small farmers to produce perennial crops such as coffee (*Coffea arabica*) and cacao (*Theobroma cacao*), implementing an agroforestry system. But cattle raising is still the most attractive activity among both small- and large-scale rural producers. Clearing the area for pasture by cutting valuable trees and selling them to local markets means a prompt source of cash and personally beneficial use of the land. At the present time, there are no incentives for small producers to invest more productively in the land due to the gap between them and the policy makers.

Land Policy versus Environmental Policy

The Institute for Agrarian Reform and Colonization (INCRA) along with the State Rural Extension Agency (EMATER), the National Cacao Research and Extension Program (CEPLAC), Amazon Bank (BASA), and Bank of Brazil (BB) are responsible for policies related to land distribution, regulations, and patterns of land use in terms of technical assistance and financial support (agricultural credit line). Beneficial use (cleared forest land) is one of the criteria used by INCRA to define form of land use, and thus not subject to expropriation (see Alston et al. 1999 for land reform and land conflict in the Amazon region). This criterion has been encouraging large landholders to clear more forest for pasture area (Alston et al. 1999). Raising cattle means a long-term use of land and is a low-labor activity (Hetch 1993; Mattos and Uhl 1994).

In contrast, the Brazilian Institute for Renewable Natural Resources and the Environment (IBAMA), which is responsible for conservation of renewable natural resources such as fauna and flora, requires that a farmer in the Amazon region leave 80 percent of her/his lot intact (with a lot of 50 hectares, a farmer can use only 10 hectares). On one hand, a farmer needs to clear the land in order to prove that it has been used and not risk losing it (expropriation or simply transference). On the other hand, environmental policies mandate that s/he preserve 80 percent of the forest lot.

Currently, the reported average amount of cleared area among the Gleba Ituqui and Patos lots has not reached 20 percent—3.2 hectares for farming and 1.8 hectares for pasture in an average lot size of 56 hectares, and 3.5 hectares for farming and 1.3 hectares for pasture in an average lot size of 54 hectares, respectively (tables 4.1 and 4.2). At the opposite end of the spectrum, most ranchers are using larger areas, clearing more than 60 percent of their private lots. Land policies should be supportive of and consistent with environmental policies so that producers adopt a more conservative strategy rather than "destructive" or even speculative behavior.

Floodplain Ownership: Customary Rules versus Federal Policy Drawback

The Patos CP households' decision to purchase and appropriate the natural grassland on a collective basis is similar to Netting's findings. His study of the Swiss Alps (1976) shows that customary law is based upon land-use systems and types of resources. Communal tenure occurs in cases of diffuse resources with high costs of fencing and labor increases due to splitting land into parcels, such as in a grazing area (Netting 1976). However, in the Lower Amazon, cases of collective appropriation are more complicated due to presence of more than one actor—in Ituqui, local small producers and ranchers. The matter becomes even more complicated when the government has no ready solution for regulating or specifying rights to floodplain areas.

The Department of National Patrimony (DPU) is in charge of regularizing and distributing floodplain lands; however, due to lack of appropriate wetland policies and existence of irregular land titles held by large landholdings, social conflicts are frequent and spread out all over the Lower Amazon region (de Castro 2000; Schönenberg 1994). These conflicts are usually not legally resolved (see Chapter 5). It is likely that lack of incentives to invest in agriculture and lack of infrastructure is driving the younger generation to leave the community. Some smallholders sell wood trees and then abandon their private lots. A brief discussion on ongoing out-migration follows.

Out-Migration and Landless People

Lack of economic opportunity or lack of a better infrastructure (school, health care, electrical power lines) is still contributing to drive young adults to go elsewhere in search of better economic activity or more attractive places which, at first, seem to provide them with a more secure welfare. A household's private land does not seem to indicate a secure life to the young generation, as suggested by some households whose composition is a lonely mother. Sometimes, one or two married children will stay to take care of their parents and, eventually, will receive a piece of the private lot (see Chapter 4 for more information on land tenure). One third of the total Patos adult children (from16 households) are living elsewhere because of job opportunities, education, and marriage. At the beginning of the mining wave in the Itaituba region, another county south of Santarém along the Tapajós River, a large number of Patos male residents went away to work in the mines. Approximately 17 of them returned. Several had died or completely disappeared without any news. The main causes of death were/are malaria and physical violence between miners and mining managers.

