

FOREST PRODUCTS FOR SUBSISTENCE AND MARKETS: LIVELIHOOD SYSTEMS  
AND VALUE CHAINS OF BURITI (*MAURITIA FLEXUOSA*) IN BRAZIL

By

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To my husband

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## LIST OF ABBREVIATIONS

IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
ICMbio	Chico Mendes Institute for Biodiversity Conservation
IRB	Institutional Review Board
NTFP	Non-timber forest product
SEBRAE	Brazilian micro and small businesses support service

Abstract of Dissertation Presented to the Graduate School  
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Forest-based markets are important tools for conservation and development, although their impact both on forest users and resource sustainability is often debatable. Using a complex system approach, forest-based market participants were considered as a web of actors set within a dynamic socio-economic and political environment operating on multi-level spatial and temporal scales. The effects of an emergent buriti (*Mauritia flexuosa* L.f.) leaf handicraft market among residents in Barreirinhas, Maranhão were assessed by evaluating livelihood strategies and socio-economic differences among value chain actors. I also assessed the effect of resource access on market participation, and perceptions of sustainability of leaf harvesting.

Socio-economic data were collected through interviews with 149 landowners, extractors, artisans, vendors, and non-participants in the buriti market, and 7 community experts of history and 10 governmental and non-governmental stakeholders. Qualitative and quantitative analyses were conducted by identifying patterns among interview responses, and by comparing means of socio-economic variables between different types of buriti users.

By shifting from buriti-based subsistence to income earning activities, people in Barreirinhas adapted their livelihood strategies to reflect an increasingly globalized economy. Buriti resources were important as a security net and part of a diversified livelihood strategy. People chose to participate in buriti activities depending on gender roles, household cycle, personal perceptions, and relationships among different activities. Contrary to expectations, poverty, tradition of use of buriti, and affinity to handicraft production did not always ensure market engagement. Property regimes and social networks affected peoples' access to buriti resources, depending on their distance to the forests. Value chain actors, who were characterized by their economic relationship with buriti resources and market, differed by livelihood strategies, socio-economic characteristics, and perceptions about the sustainability of leaf collection. The emerging buriti handicraft market introduced new actors and resource demands that interact with pre-existing users and livelihood needs, and threaten sustainability of buriti resources. By demonstrating the social and ecological challenges of a global forest product market, this study can be helpful for informing more effective policies for reaching conservation and development goals through the application of forest markets.

## CHAPTER 1 INTRODUCTION

The social and environmental impacts of local people's participation in forest product markets are a central issue in many conservation and development initiatives. Although it has been proposed that biological conservation can be achieved by demonstrating the economic importance of natural resources (Pearce and Moran, 1994), it remains debatable whether or not forest-based markets actually reduce forest degradation and poverty (Crook and Clapp, 1998; Kusters et al., 2006; Shackleton, 2001). Forest products, however, do contribute to livelihood stability by providing households with an important source of insurance, security and income diversity (Shackleton et al., 2007).

Forest product commercialization is often based on existence of prior local knowledge and tradition regarding utilization and harvest of the forest product as a subsistence source. When financial value for a forest product grows, commercial harvest often expands rapidly outside of regions with a history of traditional use (Shackleton et al., 2009). Development organizations may aid this expansion by encouraging people to participate in new forest-based market opportunities. Because of complex human-environment relationships and social-economic heterogeneity, people react differently towards exploitation of forest resources and new market opportunities. This can have varying consequences on the impacts of forest product exploitation on livelihoods and resource sustainability.

This study seeks to evaluate the conditions under which people are driven to maintain or join forest product exploitation activities as a part of a livelihood strategy. The case study used was a community of buriti palm (*Mauritia flexuosa* L.f.) leaf users

in Barreirinhas, Maranhão, Brazil where a recent increase of tourism offered new market opportunities for buriti handicrafts. The following research questions are addressed:

- How do new markets for NTFPs affect people's livelihood strategies and their perception of sustainable harvesting of forest resources?
- What is the impact of resource access and value chains on people's participation in the market and their perception of sustainable harvesting?
- Does commercialization of buriti derivatives contribute towards increased livelihood security and sustainable use of forest resources among forest-based people in Barreirinhas?

The remainder of this chapter presents an overview of literature that evaluates forest product markets as a conservation and development strategy. Literature regarding livelihood systems and strategies is used to demonstrate how livelihood constraints and advantages vary among individuals and affect their relationship with forests. In the last section, the research methods and case study are presented.

### **Non-Timber Forest Products (NTFPs)**

Non-timber forest products (NTFPs) were initially defined to counter the perspective that timber is the only valuable resource of forests and to draw attention to the value of other forest products that can be extracted. NTFPs are biological resources that are neither timber resources nor agricultural crops. It has been estimated that there are 4,000-6,000 NTFP plant species with commercial importance worldwide (Iqbal, 1993). Global trade of NTFP is easily several times the value of internationally traded timber (Molnar et al., 2004; Shanley et al., 2005).

NTFPs include wild products, managed products and cultivated products. Most NTFPs worldwide are collected from wild areas (Shanley et al., 2005), including fallow, secondary forests or mature forests that regenerate naturally. Wild products require little

human management, less transportation infrastructure, and low labor inputs, product yields per unit area, and human population density (Belcher et al., 2005). Managed products are collected from semi-domesticated areas, which are forests partially transformed through treatments to improve the production of NTFP species that regenerate naturally. Cultivated products are planted in domesticated areas, which are transformed forests including managed fallow forest gardens and specialized plantations. Plant-based and wild-collected NTFPs are the focus of this discussion. Although household level dynamics will be emphasized, it is recognized that NTFP use is part of a larger spatial and temporal scale of human-environmental interactions.

### **NTFPs as a Conservation and Development Strategy**

NTFPs entered into the global dialogue in the late 1980s and early 1990s as part of the international movement towards “sustainable development” (WCED, 1987), which recognized a relationship between poverty and deforestation (Sayer, 1995). Sustainable development merged conservation and development concepts under a market-orientated approach to conservation (Pearce et al., 1989). This approach was based on economic theories that assumed increased monetary benefits from standing forest could out-compete alternative and destructive land-uses, such as agriculture, pastures, and plantations (Pearce and Moran, 1994; Swanson and Barbier, 1992). Driven by economic incentives to maintain the forest as a whole, forest users would be encouraged to sustainably manage and conserve the forest. The underlying logic of these arguments is that utilization is a necessary component for conservation strategies (Crook and Clapp, 1998) and poverty alleviation can be achieved through economic growth and participation in market value chains (Shackleton et al., 2007). Other tools proposed for market incentive conservation have included recreation and tourism,

ecosystem services, carbon credits, and potential future uses (Edwards and Abivardi, 1998; Godoy, 1992; Pearce and Moran, 1994; Wunder, 1999). Although markets are recognized as major drivers for promoting change in tropical forests, the mechanisms and linkages by which these market forces operate still remain a topic of debate (Angelsen and Kaimowitz, 1999; Geist and Lambin, 2002). Opponents express concern that market-oriented conservation strategies legitimize exploitation and development of nature (Ehrenfeld, 1988), although most scholars recognize that these strategies are useful for reaching some conservation goals.

Theoretically, NTFPs have high potential to produce economic benefits for local people (Beer and McDermott, 1989; Panayotou and Ashton, 1992; Plotkin and Famolare, 1992). Of all forest market segments, NTFPs involve the largest number of low-income producers; many poor people engage in extractive activities (Neumann and Hirsch, 2000). NTFPs account for as much as 25 percent of income for close to 1 billion people (Molnar et al., 2004). Extractive activities are a substantial component of the non-farm rural enterprise sector by providing rural income and employment (Mead and Liedholm, 1998; Scherr et al., 2004) and this sector appears to be growing (Arnold et al., 1994). NTFPs can be especially important as a cash income for people in remote areas (Enriquez et al., 2006). Local NTFP trade also tends to be one area where women are free to earn income with little interference from men (Schreckenberg et al., 2006). Although the contribution of NTFPs to international and global markets is often highlighted, NTFPs also play an important role on a household and local scale by contributing to subsistence goals and local markets (Shackleton et al., 2007), livelihood

security (Scherr et al., 2004; Shackleton and Shackleton, 2004), and poverty prevention rather than alleviation (Angelsen and Wunder, 2003).

Once proposed as a simple solution for achieving conservation and development goals, more extensive research has shown that NTFP use dynamics demonstrate the high complexity that is evident in most human-environmental relationships. Just as simple models based on few factors are not effective in demonstrating land-use/land-cover change (Lambin et al., 2001) or deforestation (Angelsen and Kaimowitz, 1999; Geist and Lambin, 2002), NTFP dynamics are determined by multiple underlying factors (Runk et al., 2004). Although improved livelihood outcomes can have a negative relationship with NTFP sustainability, sustainable NTFP use systems do exist.

Sustainable NTFP systems are characterized as having a well-understood forest system, high NTFP growth rate, cost-effectively produced resources, property rights, high direct use value to local communities, opportunities for multi-purpose land use, and low human population density (Crook and Clapp, 1998; Shackleton, 2001). Ecological, social and economic factors associated with successful commercialization of NTFPs have been identified (Lacuna-Richman, 2007) to help predict the impact and changes of NTFP markets. There is insufficient evidence to resolve debates that poor people are more likely than wealthier people to engage in deforestation activities (Angelsen and Kaimowitz, 1999; Wunder, 2001) and if NTFP markets are a failure or success (Shackleton, 2001). The contexts that drive people to engage in forest product markets are highly diverse.

### **Sustainability and Management**

Early efforts to understand NTFP sustainability were based on maximum sustainable yield theory, which assumed stable equilibrium (Zimmerer, 1994), that

environments were spatially and temporally homogeneous, and that resources were most valuable when exploited. The environment was treated as a set of discrete boxes of resources from which yields could be individually maximized, and forest management problems could be approached by fixing individual parts of the problems. To demonstrate the potential of NTFPs to outcompete destructive forest use, valuation studies estimated the potential per hectare revenue generated from NTFP extraction (Balick and Mendelsohn, 1992; Chopra, 1993; Muñiz-Miret et al., 1996; Peters et al., 1989). Later, these economic models were considered by critics to be too simplistic (Browder, 1992; Coomes, 1996; Godoy et al., 1993; Godoy and Bawa, 1993; Southgate and Clark, 1993). More recent complex systems theories assume that stable equilibria do not exist and, rather, move about an area of equilibrium. Problems are viewed as a system in which the interactions among parts must be examined (Shindler and Cramer, 1999). For these reasons, complex system theory was used in this study as a basis for understanding NTFP sustainability.

Sustainability can be defined as when use does not exceed the population capacity to replace individuals (Hall and Bawa, 1993). Overharvesting or overexploitation occurs when products are harvested until the NTFP population is no longer sustained (Varghese and Ticktin, 2008). Management can be defined as deliberate steps that are taken by people to modify the environment in ways that enhance the availability of natural resources (Balée and Erickson, 2006). NTFP sustainability is dependent on such factors as a rapid reproductive rate (Ticktin, 2004), cheap and reliable production, whether sufficient scientific knowledge and ecological knowledge is available for users and managers, and what incentives may be available

for people making land use decisions (Crook and Clapp, 1998). Understanding NTFP sustainability is challenging because effects of harvesting are specific to the NTFP species and the ecosystem, region, and adopted management practices and harvesting strategies (Ghimire et al., 2005; Runk et al., 2004; Ticktin and Johns, 2002). In some cases, increased demand for NTFPs leads to more intense management to improve the quality and quantity or timing of production in order to increase their earnings (Belcher et al., 2005). Intensity of harvest can also vary due to changing socio-economic circumstances (Ticktin, 2004). There is a lack of ecological knowledge about most NTFPs (Peters, 1994; Shanley et al., 2005; Ticktin, 2004), although local and traditional knowledge can help to overcome this gap.

Besides the ecological aspect of NTFPs, political, socio-economic and cultural criteria must be considered regarding any natural resource utilized by people (Berkes et al., 1998), particularly in regards to harvesting strategies (Ghimire et al., 2004; Kusters et al., 2006). Newer valuation methods now look to broader definitions of value, such as cultural (Pieroni, 2001; Reyes-García et al., 2006) and subsistence (Ganesan, 1993). Identifying drivers that lead to overharvesting is a necessary step to achieve sustainability of NTFP exploitation (Ticktin and Johns, 2002). Proposed drivers include increased commercialization (Godoy et al., 1993; Homma, 1992), specialization of NTFP products (Ruiz-Perez et al., 2004a), systems of land tenure and governance (Gibson et al., 2000), socio-economic status, population and cultural pressure, government policies, and distance to resource (Murali et al., 1996; Sampaio et al., 2008; Uma Shaanker et al., 2004). Macro-studies are useful for understanding patterns of socio-economic and political characteristics that characterize different NTFP cases

(Ruiz-Perez and Byron, 1999). Sustainability must be assessed using a large-scale, comparative approach to consider social and ecological variation among a broader range of environments, resources, and contexts (Runk et al., 2004; Shackleton, 2001; Ticktin, 2004). Clearer theoretical frameworks and a functional typology of NTFP cases are also needed (Belcher et al., 2005). In general, it is still not well understood which circumstances and context creates sustainable NTFP markets and how NTFPs contribute to livelihood improvement and conservation objectives.

### **Property Rights**

Different types of land tenure, such as private property, common areas, and open access, can influence access to and sustainability of forest resources. Private property is governed by restricted use unless permitted through sale or case-by-case permission. Open access resources are available to all individuals with no restrictions for harvesting. Common property areas are shared by a group of people and local rules and regulations restrict use of the resources (Gibson et al., 2000).

The tragedy of the commons theory (Hardin, 1968) brought attention to the issue of land governance in regards to sustainable management of natural resources. It was proposed that common use inevitably leads to overexploitation of resources and external rules must be imposed to control resource use. Having political implications, in which it was assumed that people were bad for forests and nature was pristine before human contact, governments sought to protect forests by removing and banning some peoples' use of forests. After scholars dispelled the myth of the pristine forest (reviewed by Clark, 1996) and recognized heterogeneity among local management of resources, these types of conservation strategies have been accused of favoring or discriminating

against different groups of people such as local communities (Schwartzman et al., 2000).

Although a private property regime is sometimes considered the best solution for managing forest product resources (Hodson et al., 1995), empirical studies have shown that users are indeed capable of managing their own use of resources under a common-property regime (Ostrom et al., 1999). After all, traditional people have long been using social controls to manage resources. Some extractors have been shown to practice forest management techniques to promote NTFP regeneration to increase the potential for NTFP sustainability (Anderson and Ioris, 1992). It is widely agreed that any existing local management and governance of resources must be taken into account before imposing external laws or strategies for resource management (McKean, 2000). Most unmanaged forest products are harvested from common-property and de facto open-access land (eg. state forests), especially by people who derive a greater share of their overall needs from these forest resources. In contrast, people who seek to cultivate forest products tend to do so in more secure private land rights (Belcher et al., 2005). Tenure rights can also encourage harvesters to invest in higher quality products, which can reduce the destructive impact on the forest (Varghese and Tickin, 2008).

Some type of secure ownership such as common property or private property, which allows extractors to enforce exclusive rights and control over the forest, is essential for sustainable management of NTFPs or other natural resources (Crook and Clapp, 1998; Mendelsohn and Balick, 1995). Property rights can be used as barriers to reduce the impact of people entering the trade of harvesting (Hansis, 1998). Regulating access to resources can prevent over-harvesting and promote good harvesting

practices (Gibson et al., 2000). There is no single property regime that works efficiently and sustainably for all types of resources use. It is clear, however, that poorly defined property rights are often linked to overexploitation and deforestation (Mendelsohn, 1994). While secure property rights do not guarantee long-term well-being, they do make an important contribution towards encouraging responsible management of natural resources.

### **Local Markets and Value Chains**

Until recently, most NTFP research has focused on global markets, while local markets have been largely overlooked. Global markets are often unpredictable and risky when they follow a “boom and bust” economic cycle (Coomes, 1995; Homma, 1992; Shanley et al., 2002) in which cheap NTFP resources are exploited until it is no longer profitable. In contrast, local markets may be more stable and robust, although they are dynamic and show evidence of constant adaptation and experimentation. Local markets are important for strengthening livelihoods and providing income opportunities among poor people as well as among residents of urban and peri-urban environment (Stoian, 2003). They are commonly based on long-standing traditional knowledge and skills and are the result of considerable local initiative, innovation, self-reliance and a continuing demand for the products offered (Shackleton et al., 2007).

Studies show that villages located at varying distances from the urban local market can be faced with different challenges (Shanley et al., 2002). People from distant villages who wish to sell NTFPs in the urban markets are often poor, with little education and market expertise, depend on forest products for their health and nutritional welfare, and cannot afford to bear additional risk. Prices for NTFPs may also be low and poorly compensate for collection and transport time. In contrast, villages close to large city

markets often have well-developed physical and social infrastructures, which greatly facilitate the marketing of extractive products. These communities, however, often have problems with forest degradation, which they sometimes try to overcome by more intensely managing resources (Anderson and Ioris, 1992).

The small enterprises and emerging markets that characterize local markets are often part of market value chains, which consist of the activities required to bring a product from conception, through phases of production, and to final delivery to consumers (Kaplinsky, 2004). NTFP market value chains are made up of several subsets of activities including production, collection, processing, storage, transport, marketing and sale (Belcher and Schreckenberg, 2007). Actors who carry out these activities are extractors who collect forest products, producers who process forest products into a marketable item, intermediaries who facilitate trade, vendors who sell products, and consumers who purchase the product. Local forest product markets tend to be simpler than global markets; activity chains can be shorter and actors may carry out more than one activity.

Different actors in a value chain contribute towards the overall success of the forest product value chain (Belcher and Schreckenberg, 2007; Velde et al., 2006). Intermediaries were once considered as extraneous and even harmful to the process of an NTFP market because they sometimes reduce the amount of income that actually reaches the extractors. Yet, some intermediaries help to link local production systems and potential buyers (Keys, 2005; Padoch and de Jong, 1989), such as among poor producers who rely on intermediaries to organize their small and irregular surpluses.

Bypassing intermediary roles can lead to greater market risk exposure among extractors and producers of NTFPs (Padoch, 1992).

Efficient governance of market value chains and social organization among users can lead to more efficient NTFP production and sustainability, and ensure better returns for actors at the beginning of the chain (Padoch and De Jong, 1992; Velde et al., 2006). State regulated marketing cooperatives have been successful in India, for example, in reducing the level of exploitation by middlemen, and protecting producers from marketplace volatility (Neumann and Hirsch, 2000). NTFPs collected from communal land may be best managed by using community organizations to ensure that over-exploitation does not occur. Cooperatives are also sometimes appropriate for managing NTFPs collection from individual privately owned plots (Marshall et al., 2006). Social organization can provide more negotiating power with intermediaries and within larger market systems (Ghimire et al., 2004).

The structure and functioning of market value chains, as well as relationships between value chain actors, their defined roles, and profit returns can be highly dynamic (Neumann and Hirsch, 2000). Relationships between actors can shift through time, from locale to locale, and at different points along the market chain. Shifts in roles can be tied to changes in the market structure, relationships between actors, and actors' available livelihood assets and market proximity to end-consumers (Jensen, 2009). Overall, studies on NTFPs have suffered from a lack of rigor in identifying different social actors who participate in NTFP markets and their roles in market chains (Neumann and Hirsch, 2000).

## **New Directions in NTFP Research**

This section has demonstrated that some underlying theoretical assumptions that have been guiding NTFP studies are changing. Recent approaches in NTFP research focus on understanding the social, economic and political conditions that affect NTFP use within a local household economy (Amacher, 2002; Kline et al., 2000; Parks et al., 1998; Shackleton, 2001). Relationships between poverty and deforestation are more complex than originally thought. Advances in land governance studies have recognized that local people can efficiently manage their own resources through local rules and institutions. Traditional management and monitoring can be useful for overcoming gaps in scientific ecological knowledge and management strategies. As complex system theories are integrated into NTFP sustainability concepts, maximum sustainable yield is no longer recognized as the sole goal for NTFP production and use among local people. A broader array of values generated from NTFPs is now considered.

Forest users are seen as a heterogeneous population in which values of NTFPs do not reach all people equally. The importance of forest markets and small enterprises are particularly important among marginal groups and women. Market value chains are particularly important in local markets, and social organization can help these chains function more efficiently. Roles and relationships between different actors of value chains are complex, because they reflect a shifting socio-economic and political environment and structural changes in NTFP markets.

Although NTFP dynamics are much better understood today, forest resources are still being depleted rapidly and new forest markets are emerging and presenting new challenges for local people. More studies are needed to improve NTFP resource management, market structure and institutions, enforcement, and property rights (Crook

and Clapp, 1998; Ehringhaus, 2006). Better understanding of the drivers and context that contribute to engagement in the NTFP market (Neumann and Hirsch, 2000) and mechanics underlying local markets are needed to evaluate the impact of new commercial enterprises on established patterns in household systems.

## **Livelihood Strategies**

### **The Livelihood Approach**

Household studies highlight peoples' active role in providing for themselves despite numerous social and economic constraints (Schmink, 1984). Defined as a group of people residing together and sharing a common pool of resources to ensure a certain standard of living, households are often chosen as the fundamental unit for studying decision-making and behavior in relation to exploitation and production of local resources (An et al., 2005). The household, as a unit of analysis, provides an intermediate step for bridging microeconomic studies on the individual and understanding dynamics in the socio-economic and political environment.

Household studies of the 1980s looked at 'survival strategies' (Duque and Pastrana, 1973) or 'livelihood strategies' (Long, 1984) by examining such issues as labor, land allocation, and income strategies. A strategy is a broad overall plan that refers to long-range goals, not short-term practices or activities (Sutton and Anderson, 2004). Strategies entail using resources as efficiently as possible and in different combination depending on the constraints, goals, opportunities and composition of the household. Households retain freedom of choice, although their decisions are made within the confines of structural social constraints (Guyer and Peters, 1987; Schmink, 1984). The term 'strategy' is used loosely, by recognizing that households may not

always have control over their assets and environment and instead react opportunistically to make decisions based on their circumstances (Rakodi, 2002).

Following interest in 'sustainable development' of the early 1990's (WCED, 1987), Chambers and Conway's (1992) 'sustainable livelihoods' concept introduced a new direction by emphasizing livelihood security and interpreting sustainability as a trade-off between vulnerability/risk and poverty. A livelihood system consists of the capabilities and activities required for a means of living. It is sustainable when it can cope with and recover from stresses and shocks, as well as maintain or enhance its capabilities and assets, while not undermining the natural resource base (Carney, 1998). This definition is tied to theories regarding resiliency and diversification of livelihood strategies (Ellis, 1999; Marschke and Berkes, 2006).

The sustainable rural livelihoods framework (Carney, 1998; Scoones, 1998) is often applied in studies on rural and urban livelihood strategies (Ellis, 1999). This framework is an analytical structure that aims to encompass the complexity of livelihoods. It assumes that people draw on a range of assets to pursue a variety of activities and livelihood outcomes. People are rational decision-makers who invest in asset building depending on their preferences and priorities, although their choices are influenced by vulnerabilities (eg. natural shocks, trends, and seasonal variations), social structures (eg. government, private sector), and processes (eg. policy, culture). Household and environmental conditions determine access to assets and livelihood opportunities and how they can be converted into outcomes.

Assets, or resources, are made up of material capital like land and wealth, and non-material capital, such as circulation of information, skills, management of

relationships, and affirmation of personal significance. Besides providing resources needed to make a living, assets give meaning to a person's world and provide the basis for them to act, challenge, and change rules that govern the control, use, and transformation of resources (Bebbington, 1999). Assets have been defined as the following (Department for International Development, 2006; Scoones, 1998):

1. Natural capital: natural resources extracted from ecosystems and environmental services sustained by the workings of ecosystems.
2. Financial capital: financial resources including savings, credit, and income from employment, trade and remittances.
3. Human-made capital: skills, knowledge, health, labor resources, and other resources generated through human ingenuity and economic activity
4. Physical capital: basic and essential infrastructure such as roads, water, sanitation, schools, shelter, transport, energy, tools and equipment.
5. Social capital: features of social organization such as trust, norms, formal support groups and informal networks.

Cultural capital, which includes social/political institutions, environmental ethics, and traditional ecological knowledge, has been proposed as an additional category to explain how society uses natural capital to create human-made capital (Berkes and Folke, 1994; Buchmann, 2009). The combination of different assets is flexible; capital can be traded to acquire resources that are lacking. For instance, social capital can be exploited by an individual who seeks to acquire a plot of land through his or her network of social relations. Human capital, in the form of labor, can be used to transform a forest into an agricultural plot. The following discussion explores livelihood strategy concepts by considering decision-making theories and variability caused by heterogeneity among populations and households, the role of NTFPs in livelihood strategies, and socio-economic factors that affect NTFP market participation.

## **Decision-making**

Households must make complex livelihood decisions that consider their available assets, risks, opportunity costs, benefits, and perceived uncertainty. Although decision-making is often evaluated as a process, in reality individuals most likely use a mixture of different ways to make the many decisions needed on a day-to-day basis. Rational choice theory (Green and Shapiro, 1994) asserts that people, as rational choosers, set goals and then methodologically decide how to achieve these goals. Their decisions are made on the basis of deliberate consideration of all available information, although their choices may be affected by emotion, social pressures, and cultural traditions (Sutton and Anderson, 2004). It is assumed that people seek out better information, and that they are good calculators of changes and have a good grasp of knowledge regarding their livelihood activities. In an evolutionary sense, natural selection theory predicts that people make the best (optimal) decision in a rational manner, because poor choices are subject to negative selective pressure.

A number of trends have emerged to question the perspective that behavior is strategic and rational (Moran, 2008). Human behavior, however, may not always be rational. First, a household may not be a homogeneous unit of corresponding interests. Individualization may accelerate the breakdown of households when men, women and children pursue different goals and have different interests. Second, livelihoods are diversified because multiple motives prompt households and individuals to diversify assets, incomes and activities. Third, people's livelihoods are becoming more mobile, for example, by travelling to work. In addition, some choices are made for people before they are able to make their own decisions. People are born into some traits, such as language and diet. They may also take shortcuts by imitating others or following habits

in order to minimize decision-making. Forced change can result in irrational decisions, and previously considered rational decisions can morph from rational to irrational. For instance, a cultural practice is adopted when it seems the most rational thing to do under the existing circumstances, but can still persist even after the practice is no longer needed.

External social constraints have an impact on decision-making and livelihood strategy. Social pressures may steer the individual away from making independent and conscious choices. Past routine and socially constructed rules, such as common property regimes, can constrain choice. Use and access to livelihood opportunities are governed by social factors (eg. social relations, institutions, organizations), power (De Haan and Zoomers, 2005), infrastructure and services, policies, institutions and processes, livelihood opportunities, vulnerability context (Carney, 1998), trends (e.g. economic trends) and shocks (eg. drought, disease, floods, pests) (Ellis, 1999).

The role of risk and opportunity costs in determining livelihood outcomes must also be addressed. Risk can be favorably managed with intelligence, creativity, and prior planning (Saaty, 1987). Uncertainty, defined by the level of knowledge and confidence that an individual has about his/her knowledge, is a major component of risk management. Uncertainty can be reduced by generating knowledge (Sigel et al., 2009). People consider opportunity costs, or cost of forgone opportunities after making a choice, to decide their best options. Opportunity is particularly important for making decisions regarding income. People make land change decisions, for example, by weighing opportunity costs, labor availability, economics, and institutional constraints or benefits (Evans et al., 2001). If opportunity costs for working with NTFPs are high,

people may choose to invest in other land uses, such as agriculture and cattle ranching, which require less time investment and generate more income (Shone and Caviglia-Harris, 2006).

### **Social Heterogeneity and Livelihood Strategies**

Important characteristics that determine heterogeneity among natural resource users are personality traits, household composition, wealth, and gender. People with similar characteristics are considered part of a common social group, although dividing lines between individuals and groups are variable and never rigid (De Haan and Zoomers, 2005). Interactions between groups using the same resources can result in conflicts, which are resolved in local and extra-local political arenas, or specialization into different livelihood strategies and niches as groups take advantage of their strengths or are limited by their constraints. Social exclusion can also occur when groups try to monopolize opportunities to their own advantage. To legitimize their monopoly, people often rely on social and physical characteristics such as status, race, gender, ethnicity, religion, wealth, and a common historical trajectory of livelihood strategies (De Haan and Zoomers, 2005). Different perceptions of resource values can lead towards conflict between groups, and managing for rights to use resources can help to resolve some conflicts (Hansis, 1998).