In regard to remittances, some children send money or material assets to help their parents' household in Patos. However, the remittance issue is beyond the scope of the present analysis. Another change in the household economy and structure, during the past 15 to 20 years, is related to the fact that a larger number of young female residents have moved to the town of Santarém to become elementary school teachers or housekeepers for middle-class urban families. Some never came back, choosing to live in the urban area.

Besides out-migration of children, another problem this study uncovered is the increasing class of landless people. During the land distribution, most of the households whose heads were 18 years old or older at the time (end of the 1980s) received a piece of land (average of 56 hectares). On the one hand, privatization has assured rights to land for most of the households; on the other hand, several new households in the Gleba Ituqui whose heads are now 18 years old or older have no land. They are the landless class. In fact, there are several private lots in a new colony, Nova Aliança (figures 4.2 and 4.3) that are still unoccupied, and new households are moving out of their parents' community in order to occupy these vacant private lots. However, due to precarious infrastructural conditions, such as lack of accessible roads and lack of water source (no wells), the occupation and use of these new lands have been taking place at a slow pace.

To conclude, this dissertation contributes to show that small producers' decisions about use and distribution of natural resources depend on several internal and external factors, such as household attributes, surrounding biophysical characteristics, and external political economic incentives. This study also shows the importance of studying collective action at different levels of social structure (household and community) and across time (historical account) in order to uncover opportunities and constraints that small producers face in making their decisions of whether to cooperate or not. Finally, assessment of the ecological effects of shifting property rights on forest change also requires a multi-temporal and multi-spatial approach.

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Curriculum Vita

Célia Regina Tomiko Futemma

Personal Information
Citizenship: Brazilian
Place of Birth: Sorocaba, São Paulo, Brazil

Education

1995-2000	Ph.D. in Environmental Science. School of Public and Environmental Affairs (SPEA), Indiana University, Bloomington, Indiana, USA.
1993-95	M.A. in Sociocultural Anthropology. Tulane University, New Orleans, Louisiana, USA
1986-89	B.S. in Biology. State University of São Paulo-Rio Claro, São Paulo, Brazil.

Work Experience

2000	Research Assistant. Anthropological Center for Training and Research on Global Environmental Change (ACT), in collaboration with The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) project, conducting remote sensing data analysis of the Santarém site. Bloomington, Indiana, USA.
1991-93	Research Assistant. The Amazon Institute of People and the Environment (IMAZON). Várzea Project, working with riparian communities in the Lower Amazon region, focusing on local farming systems and seasonal movement of small producers and cattle between upland and floodplain areas (supported by World Wildlife Funds-USA, Heinz Foundation and Conservation, and Food and Health Foundation). Belém, Santarém, Pará, Brazil.
1990	Assistant Coordinator. Environmental Education and Garbage Recycle Project. Municipality of Nazaré Paulista, Nazaré Paulista, SP, Brazil
1990	Teacher. Biology and chemistry for high school. Public school of Nazaré Paulista, Nazaré Paulista, São Paulo, Brazil

Grants

1995-2000	Doctoral Scholarship. The Brazilian Research Council (CNPq) No. 20.0685/95-3
1998	Doctoral Research Grant. World Wildlife Funds (WWF) No. CSR-107-98
1997	Doctoral Research Grant. National Science Foundation (NSF) Grant No. SBR-95-21918 as a part of the Center for the Study of Institutions, Population, and Environmental Change (CIPEC) project in the Western Hemisphere
1993-1995	Master Scholarship. Latin America Schorlaship for American Universities (LASPAU)
1987-1989	Undergraduate Scholarship. The Brazilian Federal Agency for Advanced Studies (CAPES)