Previous assumptions, linked to the tragedy of the commons theory, considered all individuals as selfish, norm-free maximizers of short-run results. More recent studies show that people react differently to opportunities to exploit resources (Ostrom et al., 1999). Selfish individuals never cooperate in dilemma situations. Some individuals will not cooperate unless they are assured that they will not be exploited by selfish individuals. Some individuals willing to cooperate hope that others will return their trust.

Altruists try to achieve higher returns for the group. Personality traits, which may be grounded in the personal experience and history of the individual, can affect how people interact with natural resources.

Household composition can impact livelihood goals and household resources. Household composition is often defined by its age, which refers to the maturation of a household from a young couple, to a family with children, and finally, to an aged household in which the children take over the possessions of the parents. Behavior and goals change as a household ages, because labor resources in proportion to consumption demands have an impact on household income and wealth (Friis-Lund and Meilby, 2006). A household with small children, for example, is under more financial pressure (Schmink, 1984). Middle-aged households with more working family members are relatively wealthy. By considering household composition, differences in wealth among households may be just a moment in the cycle of household demographics. Household livelihood strategies are always evolving, because opportunities and household composition are always changing.

Livelihood strategies change depending on the condition of the household, available opportunities, and shifting assets. Strategies, therefore, can be conceived as a stage rather than a structural category. To understand livelihood strategies, it is important to characterize the household's objectives, priorities, and assets. As a common economic approach to explain local household behavior, risk-averse peasant theory (Ellis, 1992) considers that most local people live under high levels of uncertainty induced by natural hazards, market fluctuations, and social instability. Therefore, they are cautious in their decision-making by choosing to engage in activities that reduce risk

rather than maximize their profit. In terms of poor versus wealthy people, poor people generally do not use their own assets as efficiently as the rich nor have the resources to deal with any downside associated with some risks. In general, the poor select a low-risk, low-return portfolio, while the rich take on riskier activities (Mendola, 2007).

Household composition, which describes the gender and age groups of people in the household, relates to different categories of rural livelihood strategies, consisting of accumulation, consolidation, compensatory and security (Zoomers, 1999).

Accumulation strategies involve establishing a minimum resource base and preparing for future expansion. These strategies, including migration, land acquisition and labor recruitment, are common among recently married couples and families with young children seeking to accumulate capital. Wealthier and often older households, who have more surplus assets to invest, apply consolidation strategies, which involves investing to stabilize the household's well-being and improve quality in the short term.

Compensatory strategies are used by people recovering from a sudden shock, such as crop failure or loss of labor, or dealing with a structural shortage of in livelihood assets.

The household employs this strategy in order to survive and seek a to recover from downward social mobility. Security strategies, such as diversification, are used by families with young children and whose lives are more insecure.

NTFP use is shaped by need, opportunity, local markets and institutions, resource abundance, and relative level of development (Ruiz-Perez et al., 2004a). Most NTFPs provide a subsistence function among households, either through direct consumption or trade. A much smaller subset of NTFPs are regularly traded in local, regional, or international markets. In a subsistence economy, people devote their

available resources to producing food and maintaining shelter and security. In a cash-based economy, households have the opportunity to specialize in activities that offer the best economic opportunities. If food and other necessities can be purchased, people concentrate their efforts on activities that provide the highest rewards. This implies that a household's integration into the cash economy both influences and is influenced by the way they use forests and other resources (Shackleton and Shackleton, 2004).

Broad typologies of forest-based livelihood strategies have been defined based on availability of assets, risk management (Belcher et al., 2005; Jensen, 2006), and involvement in commercialization. Commercialization is defined as any use in which the extractor does not use the product directly and exploits the product to gain a different value (Ruiz-Perez et al., 2004a). People who use a coping strategy depend on forest products mostly for household subsistence; few products are sold in markets (Belcher and Kusters, 2004). People who use a diversified strategy utilize forest products as a supplement to other household livelihood activities (Arnold and Townson, 1998) and as a safety net (Shackleton and Shackleton, 2004). A specialized strategy focuses on specific forest products as a major contribution to income and high household integration into the cash economy because it is driven by market opportunities for these products (Belcher and Kusters, 2004). Definitions of forest-based livelihood strategies can vary according to the socio-economic and political characteristics of the case context (Ruiz-Perez et al., 2004a).

Diversified livelihood strategies are adopted to spread out risks, smooth out consumption and labor allocation, and cope with credit market failures, shocks and surprises. By diversifying assets, incomes, and activities, households can be more

resilient (Marschke and Berkes, 2006), reactive, and opportunistic. Diversification can increase ability to participate in seasonal activities, reduce risk, and increase income, but it can also worsen income distribution and have adverse gender effects (Ellis, 1999). NTFPs play a role in diversified strategies by acting as part of a safety net among households that engage in seasonal activities (Shackleton and Shackleton, 2004), and particularly for poorer resource-dependent communities without access to markets (Pyhala et al., 2006). NTFPs seldom account for a large share of a household's total income. They are more important in terms of timing, by filling seasonal or other cash flow gaps, and helping families cope with expenses, shocks, and risks, and to respond to unusual opportunities. Seasonality may reflect availability of the raw material, needs for additional cash at particular points in the annual cycle, fluctuations in demand, and availability of labor (Arnold and Townson, 1998). In cases where people are prevented from diversification, forest products may turn from safety nets into poverty traps (Belcher et al., 2005; Browder, 1992; Neumann and Hirsch, 2000).

Much of the literature on social heterogeneity among forest users revolves around wealth inequalities. Revenue from NTFPs is often unevenly distributed among community members (Padoch and de Jong, 1989). Through market value chains, much less of the value of NTFPs cited by consumers or intermediaries actually reaches local people and extractors (Angelsen and Wunder, 2003; Coomes, 1996; Neumann and Hirsch, 2000). NTFP trade can also increase inequality between households (Kusters et al., 2006). Poor people rely on NTFP resources for subsistence, while wealthier people are in a better position to exploit NTFPs commercially (Arnold and Perez, 2001; Belcher and Kusters, 2004; Cavendish, 2000; Warner, 2000) because they control opportunities

and have more resources to devote towards production (Arnold and Townson, 1998). For activities requiring access to skills, technology, capital, or more labor, the poor may find it difficult to take advantage of market opportunities (Arnold and Townson, 1998) because of low education, higher risk, and lack of organization and financial and physical capital (Shanley et al., 2005). Poorer people are also more likely than wealthier people to divert their subsistence resources towards new market opportunities, which increases their risk level (Falconer and Koppell, 1990). The poor are more dependent on NTFPs, because they tend to be located in rural and remote areas, are engaged in diversified household strategies, and are partially subsistence oriented.

The poor and wealthy generally have diverse livelihoods, while middle ranges of income have less diversity. Wealthier families typically diversify more successfully than poor rural families because they have more resources to devote to forest gathering and production and are the heaviest users (Arnold and Townson, 1998). In contrast, poverty induces people to intensify ways of generating income in order to optimize their use of available capitals (Ellis, 1999). NTFPs, as part of a diversification strategy, can prevent poverty by helping people maintain a minimum standard of living (Angelsen and Wunder, 2003) and by providing subsistence and a safety net against unexpected events among local communities (Shackleton and Shackleton, 2004; Wunder, 2001). Diversification can make the difference between viable livelihoods and destitution of poorer people.

Men and women have different assets, access to resources, and opportunities. Men usually have more options than women to diversify. In comparison, women have a disadvantage because they have less access to livelihood resources, reduced range of

labor markets, and lower wage rates, and men often mediate their resources. In this sense, diversification can improve household livelihood security while at the same time trapping women in customary roles. Women can be disproportionately more reliant on local NTFP trade than men (Neumann and Hirsch, 2000), because they can easily enter markets and combine NTFP activities with household tasks (Arnold and Townson, 1998; Marshall et al., 2006). In rural areas, where the opportunity cost of their labor is relatively low, there is even greater participation of women in NTFP markets.

Involvement of women in the NTFP production system can have a positive impact on intra-household equity (Kusters et al., 2006) as women become more empowered, head households, and dominate some important NTFP markets (Hecht et al., 1988), such as handicraft production (Coomes, 2004). In some areas of the world, such as among the babassu processors in Maranhão, Brazil (Pinheiro and Frazao, 1995) and basket makers in Botswana (Bishop and Scoones, 1994), NTFPs are the main source of income for women and children. For this reason, gender must be considered in social development strategies regarding NTFP commercialization (Neumann and Hirsch, 2000).

As a specialized strategy, commercial NTFP trade drives a process of intensified production and household specialization among forest peoples (Ruiz-Perez et al., 2004a). High-value products tend to be managed intensively by specialized producers and yield higher incomes than those generated by less specialized producers of less managed, low-value products (Ruiz-Perez et al., 2004a). Specialized NTFP extractors mostly practice extraction for lack of better alternatives (Neumann and Hirsch, 2000), and their activities can often have a detrimental effect on species population (Kusters et

al., 2006). These extractors usually fill a profitable market niche, which allows them to earn an exceptionally competitive income from their activity (Wunder, 2001).

### **Participating in the NTFP Market**

As a tool to prevent poverty (Neumann and Hirsch, 2000; Wunder, 2001), NTFPs play a positive and important role in the livelihood stability of rural people (Angelsen and Wunder, 2003; Scherr et al., 2004). Growth and development of local markets is a popular development strategy used among communities with access to natural resources and sustenance-based livelihoods. Development initiatives, however, are often successful at reaching only sub-sets of the population that are better prepared to take advantage of new market opportunities. Markets are not for everyone because rapidly changing commercial forest markets can be too risky or present too low potential returns to be important as part of a livelihood strategy (Scherr et al., 2004). Market-oriented forestry strategies may be unsuitable for local communities where market incentives are culturally incompatible with traditional institutions, the resource base is not easily managed sustainable, or there is a high level of conflict between different groups (Richards, 1997; Schmink, 2004). Despite the risks, it is almost inevitable that people who live in forest areas will use NTFPs to generate income.

Diversified households are likely to abandon NTFP markets if more lucrative opportunities arise because they lack alternative means for reaching livelihood goals. In contrast, households that respond to market opportunities by specializing in forest products for income usually remain in the market, unless other constraints arise (Arnold and Townson, 1998). Business and marketing capacity, access to capital, and good organization are necessary for successful enterprises, and wealthier people tend to have better access to these resources than poor people. Knowledge, skill (Arnold and

Townson, 1998), and availability of household labor resources (Ruiz-Perez and Byron, 1999) are needed for an individual to participate in the NTFP market economy. A case study of argan oil markets in Morocco, however, showed that people with more sophisticated processing, market development, and wealth can outcompete local people who have greater knowledge, skill, and ownership of the resource (Lybbert et al., 2002). Skills are easier to attain than knowledge (Reyes-García et al., 2007). Practical skills are acquired later in life than theoretical knowledge. In contrast, knowledge is usually acquired before adolescence (Zarger, 2002).

Household cycles also affects household NTFP enterprises, because labor roles are often divided among household members according to gender and age (Punch, 2002). Households of younger average age that have fewer members and less land dedicated to subsistence crops have greater time constraints for producing forest products (Coomes, 2004). Households lacking labor resources must seek it elsewhere, often through social ties (Montgomery, 1991). Gender must also be considered among NTFP market dynamics, because NTFPs are often important to women as an income source. Household goals, balance of risks and opportunity costs, and personal motivation plays roles in how individuals, as part of households, decide if and how they engage in markets. Although livelihood assets may be building blocks of livelihood outcomes, the decision-making process and environmental constraints affect how livelihood assets are used.

Participation and financial returns from forest markets can be improved when favorable contexts and appropriate support are available, such as accessible market information or improved harvesting and processing techniques (Shackleton et al., 2007).

Increasing demand makes NTFPs an attractive market for new participants, who are often more productive than pre-existing forest users because they respond directly to market opportunities. New participants, who often lack comprehensive knowledge regarding extraction and management of natural resources, can have negative impacts on forest resources (Jensen and Meilby, 2008). Changing populations, such as new consumer groups or rapidly urbanizing populations, can also affect demand for NTFPs (Cunningham, 2001; Williams et al., 2000).

Emerging NTFP markets remain an important issue among developing countries, as they become globalized. There is much to be learned about the impact of new and growing NTFP markets on forest product users and sustainability of forest product resources. In this study, a case study of the buriti palm leaf users in Barreirinhas Maranhão, Brazil was used to understand the conditions under which people are driven to maintain or join forest product exploitation activities as a part of a livelihood strategy.

### **Overview of Methods**

I first visited the field site in June 2009, while conducting exploratory research in the Barreirinhas region. It was hard to miss the roadside vendors of brightly colored buriti fiber handicrafts, who were strategically located underneath the giant buriti palms that dominated the riverbanks. Vying for the attention of tourists, vendors were eager to explain to me the origin of their wares. Further inquiry with community members led me to discover that the buriti fiber handicraft market provided a unique glimpse into a complex human-forest system that included different actors with varying resource access, market opportunity and pressure, and socio-economic assets. Through these initial interactions, I considered theoretical questions about the impact of new markets on peoples' relationship with forest resources, household dynamics between

subsistence and market use of forest products, and the factors and context that lead people to exploit and interact with the forest in different ways.

In spring of 2010, I received research grants to support my project from the Botany in Action program from the Phipps Conservatory, Pittsburgh, PA; Brazil Initiation Scholarship from Brazil Studies Association (BRASA); and Doctoral Dissertation Research Improvement Grant (DDRIG) in Decision, Risk and Management Sciences from the National Science Foundation. After submitting my research proposal and interview surveys for review by the Institutional Review Board (IRB) at University of Florida, my project was considered exempt from IRB protocols in January 2010 (#2010-U-003). An application for a Brazilian research visa was made possible through collaboration with Dr. Noemi Mayasaka Porro, Núcleo de Ciências Agrárias e Desenvolvimento Rural at Federal University of Pará. To formalize the collaboration, Dr. Porro added my study to her CNPq certified project called “Culture in the construction and defense of traditional territories: legislation and public politics for the protection of traditional knowledge and pluri-ethnic societies.” In addition, Dr. Roberto Porro of World Agroforestry Center (ICRAF) provided institutional support by linking my project to their Amazon Initiative Consortium on markets and value added strategies for agroforestry products, which included a focus on economic palms. Through the support of these formal associations, my Brazilian research visa was granted in May 2010. Aside from the research visa, these collaborations also helped improve the design, potential application and overall success of my research project.

Field data collection in the region of Barreirinhas, Maranhão was conducted in three phases. Four weeks during June-July 2010 were used to identify research

participants, test interviews, and collect baseline data; data were analyzed and used to construct semi-structured and structured interviews that were used in the next data collection phase. Seven weeks from October-November 2010 were used to conduct the interview surveys developed in the first phase. Three weeks during July 2011 were used to verify data and conduct interviews on oral history and among governmental and non-governmental representatives of different stakeholder groups in order to obtain a broader picture of the study context. Final data analyses and dissertation writing was carried out during 2011-2012 at University of Florida under the guidance of dissertation committee members.

### **Study Site**

Buriti fiber is one of the top ten most economically valuable forest products recorded in Maranhão state (IBGE, 2012). Buriti fiber is extracted from young leaves of buriti trees, which are single stem, dioecious, and arborescent palms reaching up to 25 m tall. According to IBGE, only four districts of Maranhão harvest buriti fiber commercially, and Barreirinhas was the highest producer. Barreirinhas has produced 95 to 125 metric tons of fiber annually from 2004-2012. Value for the fiber in the district has increased over the years; adjusted for inflation rates of 2011, one ton of fiber was worth R\$7,178 (US\$3460) in 2004 and R\$10,791 (US\$5200) in 2011 (IBGE, 2012). Although accurate values of NTFP production are notoriously difficult to obtain, these figures demonstrate federal recognition of an increasingly important NTFP in the region.

Barreirinhas district covers an area of 3,112 km<sup>2</sup> and has 54,930 inhabitants (IBGE, 2010), who are mostly *caboclos*, or mixed descendants of indigenous, European, and African people. Buriti palm trees grow naturally in swamp forests as a dominant tree species. According to exploratory field research conducted in 2008, local

people exploited all parts of buriti trees, but fruit, mature leaves, and young leaves were most popular. In contrast to fruit and mature leaves, which were used to meet subsistence needs, the young leaf market has changed considerably in the previous fifteen years. Traditionally used to make hammocks and cords, young buriti leaf fiber has been increasingly exploited by community members to make handicrafts for a rapidly growing tourism market (Lobato, 2008) stemming from the nearby Lençóis Maranhenses National Park. In 2005, buriti fiber handicrafts were considered the second most important source of income in Barreirinhas (Prefeitura Barreirinhas, 2005). In comparison to buriti fruit and mature leaf markets, increasing demands and production of fiber handicrafts have great potential to affect the dynamics of buriti use.

Within the Barreirinhas region, two study sites were selected during exploratory research to represent areas with varying access to buriti resources and markets (Figure 1-1). “Laranjeiras” consists of communities with direct access to buriti located less than 30 min away from Barreirinhas via public transport. “Atins” consists of communities that lack direct access to buriti forests located 2-3 hours travel time (28-45 km) from Barreirinhas via public transport. Both field sites have households that participate in the buriti handicraft market and rely on Barreirinhas as the main market and political center.

### **Sampling Strategy**

The unit of study is the individual, while household was used as an intermediary unit of measure. Adult heads of households were usually targeted for interviews. The definition of “adult” used in this study is an individual who carries or has carried the responsibilities of a mature individual such as managing a household, working for household income or subsistence, and raising children. The sample group consisted of 149 individuals, who represented 129 households. Table 1-1 shows the sample group

according to their community and field site. The total population of the study communities was about 12,800 people (according to records of the City Health Department, Barreirinhas, 2010).

Individuals for the sample group were selected during two phases of data collection using a mixed approach of multi-stage stratified sampling (Neyman, 1934). Respondent-driven sampling, which is appropriate for making estimations about hidden populations (Salganik and Heckathorn, 2004), was applied by asking community members to name individuals who participated in the buriti market in different ways. In the first phase, 47 individuals were selected to ensure that the sample group included at least three individuals per user role in the buriti market and per study site, if the role existed, and individuals from as many different households as possible in order to maximize the available data on livelihood strategies. User roles, which were identified based on exploratory data, consisted of owners of buriti resources (owners), extractors of buriti derivatives (extractors), artisans of buriti handicrafts (artisans), vendors of buriti handicrafts (vendors), and general non-users. Initial interviewees were identified using triangulation (Mathison, 1988), in which community members were asked to identify an individual who fulfilled one of the user roles. Then, snowball sampling was utilized by asking interviewees to identify other potential interviewees who fit the desired criteria.

In the second phase of data collection, criteria established for non-participant individuals were used to select 102 individuals. Data from the first phase of data collection were analyzed to re-define user roles. Demographics from user roles were used to create criteria for selecting comparable individuals who do not currently extract buriti derivatives (non-extractor), do not currently produce buriti handicrafts (non-

artisan), and do not currently sell buriti handicrafts (non-vendor). Criteria for non-extractors were male, aged 15-55 years, and resident of Laranjeiras. Criteria for non-artisans were female and aged 16-65 years. Criteria for non-vendors were all individuals aged 18-65. Individuals were selected using a purposive sampling strategy, in which individuals were selected based on the specific criteria developed through the process of the study (Coyne, 1997). The sample numbers were limited by constraints on time and human resources, although efforts were made to include as many individuals as possible for each user group and from each field site. Individuals could fill more than one user role. Few buriti owners and extractors were located in Atins because there were no buriti forests in this region.

In addition to the sample group of community members, ten stakeholder representatives and seven community elders were selected for collecting supplementary data that could provide a broader qualitative context to the study. Individuals from stakeholder groups were representatives of Brazilian Service of Support for Micro and Small Enterprises (SEBRAE), Chico Mendes Institute of Biodiversity Conservation (ICMBio), Ministry of the Environment, Ministry of Education, Rural Workers' Union (*Sindicato de Trabalhadores Rurais*), buriti handicraft/vendor cooperatives, and a tour operator. Community experts on regional history were selected based on their reputation among community members as long-time residents of one of the study communities, who were knowledgeable of local history and good, lucid storytellers.

### **Data Collection**

Main research tools were semi-structured interviews, which were conducted with the sample group during the first and second phases of data collection. Participant

observation and semi-structured interviews with stakeholders and community elders were conducted mostly during the third phase of data collection. Data were collected from the following sources:

- Literature review
- Regional data, such as statistics, maps, informal studies, and observations, collected from organizations based in São Luis and Barreirinhas, Maranhão
- Semi-structured interviews with the sample group, representatives of stakeholder groups, and experts of regional history in the study communities
- Participant observation (Smith and Kornblum, 1996) in the study communities to provide ethnographic data
- GPS mapping of interview sites, location of buriti forests, and location of roads/travel routes

Interviews were used to collect data on livelihood strategy, buriti value chain participation, and history. The livelihood interview was a semi-structured interview used to collect data about livelihood activities and demographics of interviewees and their households. Market chain interviews were conducted with buriti resource owner, extractor, artisans, and vendor sub-sample groups to collect data on buriti value chains. History interviews were used to understand the historical context of the buriti market, community infrastructure, changing access to buriti resources, and stakeholders. Livelihood and value chain interviews averaged 54 minutes. History interviews averaged 35 minutes.

Interviews were conducted by the author in Portuguese, which was the native language of the interviewees. Interviews were most often conducted in the interviewees' home, although some interviews were conducted in their workplace. A local field assistant was present at most interviews to facilitate introductions and negotiate cultural nuances. Responses to interviews and field observations were documented as

handwritten notes by the author, although some interviews were recorded as voice recordings. After each data collection phase, handwritten notes were expanded into more detailed accounts and, later, coded to identify socio-economic factors that affected participation in the buriti market in order to facilitate data analysis.

Research questions were explored from the cultural point of view of the interviewees in an effort to discover “culturally correct” responses (Spradley 1979). Validity, which was defined as whether or not the response honestly reflected the reality from the point of view of the culture, was verified by cross checking responses during an interview or between interviews with other respondents. Accuracy of the data was enhanced by repeated listening to voice recordings to double-check hand-written notes taken during interviews.

Data analysis was specific to each research question; detailed descriptions of data analysis are found in each chapter. Both qualitative and quantitative analyses were used. Qualitative analysis was usually the first step in the analysis, by grouping together interview responses, cross checking between interviews, and identifying patterns and factors that could be analyzed quantitatively. Socio-economic factors (explanatory variables) were quantitatively presented as descriptive statistics, by using frequency tables. Relationships between variables were statistically tested using Pearson’s correlation analysis. Statistical comparison of means was conducted using two-sample t-test, wilcoxon rank sum test, ANOVA, and kruskal-wallis test. Logistic regression analysis was used to identify statistically significant factors of socio-economic models. Quantitative analysis was conducted using Microsoft Excel and SAS 4.3 software.

I focused my compensation efforts on Laranjeiras and Atins communities, where I spent the majority of my time on the field. I took all opportunities to purchase products from interviewees during data collection. Products were mostly buriti handicrafts purchased at “tourist” prices (prices at the consumer end of the value chain). To provide additional income to the study communities, I hired local field assistants and resided in a rented house in the community during data collection. As part of each interview, I asked interviewees to discuss problems in their community. Their responses were used to generate different ideas for contributing to the greater community. During the third phase of data collection, I discussed ideas for community compensation with field assistants and community members. Based on their advice, I interviewed school directors to identify the needs of the schools. School supplies were purchased and delivered to four schools in the study communities at the same time that research results were presented (2013).

### **Dissertation Outline**

In Chapter 2, the importance of buriti in the livelihood system is explored. In this chapter, a household schematic is made to identify the resources and activities that are available to interviewees. Livelihood activities are explored in detail, including the limitations and benefits of each activity. By comparing between people who participate and who do not participate in the buriti market, important socio-economic factors that characterize participation in the buriti market are identified. Results showed that peoples’ participation in livelihood activities was affected by environmental constraints, demographics, and personal preferences. Buriti use was influenced by cultural identity, governance, social and cultural perceptions, and relationships between different livelihood activities. Participation in the buriti market was favored by people, and

particularly among women, as an income earning activity because it allowed for high flexibility, low risk and investment, fast cash, and participation in diverse livelihood strategies. Although subsistence use of buriti leaves was becoming replaced by commercialization of young leaf fiber, subsistence use of buriti persisted due to cultural identity, current utility, land development restrictions, and its good fit with other activities in the livelihood system.

In Chapter 3, the impact of resource access on participation in buriti markets was evaluated. Results included an overview of the history and policies of natural resource use in the region, and comparison between people who had direct and indirect access to buriti resources. Regardless of their access to resources, people participated in the buriti market because it provided a good income source. Some people with direct access to buriti forests did not participate in the buriti market because of lack of interest, skills, and household cycle. Their resource access was most affected by property regimes and ecological attributes of trees. People with indirect access to buriti forests were indeed prevented from market participation because of their lack of access to buriti resources, but also because of their existing time commitments to other activities. Their lack of access to buriti forests was most affected by competition for resources and lack of social networks.

In Chapter 4, value chain analysis was used to examine the impact of the emerging fiber handicraft market on livelihoods and resource management. Results included construction of buriti value chain diagrams, analysis of relationships between actors, and identification of socio-economic patterns among actors. The new market introduced new actors who interact with pre-existing buriti users, and resource demands

that compete with pre-existing local and subsistence uses of buriti derivatives. Actors can be classified according to their proximity to the resource or market on the value chain. Actors differ in their livelihood strategies, socio-economic characteristics, and perceptions regarding sustainability of young leaf collection. Historical exposure to buriti and household cycle both shape roles in the value chain. New market demand for young leaves poses a threat to sustainability of buriti harvesting

Chapter 5 concludes the dissertation. The shift from buriti-based subsistence to income-earning activities that was apparent in the Barreirinhas region demonstrated how people adapt their livelihood strategies to an increasingly global economy. Although individuals may be part of the same livelihood system, socio-economic heterogeneity within the region results in differences among people's dependence and engagement in buriti activities. Social heterogeneity should be considered by conservation and development initiatives that seek to influence participation in NTFP markets, evaluate effects of commercialization on livelihoods, and effectively design and implement resource management strategies.

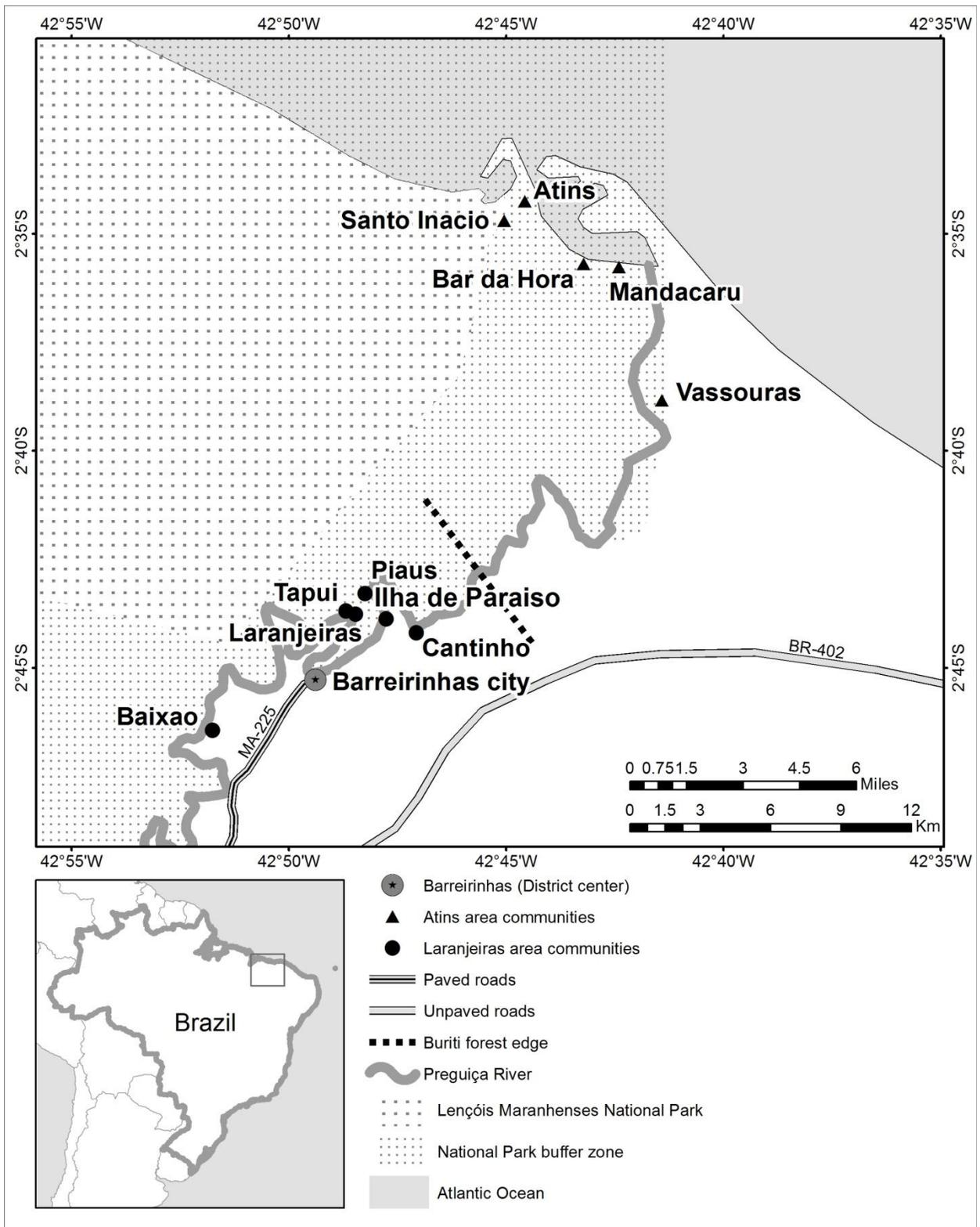


Figure 1-1. Map of the study site (created by Mariano González Roglich)

Table 1-1. Number of individuals interviewed in each community in the two study areas

Laranjeiras area communities	Number of individuals	Atins area communities	Number of individuals
Barreirinhas city	5	Atins	18
Baixao	3	Bar da Hora	1
Cantinho	9	Mandacaru	8
Ilha de Paraiso	1	Santo Inácio	16
Laranjeiras	47	Vassoura	2
Piaus	6		
Tapui	33		
Total	104	Total	45

## CHAPTER 2 THE ROLE OF BURITI IN THE LIVELIHOOD SYSTEM

### **Chapter Summary**

Although the growth of new NTFP markets (non-timber forest products) among forest users is often promoted as a strategy to meet conservation and development goals, markets are not for everyone. A livelihood systems analysis was used to explore subsistence and market dynamics of forest products by assessing parameters of the livelihood system and identifying socio-economic factors that affected participation in the buriti market. First, data collected from interviews with 149 individuals in Barreirinhas, Maranhão were analyzed to identify resources, activities, and livelihood strategies within the livelihood system; preferences and limitations that influenced selection of activities were assessed. Secondly, socio-economic characteristics of participators (n=83) and non-participators (n=66) in the buriti market were compared. Results showed that interviewees prioritized livelihood stability. Their reliance on resources and livelihood activities varied according to environmental constraints, demographics, and personal preferences. Buriti use was influenced by cultural identity, governance, social and cultural perceptions, and relationship between buriti activities and other traditional livelihood activities. As an income earning activity, buriti was favored by interviewees, particularly women, because it allowed for high flexibility, low risk, fast cash, low investment, and participation in diverse livelihood strategies. Subsistence use of buriti persisted due to cultural identity, potential value, current utility and politics, and role of buriti within a traditional livelihood system. Although individuals may be part of the same livelihood system, socio-economic heterogeneity within the

region differentially affected peoples' dependence on and preference to engage in buriti activities.

### **Background**

Although the growth of new NTFP markets (non-timber forest products) among forest users is often promoted as a strategy to meet conservation and development goals, markets are not for everyone. New global markets for NTFPs (non-timber forest products) must often compete with pre-existing subsistence forest uses and local markets. Local NTFP markets are commonly based on traditional knowledge and skills, and are the result of community-based initiative, innovation, and self-reliance (Shackleton et al., 2007). In contrast, globally oriented markets are more complex and foreign to most NTFP users (Philip, 2002). Exploitation of açai (*Euterpe oleracea*) fruit provides a well-documented example of the complexity of shifting from local use to global market (Brondizio et al., 2002). Although the growth of new NTFP markets is often encouraged by development initiatives, participation in rapidly changing forest markets can be risky for some people (Belcher and Schreckenberg, 2007).

Shaped by need and opportunity, NTFPs form part of people's livelihood strategies by helping them meet their subsistence and income-earning needs. Most forest products provide a subsistence function among households through direct use or trade. A smaller subset of NTFPs are regularly traded and targeted commercially in different types of markets. NTFP use is influenced by local institutions, resource abundance, and relative level of development (Ruiz-Perez et al., 2004a). In a subsistence economy, people devote their available resources to producing food and maintaining shelter and security. In a cash-based economy, households have opportunities to specialize in activities that offer the best economic opportunities. If food and other necessities can be

purchased, people can concentrate their efforts on activities that provide the highest rewards (Shackleton and Shackleton, 2004).

Broad typologies of forest-based livelihood strategies have been defined based on availability of assets, risk management (Belcher et al., 2005; Jensen, 2006), and involvement in commercialization. Commercialization is defined as any use in which the extractor does not use the product directly and exploits the product to gain a different value (Ruiz-Perez et al., 2004a). People who use a coping strategy depend on forest products mostly for household subsistence; few products are sold in markets (Belcher and Kusters, 2004). People who use a diversified strategy utilize forest products as a supplement to other household livelihood activities (Arnold and Townson, 1998) and as a safety net against unexpected events (Shackleton and Shackleton, 2004). A specialized strategy focuses on specific forest products as a major contribution to income and high household integration into the cash economy because the household is driven by market opportunities for these products (Belcher and Kusters, 2004). Definitions of forest-based livelihood strategies can vary according to the socio-economic and political characteristics of the case context (Ruiz-Perez et al., 2004a). Socio-economic factors that are influential in forest livelihoods include wealth, gender, education, and personal preference.

As part of diversification strategies, NTFPs can prevent poverty within household economies by helping people maintain a minimum standard of living (Angelsen and Wunder, 2003) and providing subsistence and a safety net against unexpected events among local communities (Shackleton and Shackleton, 2004; Wunder, 2001). Diversification can also provide convenient seasonality combinations, less risk, and

higher income. Diversification, however, can also lead to adverse gender effects and unequal income distribution (Ellis, 1999). Men more easily take advantage of diversification activities, as women are usually limited to the domestic and subsistence sphere. In comparison to men, women have fewer livelihood options, less access to livelihood resources, and lower wage rates. Women's participation in NTFP trade, however, can be an important source of self-esteem, pride, and independence, even if little income is earned (Shackleton, 2004). Women are disproportionately reliant on local trade of NTFPs (Neumann and Hirsch 2000) because they can easily enter NTFP markets and combine their activities with household tasks (Arnold and Townson 1998; Marshall, Schreckenberg et al. 2006).

Wealthier people are better positioned than poor people to diversify in labor markets. They can secure higher incomes from NTFP commercialization (Arnold and Perez, 2001; Belcher and Kusters, 2004; Cavendish, 2000; Warner, 2000) by controlling opportunities and devoting more resources towards production (Arnold and Townson, 1998). Poor people have a difficult time taking advantage of market opportunities (Arnold and Townson, 1998) because of their low education, higher risk, and lack of organization, skills, and capital (Shanley, Pierce et al. 2005, Arnold & Ruiz Pérez 2001). Although NTFPs provide poor people with important safety-net and supplementary income (Pyhala et al., 2006), they are likely to divert their subsistence resources towards new market opportunities, which increases their risk level (Falconer and Koppell, 1990). Nevertheless, barriers to entry in NTFP market are relatively low in comparison to other livelihood options, so use and trade of NTFPs is often a viable

strategy for poor people (Dubois 2003). Overall, diversity helps households to be more resilient (Marschke and Berkes, 2006), as well as more reactive and opportunistic.

Considering that there are both positive and negative impacts of engaging in NTFP markets, this study sought to understand: Why people participate in NTFP markets when other livelihood options are available? This study explored the role of buriti (*Mauritia flexuosa*) in livelihood strategies by examining peoples' participation in the buriti palm leaf market in Barreirinhas, Maranhão, Brazil. A livelihood approach was used to evaluate the resources, economic activities, external constraints, and personal preferences that influence peoples' decision to participate in buriti markets.

## **Methods**

### **Analytical Framework**

The sustainable rural livelihoods framework (Carney, 1998; Scoones, 1998), or livelihood approach, is useful for assessing different capitals and external environmental factors that shape the livelihood system (Berkes and Folke, 1994; Department for International Development, 2006; Scoones, 1998). A livelihood system consists of a group of people who share common access to resources and livelihood activities. Livelihood strategies are the combination of activities that people undertake in order to achieve their livelihood goals (DFID 2011). As strategies, resources are used as efficiently as possible and in different combinations depending on constraints, goals, opportunities and composition of the household.

### **Study Site**

Maranhão is known as the “land of palm trees” because of the many palm species, including babassu (*Attalea speciosa*), açai (*Euterpe oleracea*), carnauba (*Copernicia prunifera*) and buriti substantially contribute to local livelihood strategies. The buriti palm

is a dioecious, arborescent palm that grows up to 25 m tall, with a single stem. Buriti fiber, which is extracted from young buriti leaves, has been recorded as one of the top ten most economically valuable forest products in Maranhão (IBGE, 2012). According to IBGE, only four municipalities of Maranhão state have harvested buriti fiber for the market, and during 2004-2011 Barreirinhas was the highest recorded producer. Barreirinhas (95-139 metric tons of buriti fiber per year).

Fieldwork was conducted in Barreirinhas among 12 communities located along the Preguiça River (Figure 1-2). Barreirinhas district covers an area of 3,112 km<sup>2</sup> and has 54,930 inhabitants (IBGE, 2010), who are mostly *caboclos*, or mixed descendants of indigenous, European, and African people. Buriti palm trees grew naturally in swamp forests as a dominant tree species in Barreirinhas. Results from exploratory research showed that people in the region popularly exploited fruit, mature leaves, and young leaves from wild-grown buriti trees. Fruit was usually collected from the ground and used for household consumption, although some people sold fruit to the local market in Barreirinhas. Mature and young leaves were collected manually by extractors who climbed trees to cut the leaves. Mature leaves were harvested by extractors to sell to community members who used the leaves for construction, such as roof thatching or for building temporary structures. Traditionally, young leaf fiber was used to make hammocks and ropes or cordage. At the time of the study, community members were increasingly engaging in young leaf exploitation to make and sell handicrafts to rapidly growing tourism (Lobato, 2008) stemming from the nearby Lençóis Maranhenses National Park. Maranhão State Secretariat of Tourism (SETUR) estimated that 350,000 tourists visited Barreirinhas in 2010 (Maranhão, 2011). Buriti fiber handicrafts made up

the second most important source of income in Barreirinhas (Prefeitura Barreirinhas, 2005), and buriti handicraft production was growing in popularity as a way to earn income. In comparison to buriti fruit and mature leaf markets, increasing demands and production of fiber handicrafts have great potential to impact dynamics of buriti use.

### **Sampling Strategy**

Using a quasi-experimental research design, the sample group (n=149) consisted of a target group of market participants and control group of non-participants with key demographic characteristics similar to the target group. Individuals for both groups were selected based on a purposive sample strategy and respondent-driven sampling methods. Purposive sampling strategy entails selecting individuals based on criteria developed during the study (Coyne, 1997). Respondent-driven sampling, which is appropriate for making estimations about hidden populations (Salganik and Heckathorn, 2004), was used by asking community members to name individuals who participated in the buriti market in different ways. The target group consisted of 83 individuals who participated in the buriti market as owners of buriti resources (n=13), extractors of buriti derivatives (n=12), artisans (n=51), and vendors (n=19) of buriti handicrafts. For the control group (n=66), demographics of individuals in the target group (eg. gender, age, region) were used as criteria for selecting matching groups of individuals who did not participate in the buriti market, or did not extract buriti derivatives nor produce and sell buriti handicrafts. Criteria for non-owners were individuals from Laranjeiras area aged 20-88 years (n=39). Criteria for non-extractors were male individuals from Laranjeiras area aged 15-55 years (n=11). Criteria for non-artisans were female and aged 16-65 years (n=38). Criteria for non-vendors were all individuals aged 18-65 years (n=53). Individuals could fill more than one role in the buriti market.

Based on this sampling strategy, a sample group was selected that represented both buriti market participators and non-participators.

### **Data Collection**

Prior to collecting data, a Brazilian research visa was obtained and Institutional Review Board (IRB) process completed by submitting a research proposal and field interviews to the IRB office at University of Florida (protocol #2010-U-003). Data were collected over 18 weeks from 2009-2011 using semi-structured interviews and ethnographic techniques. A semi-structured livelihood interview was used to collect data from sample group individuals on demographics, available resources, activities, income earning sources, and livelihood necessities. Ethnographic techniques were used to collect data from community members not included in the sample group. As a case study, participatory mapping was used to survey market participation in Laranjeiras community. Three community members cooperated to draw a map of houses in the community. For each household, they identified the number of residents, age of head of households, and members of the household who participated in the buriti handicraft market.

### **Analysis**

Analysis consisted of first, identifying parameters of the livelihood system and, second, examining participation in the buriti market. Qualitative analysis of interview responses and descriptive statistics were used to identify parameters of the livelihood system of the sample group, including interviewees' resource base, constraints, activities, and socio-economic factors that impacted their participation in livelihood activities. Socio-economic variables were elicited from interview responses to represent individual and household demographics, wealth, personal history, perceptions regarding

sustainable buriti harvesting, participation in livelihood activities, and household income sources (Table 2-1). Qualitative analysis of interview responses was conducted by grouping together interview responses, cross checking between responses, and identifying patterns. Descriptive statistics included frequency tables (standard deviation reported as “s”) and Pearson’s correlation analysis ( $p < 0.0001$ , correlation coefficient “r” reported).

Participation in buriti leaf activities was examined in four different steps. First, subsistence use of buriti leaves in the region was evaluated by using qualitative analysis of interview responses to group together and cross-check between responses, and identify patterns. Second, the magnitude of buriti market participation within the case study of Laranjeiras community was assessed by reporting and interpreting statistical summaries. The objective of the third step was to identify socio-economic limitations and drivers for participating in the buriti market among a sample group of 149 individuals. Means of the variables were statistically compared between people who participated in the buriti market ( $n=83$ ) and people who did not participate in the buriti market ( $n=66$ ) by using two-sample t-test and Wilcoxon rank sum test ( $p < 0.05$ ). As the fourth and final step in the analysis, a logistic regression model of socio-economic factors was tested among the sample group to determine the most influential factors that impact participation in the buriti market. Socio-economic factors identified in the previous step as being significantly different between sub-sample groups were used to build maximum models, so that as many explanatory variables as possible were included. Variables that demonstrated collinearity were excluded from the models. Preliminary models were tested until models with the lowest Akaike Information

Criterion (AIC), as a measurement for best-fit models, were attained. All logistic models were determined to be good fit of data based on the likelihood ratio ( $p < 0.05$ ) and high percent concordant value ( $> 82$ ). Statistical significance of factors was measured at a 5% level or better. Quantitative analysis was conducting using Microsoft Excel and SAS 4.3 software.

## **Results**

### **Resource Base**

The sample group of 149 individuals consisted of 40 men and 109 women who represented 129 households. A household schematic was used to depict available resources and household utilization of resources within the livelihood system (Figure 2-1). As depicted in the figure, households participated in activities and invested inputs, such as labor and cash, to convert resources into beneficial outputs, such as income, goods, and subsistence materials.

Although interviewees shared access to similar resources, their use of resources differed. Barreirinhas was the main market center for the region. Atins area communities were more isolated than Laranjeiras area communities, because of greater distance to Barreirinhas and impassable roads during some parts of the year. As a measure of dependence on subsistence resources, 68% of interviewees had homegardens for cultivating fruits, vegetables, and herbs for household consumption. About 48% of interviewees had agricultural land for raising livestock, growing staple crops, and managing useful native trees, such as juçara (açai), buriti, and carnauba. Agricultural soil was replenished using compost from burned wood and carnauba leaves from off-farm resources, and manure from domesticated animals, and by alternating crops. Half the interviewees collected off-farm/forest resources, which were plant-based forest

products and aquatic resources. Plant-based forest products were mostly wild fruits (20% of sample group); other products were wood for charcoal and building construction and plants used for medicine, dyeing fiber, and food. Ocean resources in Atins were mostly fish (50% of sample group). For 33% of women from Atins, collection of shellfish and marine invertebrates provided important household food and income. Although most interviewees (87%) had year-round access to freshwater through wells and natural water sources, some interviewees in Atins had difficulty accessing any type of fresh water during the dry season. Important sources of income came from the government and through employment by community members or private businesses outside of the community. Federal and municipal government provided important social resources, including subsidies and basic infrastructure, such as health care, education, and law enforcement.

Environmental constraints influenced how interviewees converted their livelihood resources into benefits. Some interviewees perceived all aspects of their life to be difficult, while others believed that life was much easier than in the past. Most interviewees identified specific livelihood constraints, including health care (44% of sample group), access to fresh water (18%), scarcity of cash (10%), lack of education and training (9%), availability and/or high costs of electricity (8%), access to food (5%), and politics and governance (3%). Scarcity of cash limited peoples' options for accessing livelihood necessities such as healthcare, food, and job skill training. Health care was perceived as expensive, low quality, and with limited facilities. Food was difficult for people who relied on purchased food out of personal choice or to make up for failed crops. Without subsistence and natural resource based activities, such as

agriculture, fishing, and collection of forest products, basic necessities were out of reach for some people with low incomes.

Lack of fresh water was blamed on poor community organization and faulty implementation of political initiatives to improve water utilities. High living expenses were related to limited access to goods, and rising costs, due to increased tourism and development. Interviewees believed that a recent political conflict, in which there were essentially two mayors of Barreirinhas, had led to stagnancy in decision-making and governance in the region. Governmental assistance was expected to improve access to healthcare, education, job training, and basic utilities. Few formal employment opportunities were available for people who earned secondary or post-secondary education. Electricity was also unreliable, although there was subsidized use for poor people. Reliance on natural resources and subsistence activities fueled frustration about increased land use regulations. With growing attention to the National Park, there was increased federal enforcement of restrictions on tourism and land development within and adjacent to conservation areas. Community members felt that these restrictions reduced their few options for earning cash income, and that officials sought to remove them from their land and prevent their practice of a traditional lifestyle. For interviewees, subsistence-based activities were often as important, or more important, than cash earning activities because they provided a vital security net. Although interviewees shared the same livelihood system, use of resources and impacts of constraints varied among households. To understand this variation, participation in activities and income sources was analyzed in the next section.

## Livelihood Activities and Income Sources

Individuals of the sample group averaged 2.2 livelihood activities/person ( $s=0.19$ ) and 3.3 household income sources/person ( $s=1.46$ ). Livelihood activities were defined as activities that individuals reported to carry out on a typical day-to-day basis. Income sources were sources of household income reported by an individual of the household. Activities and income sources were evaluated for their contribution towards interviewees' livelihood goals of earning income and meeting consumption needs, frequency of participation, demographic patterns, constraints, and benefits (Table 2-2). Activities were classified by livelihood goals of fulfilling subsistence or income needs, and were listed by descending order of frequency. High frequencies for handicraft production and owning a business were influenced by a sampling bias towards handicraft artisans and vendors, respectively. Most common activities were housework, handicraft production, agricultural activities, fishing activities, and owning a business. Most common household income sources were *Bolsa Familia*, a governmental cash-transfer program awarded to women with school-aged children, handicraft production, fishing activities, retirement, and owning a business. Except for activities only for subsistence (eg. housework and studying), the most frequently reported livelihood activities and household income sources were similar. In spite of targeting buriti leaf extractors for the sample group, the frequency of individuals who reported extracting palm leaves as their main activity and household income source was lower than expected, and not always linked directly to market sales. Half of the extractors interviewed considered buriti leaf extraction to be only a minor livelihood activity because they collected young leaves only infrequently, for an artisan in their household, and did not earn direct income from the activity. In contrast, extractors who did report

palm leaf extraction as a main livelihood activity and household income source extracted and sold buriti leaves to people outside of their household.

**Description of activities.** The most frequently reported livelihood activities, described here, demonstrate the complexity of constraints and incentives among activities. Housework consisted of all domestic activities carried out in the home. Integral to the household's survival, housework often was so time-consuming that women had little time to engage in income earning activities. Intensity of these housework duties, however, changed with household composition and age. For example, young households with small children often required a larger time investment.

Palm leaf handicrafts were made of young buriti and carnauba leaves; carnauba was used to make brooms sold locally. Almost all artisans made buriti leaf handicrafts, which had a stronger market demand. Women made complex handicrafts, while some men made simple handicrafts, such as cords. Women carried out the labor-intensive process of preparing buriti fiber by stripping the epidermal layer from young leaves (the fiber), then boiling, dyeing, drying, and knotting fiber together before making handicrafts. Potential costs for making handicrafts included buying young leaves, processed fiber, and dye, transportation to markets, and hiring tailors to complete handicrafts. By investing labor and time, artisans could avoid costs by asking male relatives to extract leaves, using natural dyes, and carrying out all steps of the production independently. Although most artisans aspired to be self-reliant, they were often limited by lack of skill, time, and access to resources. Women who lacked skills to strip leaves into strong fibers, depended on other artisans to carry out this task. Artisans lacking free time purchased ready-made fiber to quickly make and sell handicrafts. Access to resources

was dependent on extractors, seasons, and regional access. During rainy and windy seasons, extractors were often reluctant to climb tall trees to extract leaves, and artisans could not easily dry buriti fibers. Artisans in Atins area lacked direct access to buriti palm stands, so they depended on intermediaries to obtain fiber from Laranjeiras. The handicraft market could be unpredictable and risky. Most women had unreliable market access, and improperly stored handicrafts could be ruined by environmental conditions. In general, handicraft production was a desirable income-earning activity with potential to grow in the future. Buriti handicrafts provided one of the few cash sources available to women, because it combined well with home-based activities and provided immediate cash.

Entrepreneurial individuals owned shops that sold groceries, dry goods, and buriti handicrafts, as well as small industries to make boats and bricks. With the exception of buriti handicraft shops, almost all shops were in homes because the main consumers were community members. Main limitations for shop owning were having available resources to invest in infrastructure and inventory. Risks included paying rent for a shop location, investing in perishable products, and giving credit to clients. Business ownership, however, was a sought-after activity that provided a fast and consistent return of dependable cash.

Ocean and river-based activities consisted of fishing, making nets, and maintaining boats. Commercial ocean fishing was carried out by groups of men in open water for up to 15-day periods. Fishing for household consumption was conducted by a few men on small riverboats or along the shoreline, where women and children often assisted. There were high maintenance costs for boats and nets. Ocean fishers in Atins

were active throughout the year. Seasonal fishers in Laranjeiras spent winters fishing and summers engaged in other activities, such as making and mending nets. Net making was a skilled task that provided good income because it could be carried out at home with little overhead and flexible hours. Due to reduced fish stocks, most fishers supported increased regulations to reduce overfishing and environmental damage by large commercial boats.

Brick-making activities were conducted only in Laranjeiras, where good sources of clay were available. Community members were hired by factory owners to make ceramics by excavating clay that was mixed, shaped, dried, and fired in kilns. Men made bricks and roof tiles; women made floor tiles. Clay-based products were made during the dry season, when products could dry in the sun. Drawbacks of working in a factory were heavy physical work and delayed payment. Benefits included working close to home and having dependable annual work; it was one of the few consistent income earning activities located within communities.

Government employment was one of the best sources of income because it provided a dependable monthly salary that could be long-term and based close to home. Only some types of work, such as health providers and teachers, required skills training. Although a strict schedule limited participation in other activities, most work did not require full day and all year commitments. Most positions were not permanent but rather lasted for one to several years. Often linked to politics, government employees could be replaced when new political parties entered office.

Providing transportation was a popular income source for men. Vehicles and pack animals were used to transport people and goods. Because few community

members had the means to own a vehicle, they were hired as operators. Driving vehicles for tourists and as public transportation often required training and certification. The government supported most public transportation, such as river-crossings and school transport. Most operators could work from their community. Although considerable investment was needed to purchase and maintain a vehicle, providing transportation was a desirable activity.

This evaluation of activities demonstrated that people participated in activities based on potential benefits and constraints of each activity, and their livelihood priorities. The following section focused on identifying the influence of socio-economic factors on peoples' participation in different activities.

**Socio-economic factors that affect participation in activities.** Relationships between socio-economic factors, activities, and household income sources were analyzed using correlation analysis and frequency tables. Gender patterns were evident among activities. According to correlation analysis between gender and activities, female interviewees dominated housework ( $r=0.68$ ), *Bolsa Familia* ( $r=0.50$ ), handicraft production ( $r=0.47$ ), owning a business (86% were women), and working for the government (85% were women). Male interviewees were correlated to brick-making ( $r=0.40$ ), agricultural activities ( $r=0.44$ ), palm leaf collection ( $r=0.34$ ), and fishing activities ( $r=0.50$ ). No strong relationship was found between gender and education.

Interviewees averaged 41.7 years of age ( $s=16.3$ ) and had 4.7 years of formal education ( $s=3.5$ ). Although there was a negative relationship between education and age, because high schools had been accessible to study communities only within the last ten years, some activities were more strongly related to age or education level.

Brick making, housework, and government employment were all conducted by individuals aged 32-40 years old, which was an age group that often had a growing household with dependents. Older and younger people were more likely to be retired and studying, respectively. More highly educated individuals were more likely to be government employed. Less educated people were more likely to engage in agricultural activities and receive retirement pension, which were statistically correlated ( $r=0.38$ ). Retirement and handicraft production were negatively correlated ( $r=-0.37$ ), partly because of age differences; artisans averaged 40.7 years ( $s=11.6$ ) and retirees averaged 66.6 years ( $s=9.8$ ).

A wealth index, based on the presence of six wealth indicators (eg. tile roof, bathroom inside the house, well-made floor and walls, water plumbing, and vehicle ownership), averaged 3.82 per person ( $s=1.94$ ). Individuals who earned a retirement pension and owned a business were wealthier. Poorer households earned income from brick-making and had a high number of income sources. Households had an average of 4.9 people ( $s=1.8$ ). Labor per capita, defined as the number of people earning income in a household/number of household members, averaged 0.41 ( $s=0.23$ ). Higher household labor was related to earned income from *Bolsa Familia* and owning a business. *Bolsa Familia* was also correlated to an individual's participation in housework ( $r=0.43$ ) and making handicrafts ( $r=0.37$ ). Lack of correlation between *Bolsa Familia* and other income sources suggested that *Bolsa Familia* was often a main income source, because women had limited income-earning choices while raising children. As people aged within the household, their roles changed, but almost all age groups were valuable as

household labor. Elderly who received retirement pensions were some of the most valuable members of a household because of their consistent and high income.

Most interviewees (83%) came from households headed by couples; the remaining households were headed by a single woman. The majority of men and women head of households were involved in income-earning activities. Women who did not earn incomes (7%) participated in housework and assisting their spouse. Of the 11% of men that did not earn income, most participated in subsistence activities, such as fishing, farming, and maintaining the structure of the home.

Seasonality was analyzed to assess the feasibility for an individual to participate in more than one activity. Seasonality described months of the year that activities could be carried out, based on climatic seasons and demand (Table 2-2). Climatic seasons in Barreirinhas were distinguished as rainy or winter (January to June), dry or summer (July to December), windy (Atins, November to January; Laranjeiras, October to November), and non-windy season. Seasons drove activities dependent on natural resources, such as fishing and handicraft production. Activities linked to the tourism market were also dependent on the seasonal popularity of the Lençois Maranhenses National Park, which was popularly visited at the end of the rainy season (June-July) and on national holidays.

Time investment referred to the amount of time required to participate in an activity during its active months. Full-time activities require full days of commitment during all active months. Some-day activities required full days of commitment for short periods during active months of the activity. Part-time activities required only part of the day during active months. Sporadic activities were determined by the availability of

unpredictable work. Activities that were some-day, part-time, and sporadic were more likely to be combined together (Table 2-4). An individual could carry out more than one full-time activity that was active during different months of the year. For example, men often engaged in both fishing and brick making activities ( $r=0.39$ ), which were both full-time activities and seasonally compatible, and transportation and palm leaf collection ( $r=0.46$ ), which were part-time and sporadic, respectively. Most work categorized as “full-time” and “some days” was male-dominated. Most part-time and sporadic work was female dominated. Women with reduced housework loads often participated in handicraft making, owning a business, agriculture, and working as a government employee, which were all “part-time” activities. In contrast, popular male activities such as, fishing, brick-making, and agriculture activities, were seasonal full-time and some-day activities. Women engaged in an average of 2.13 activities ( $s=0.75$ ); men engaged in an average of 2.03 activities ( $s=1.03$ ).

Most interviewees had strong cultural and historical ties to the Barreirinhas region; almost all interviewees were born and raised in the region and about half of interviewees had at least one parent who was born in their current community of residence. Activities with historical significance, such as fishing, agricultural, and brick-making dominated among interviewees because they were socially familiar activities. Fishers in Laranjeiras, for example, often engaged only in fishing-related activities, such as making/repairing nets and repairing boats; they rarely engaged in land-based activities like agriculture and brick making. In some cases, participating in these familiar traditional activities was a priority over earned income.

Constraints, benefits, and socio-economic trends influenced how activities were combined into strategies for meeting livelihood goals. Gender, age, and education limited peoples' participation in activities. To meet subsistence needs, women were usually responsible for domestic activities, while men participated in subsistence-based activities outside of the home. Commitment to these gender roles meant that men and women's activities were limited. Being based at home, buriti handicraft production was a particularly important income source for women. Participation in activities changed with household cycles, in which peoples' needs and access to resources changed as household members aged. Most interviewees engaged in diverse livelihood strategies, so seasonality and combination with other activities were important determinants of participation in activities. Wealth was associated with the most lucrative and stable income earning activities. Finally, people chose activities that were most culturally comfortable.

### **Participation in the Buriti Leaf Activities**

In this section, participation in the buriti leaf activities was examined in a series of four steps. First, the persistence of subsistence use of buriti leaves in the region was evaluated. Second, a comprehensive survey with residents in the Laranjeiras community was conducted. Third, socio-economic limitations and drivers for participating in the buriti market were identified among a sample group of 149 individuals. Fourth, a logistic regression model of socio-economic factors was tested among the sample group to determine the most influential factors that impact participation in the buriti market.

**Subsistence use of buriti leaves.** Throughout the study communities, subsistence use of buriti leaves had become less important because industrial

substitutes, such as for construction purposes, were more accessible and there was social stigma associated with remaining at subsistence levels. Only the poorest households still used buriti thatch. Young leaf fiber handicrafts were rarely used in the household. Instead, they were sold to tourists to earn cash income. Regardless, buriti leaf resources continued to provide community members with a security net of both subsistence and income resources. Reflecting these values, landowners who did not exploit buriti derivatives were more likely to abandon buriti trees, rather than replace them with more useful species. Removal of buriti trees was more likely to be carried out by new migrants who cleared forest for new building construction.

Although market use of buriti was increasing, subsistence use of buriti still persisted because of cultural preference, current utility and politics, and role of buriti within a traditional livelihood system. To community members, buriti was aesthetically pleasing and representative of clean fresh water, which was one of the most important natural resources in the region. Some buriti handicraft artisans reported making handicrafts primarily because they enjoyed it. Mature leaves were still used to build temporary constructions, such as fishing huts on the beach. Laws also protected conservation zones, such as areas along waterways and within the national park, from permanent development by requiring that buildings be made of traditional and degradable materials like buriti leaves and clay. Strong relationships between buriti activities and other traditional activities within the livelihood system, such as fishing and making manioc flour, helped to maintain subsistence use of buriti. Among fishermen, buriti fiber hammocks were popular and fishing huts were commonly made from mature

leaves. For production of manioc flour, buriti leaves were often used as thatch to cover the processing area and to make equipment used to prepare the manioc flour.

**Case study of Laranjeiras community.** A comprehensive survey was conducted to measure the prevalence of buriti market participation within the entire population of current residents in the Laranjeiras community, which was located among buriti forests. Of the 375 community members, 20% participated in buriti leaf market activities. Participators were 19% of the total male heads of household who mostly extracted buriti leaves, 44% of the total female heads of household who made buriti fiber handicrafts, and 10% of the total male and female younger family members. There were twice as many women than men working with buriti, so an extractor collected leaves for more than one artisan. Men who did not extract buriti averaged 46 years of age ( $s=14.2$ ); men who extracted buriti averaged 60 years of age ( $s=18.2$ ). These older men most likely collected leaves for their artisan wives from smaller trees (<3 m tall), although most artisans considered small trees to produce inferior quality fiber. Among women, participators and non-participators in the buriti market were similar ages, averaging 41 years ( $s=14.1$ ) and 48 years ( $s=21.1$ ), respectively. Buriti leaves provided an important income source within the community. Although this survey did not capture the importance of buriti as a subsistence source, ethnographic data showed that most, if not all, households in Laranjeiras community had experience with buriti.

**Influential socio-economic factors.** To identify socio-economic limitations and drivers for participating in the buriti market, the means of socio-economic factors (Table 2-5) were statistically compared between a sample group of individuals throughout the Barreirinhas region who participated in the buriti market ( $n=83$ ) and did not participate in

the buriti market (n=66) by using two sample t-test and Wilcoxon rank sum tests. Almost all household demographics and most individual history characteristics were the same between both groups. About half of individual demographics, perceptions, and activities, and household income sources varied between groups. The socio-economic differences and similarities between groups are reported in this section.

An analysis of individual demographics showed that gender differed between sub-groups, which was a realistic picture of the buriti market. A higher proportion of women than men do participate in the buriti market, principally as handicraft artisans. To explore the impact of personal history on participation in the buriti market, interviewees' personal and parental history regarding ties to their current community of residence and buriti forests were measured. Both participants and non-participants showed similar lengths of residence and parental ties to their current community of residence, so they were equally accustomed and integrated into their community. Both groups reported having planted a buriti tree in the past and having had parents with extensive exposure to buriti resources. Frequency of household use of buriti leaf derivatives for subsistence purposes was the same (50%) for both groups. Although participants had more extensive personal exposure to buriti resources and had learned a buriti market trade from their parents, non-participants also demonstrated high levels of parental history and personal exposure to buriti (at least 70% of non-participants). These results demonstrate that historical ties to the current community of residence and buriti helped to access the buriti market, but they were not factors that determined market participation.

Although both sub-sample groups had similar views that buriti trees were threatened, much fewer participants than non-participants believed that young leaf collection was harmful. Although appearing to be conflicting, these results can be explained by the greater percentage of artisans and vendors in the target group. Compared to other actors, artisans and vendors had greater contact with governmental small-business promotion initiatives, such as by SEBRAE (Brazilian micro and small businesses support service), which emphasized sustainable harvesting. As a result, artisans and vendors familiar with this discourse often insisted to tourists that their involvement with handicraft production was ecologically sustainable, while overharvesting by “other” market participants and land development threatened sustainability. These results suggested that concern regarding sustainability was linked to peoples’ specific type of involvement in the buriti market and exposure to green marketing ideologies.

Both sub-sample groups reported having good personal health, which was measured because interviewees had suggested that good health was necessary for participating in the buriti market. Unsurprisingly, participants were more likely than non-participants to have an affinity to buriti, meaning that they reported enjoying working with buriti or believed they would like to make, extract, or sell leaves. Of the non-participants, some were former artisans who had stopped working with buriti products because of changes in their household composition, health, or access to resources. For example, women with young children lacked time to produce handicrafts. Artisans in Atins reported leaving the market upon moving to Atins because of lack of access to buriti fiber. Both sub-groups had similar views that handicraft production was a lucrative

activity, which demonstrated that non-participants wanted to enter the market. These results suggested that although an individual had good health and perception that handicrafts could be used to earn good income, other factors prevented their participation in the market.

An analysis of household demographics showed that both sub-sample groups had similar frequencies of homegardens and active agricultural land, which were important for producing food crops. Both groups had similar household size and availability of household labor. Wealth was measured according to having a wealth index of household material goods, access to credit to borrow cash, and having outside assistance and a source of consistent income, such as a monthly salary. In this way, wealth was examined according to income stability, current material wealth, and potential access to cash. All wealth measurements were similar for both groups. The only household demographic that differed between groups was their total number of household income sources, which was higher for participants.

An analysis of individual activities demonstrated that people who participated in the buriti market reported receiving more *Bolsa Familia*, owned their own businesses, and collected palm leaves. People who attended school were less likely to participate in the buriti market. An analysis of household income sources demonstrated that people who participated in the buriti market received more household income from retirement pensions, producing handicrafts, and employment by a private company than people who did not participate in the market. People who did not participate in the market were more likely than participators to receive household income from government employment. The analysis of wealth, activities, and household income, demonstrated

that both sub-sample groups had similar wealth and potential access to cash. People who participated in the buriti market had a higher average number of household income sources and livelihood activities, which suggested that they practiced a more diversified livelihood strategy.

**Modeling participation in the buriti market.** Logistic regression analysis was used to build a model that described participation in the buriti market and to identify significant variables that influenced peoples' participation in the market (Table 2-6). The model was built using socio-economic factors that were identified in the previous section as having statistically different means between participants and non-participants in the buriti market. Preliminary models were compared until the following best-fit maximum model was identified:

$$\text{Predicted logit of (participation in buriti market)} = -6.212 + (0.555)*\text{GENDER} + (1.252)*\text{ATOTAL} + (1.546)*\text{LIVBUR} + (0.580)*\text{LEAPAR} + (1.000)*\text{LIKBUR} + (0.321)*\text{ITOTAL} + (0.522)*\text{BOLSAF}$$

According to logistic regression analysis, three out of seven variables were statistically significant ( $p < 0.05$ ). Positive coefficients indicated that individuals who participated in more livelihood activities, had more personal exposure to buriti resources, or more affinity with buriti were more likely to participate in the buriti market. These results indicate that buriti market participants were characterized as people with more diverse livelihood strategies, and who could rely on their existing skills, knowledge, and experience with buriti. In addition, most participants reported that they personally enjoyed working with buriti as a livelihood activity, which suggests that attitude was an important factor for determining participation in buriti markets.

## Final Comments

The study group in Barreirinhas prioritized for livelihood security. Most interviewees engaged in diverse livelihood strategies, so seasonality and combination with other activities were important determinants of their participation in activities. Culturally familiar activities such as farming, fishing and brick making, which were all based on local natural resource use, dominated among interviewees. People chose activities that were low-stress and located close to home, allowed for high flexibility, offered dependable salary, provided fast cash, were low risk, and required low responsibility. Buriti activities had many of these preferred characteristics, so they fit well into the local livelihood system. In general, buriti handicraft production was a desirable income-earning activity with potential to grow in the future.

Although buriti could provide good incomes, not everyone participated in buriti activities to meet their cash needs. Socio-economic heterogeneity among the study population determined whether people engaged in buriti activities. Some people chose not to engage in buriti commercialization as a personal preference or as part of their cultural identity because they identified with other livelihood activities such as fishing or agriculture. Participants of the buriti market were more likely than non-participants to practice a diversified livelihood strategy, of which buriti handicrafts figured prominently. This was expected because people who engage in NTFPs commercialization often have diversified livelihood strategies in which forests products provide a supplement to other livelihood activities (Arnold and Townson, 1998). Participants of the buriti market relied on their existing skills, personal exposure to buriti forests, and knowledge gained from their parents to participate in the buriti market.

Although many types of resources and livelihood activities were available in the livelihood system, buriti had an important role in the livelihood system by providing both subsistence and market needs, and a security net of resources that could be used when needed. Subsistence use of buriti persisted, due to perception of potential value, current utility and politics, and role of buriti within a traditional livelihood system. Contradictions between social stigma that discouraged subsistence use of forest products, and persistence of subsistence use due to cultural identity have been documented in other forest markets, such as within the Brazilian Amazonian rubber industry (Vadjunec et al., 2011). Without subsistence and natural resource based activities, basic necessities were out of reach for some people who earned low income. Community members perceived that governmental restrictions limited their few options for earning cash income, and that forestry officials sought to remove them from their lands and prevent their practice of a traditional lifestyle. Although use of mature leaves will likely decline, its use will persist to be used to complement other traditional activities and to meet needs of development restrictions that require local natural materials, such as palm leaves, to be used for construction. In contrast, demand for young leaves is expected to increase and create pressure on buriti leaf resources.

There are some recommendations that can be made as a result of this study. Social stratifications within communities must be recognized in order to anticipate the types of people who would be most receptive to forest product markets and their effect on the market. There were different types of social heterogeneity among the study community that could affect the outcomes of conservation and development initiatives to encourage NTFP commercialization. People who had historical ties to their current

community of residence and to buriti forests often participated in the buriti market, but these characteristics did not ensure that all of these people participated in the market. Rather, peoples' participation in natural resource-based activities changed as members of the household aged. As found in other studies, young households have less time to accumulate capital (Perz, 2001), so are often more reliant than older households on forest resources as a way to weather shocks and avoid risk (Ellis, 1998). For example, some non-participants were former participants who were prevented from working because of changes in their household composition. Household composition, therefore, affected how people engaged in forest product markets. Another source of heterogeneity in the communities was the entry of new participants, who were attracted to a potentially lucrative market. This study showed that some individuals who did not participate in the market demonstrated an affinity to buriti because they wanted to earn more income. As elsewhere, new participants to forest markets may exploit the market by becoming specialized users (Jensen and Meilby, 2008) in which they generate income from specific forest product markets (Wunder, 2001).

People's affinity to working with buriti as a livelihood activity was one of the most important characteristics for participants of the buriti market. Attitude and personal desire to engage in an NTFP market did not stand out in literature that evaluated different socio-economic factors that affect participation in forest markets. Instead, much of this literature focuses on demographics, such as gender (Ruiz Perez et al., 2002; Shackleton et al., 2011) and knowledge (Guest, 2002; Reyes-García et al., 2007), and financial incentives for joining forest markets (Angelsen and Wunder, 2003; Paumgarten and Shackleton, 2009). Based on the results of this study, it is recommended that more

attention be given to people's personal and desire to work with forest products as an incentive for participating in forest markets.

Forest-based handicraft markets are often important income generators for women (Bishop and Scoones, 1994; Coomes, 2004). Likewise, buriti activities were particularly important to women, because handicraft production was one of the few activities that could be done at home, allowed for flexible hours, had accessible markets, and provided a means for earning fast money. No other activities fit so well into their livelihood strategy. Women's roles can often be hidden within value chains (Shackleton et al., 2011), which can lead to their receiving less policy support and attention. The results showed that handicrafts should continue to be an important income source for all women in the study region, not only for more privileged groups.

Finally, perceptions regarding sustainability of buriti use reflected peoples' current buriti use. People who participated in the young leaf buriti market believed that their own impact on buriti forests was sustainable, but buriti trees were threatened by other peoples' use. These results demonstrate that perceptions of NTFP sustainability can be influenced by peoples' relationship to forest products and to green marketing discourses, which can have implications for resource management strategies that seek to use perceptions of local users as a basis for guiding sustainable forest use.

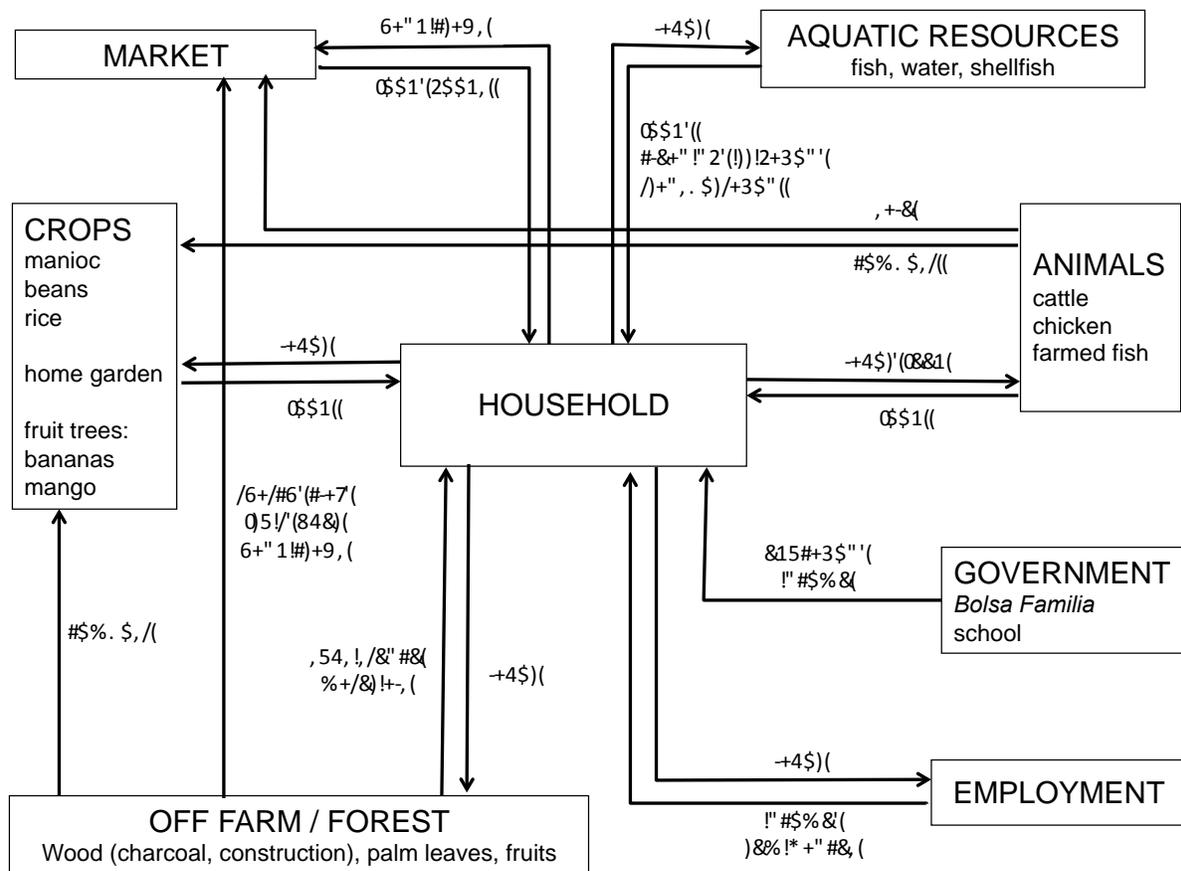


Figure 2-1. Schematic showing resources (boxes) and inputs and outputs as a result of using resources (arrows) that are available to a typical household of Barreirinhas, Maranhão.

Table 2-1. Socio-economic variables evaluated in the study

Variable name	Description	Range
<b>INDIVIDUAL DEMOGRAPHICS</b>		
Participates buriti market	Interviewee participates in buriti derivative market	0,1
Region	Interviewee lived in Laranjeiras (0) or Atins (1) area	0,1
Age	Age (years)	13-88
Gender	Gender; male (0) or female (1)	0,1
Education	Education (years)	1-13
Total activities	Number of livelihood activities reported	0-5
Years in community	Number of years lived in current community	1-73
Individual >10 yrs buriti	Individual >10 years close to buriti	0,1
Parent born in community	At least 1 parent born in interviewee's current community	0,1
Parent >10 yrs buriti	At least 1 parent lived >10 years close to buriti	0,1
Buriti learned parent	Learned current buriti trade from a parent	0,1
Planted buriti tree	Has planted a buriti tree	0,1
Good health	Believes has good health	0,1
Buriti trees threatened	Believes buriti trees threatened	0,1
Young leaf harmful	Believes young leaf collection harmful	0,1
Affinity to buriti	Likes or would like working with buriti	0,1
Handicrafts lucrative	Handicraft market provides good income	0,1
<b>HOUSEHOLD DEMOGRAPHICS</b>		
Home garden	Active home garden present	0,1
Agricultural field	Active agricultural field present	0,1
Household labor	Family members earning income/ people in household	0-1
Household size	Number of members in the households	1,10
Head of household	Head of household is a single person (0) or couple (1)	0,1
Buriti household use	Buriti leaf derivative used for household subsistence	0,1
Consistent income	Receives consistent income each month	0,1
Wealth index	Index based on presence of tile roof, inside bathroom, well-made floor and walls, water plumbing, and vehicle ownership	0-6
Access to credit	Interviewee perceives has access to borrow money	0,1
Outside assistance	People outside of household contribute cash/goods	0,1
Total income sources	Number of household income sources reported	0-6
<b>INDIVIDUAL ACTIVITIES</b>		
<i>Bolsa Familia</i>	Interviewee receives <i>Bolsa Familia</i>	0,1
Retirement	Interviewee receives retirement pensions	0,1
Studying	Interviewee attends school	0,1
Housework	Housework is a main activity	0,1
Fishing activities	Fishing is a main activity	0,1
Private business activity	Business owner or cooperative member	0,1
Brick-making	Making bricks and ceramics are a main activity	0,1
Agriculture activity	Agriculture is a main activity	0,1
Employed by gov't	Employed by the government	0,1
Collecting palm leaves	Collecting palm leaves	0,1
<b>HOUSEHOLD INCOME</b>		
<i>Bolsa Familia</i> income	<i>Bolsa Familia</i> for household income	0,1
Retirement income	Retirement for household income	0,1
Handicrafts income	Handicrafts for household income	0,1
Employed private co.	Private company employment for household income	0,1
Fishing income	Fishing activities for household income	0,1
Brick-making	Bricks and ceramic making for household income	0,1
Employed by gov't	Government employment for household income	0,1
Selling goods	Selling goods without a shop for household income	0,1
Selling agriculture	Selling agricultural products for household income	0,1
Transportation	Household income by providing transportation	0,1
Selling palm leaves	Selling palm leaves for household income	0,1

Table 2-2. Description of livelihood activities conducted by interviewees and household members

Activity	Frequency <sup>1</sup>	Description and gender	Costs	Benefits
<b>INCOME ONLY</b>				
<i>Bolsa Familia</i>	Hshold =79	Government subsidy given women to support school-aged children.	Must travel to city to withdraw cash.	One of the few income sources for women
Retirement	Hshold=43	Elderly men and women who have invested in a retirement program.	Must travel to city to withdraw cash.	Elderly people can earn cash.
Business owner	Indiv=22 Hshold=30	Men and women own a grocery, boat/brick-making, or handicraft shop, or participate in co-op.	Investment: purchase products; build, rent, buy, or accessing shop space. Risk: Not selling products; non-paying customers	Consistent source of good income; can work from home/ community; brick factory owner earns R\$300/month
Government employee	Indiv=13 Hshold=22	Men and women who work for the government (eg. health provider, school/street cleaner, teacher)	Inflexible hours	Reliable income source, can receive work benefits; work in community; est. R\$540/month
Providing transportation	Hshold=21	Men drove tourist, river-cross, and school boats, motorcycle taxi, oxen cart, and 4X4 public transport; tourist guide	Sometimes large investment into owning and maintaining their vehicle	Can work in the community; tourism work provides high income.
Selling goods without owning a business	Indiv=5 Hshold=16	Women sell cosmetics and clothes in community. Men travel outside community to sell fish and goods.	Risk: Non-paying customers; fresh produce can go bad before sale. Long periods between income.	Combines well with other livelihood activities. Can work within community.
Employee for private company	Hshold=14	Men work for petrol company; women and men can work for a private company.	Long periods spent outside community (ex.6 weeks several times a year); physically demanding work	Consistent salary; receives work benefits; long periods at home between work assignments; high salary, est. R\$850/month
Day labor	Hshold=6	Mostly men and some women who take "odd jobs", eg. grind manioc, work with agriculture.	Inconsistent source of income. Often physically demanding work.	Combines well with other livelihood activities; est. R\$25/day
<b>INCOME AND SUBSISTENCE</b>				
Handicrafts	Indiv=67 Hshold=75	Mostly women; few men; making buriti or carnauba based handicrafts.	Inconsistent income; limited access to resources; investment for materials	Fast cash; can work from home; combines well with other activities.
Fishing activities	Indiv=23 Hshold=49	Mostly men; some women. Income: ocean fishing. Subsistence: Ocean and river fishing. Income and household: Making/repairing fishing nets	Less lucrative than in the past because of reduced fishing stocks and stricter management. Making nets: Inconsistent income.	Familiar livelihood activity. Making nets: Can work from home. Income estimate: R\$140/week making river fishing net
Agricultural activities	Indiv=33 Hshold=24	Mostly men; some women. Crops and livestock.	Provides little income. Risk: failure of crops or livestock	Good subsistence source.

<sup>1</sup>Indiv - frequency of individuals participating in activity; Hshold – frequency of interviewee households participating

Table 2-2. Continued

Activity	Frequency <sup>1</sup>	Description and gender	Costs	Benefits
Brick-making	Indiv=13 Hshold=22	Men and women make bricks and tiles. Income: working at home industry brick factory. Subsistence: constructing home.	For household consumption: must pay for access to good clay. Physically demanding.	Can build their own house and work in community. Adult workers earn R\$150/1000 bricks/week. Boys earn R\$50-60/week.
Collecting palm leaves	Indiv=6 Hshold=9	Mostly men are extractors, some women collect for household use. Income and subsistence: Buriti and carnauba leaves.	Inconsistent work, uncertain access to resources, and gathering from tall trees is dangerous.	Provides additional income. Buriti income estimate: mature leaves: R\$95-120/100 leaves. Young leaf: R\$1.5-2/leaf
Caretaking house	Indiv=4 Hshold=7	Men and women who care-take vacation home built in community.	High responsibility taking care of another person's property.	Provides a place of residence. Can work in community.
House construction	Indiv=4 Hshold=7	Men who work with building construction within the community	Can be inconsistent work. Requires skills.	Can build family home and work in the community.
Fixing boats	Hshold=5	Men only. Income: ocean fishing. Subsistence: ocean/river fishing.	Can require high investment of materials and equipment.	High demand. Salary estimate: R\$40/day to fix boats.
Shellfish and forest products (not buriti)	Hshold=4	Household: Men and women collect wood for construction and charcoal. Income and household: Women sell shellfish and fruits	Large time and energy investment for little income return. Seasonal work, depending on the product.	Provides much needed income when there are few options.
Tailoring with sewing machine	Indiv=5	Mostly women; few men. Income: Women tailors. Men and women sew handicrafts. Household: Women sew for family.	Investment: sewing equipment.	Can be self-employed and work from home.
<b>SUBSISTENCE ONLY</b>				
Housework	Indiv= 89	Mostly women, some adolescent boys. Running household by cooking, cleaning, doing laundry, and caring for dependents.	Difficult to participate in income earning activities outside of the home.	Can work from home
Studying	Indiv= 12	Young and adult men and women who study in formal institutions.	Opportunity cost	Can get better work in the future.

<sup>1</sup>Indiv - frequency of individuals participating; Hshold – frequency of interviewee households participating

Table 2-3. Active months and required time investment of main livelihood activities

Time investment and type of activity <sup>2</sup>	Months of the year (January-December) <sup>1</sup>											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>FULL TIME</b>												
Housework and rearing small children	x	x	x	x	x	x	x	x	x	x	x	x
Tourist-related activities: tourist guides, boat tours, restaurants, and guest houses		x	x	x	x	x	x	x	x	x	x	x
Working for a private non-petrol company	x	x	x	x	x	x	x	x	x	x	x	x
Brick-making activities: workers and shop owner						x	x	x	x	x	x	-x
Ocean fishing		x	x	x	x	x						
<b>SOME DAYS</b>												
Ocean fishing maintenance of boats and nets							x	x	x	x	x	x
Agricultural activities	x	x	x	x	x	x	x	x	x	x	x	x
Construction or carpentry of houses	x	x	x	x	x	x	x	x	x	x	x	x
Working for a petrol company	x	x	x	x	x	x	x	x	x	x	x	x
Providing transportation	x	x	x	x	x	x	x	x	x	x	x	x
Day labor and odd jobs	x	x	x	x	x	x	x	x	x	x	x	x
<b>PART-TIME</b>												
Housework without small children	x	x	x	x	x	x	x	x	x	x	x	x
Employed by the government	x	x	x	x	x	x	x	x	x	x	x	x
River fishing and fixing/making nets	x	x	x	x	x	x	x	x	x	x	x	x
Tourist-related activities: buriti handicraft production		x	x			x	x	x	x	x	x	x
Fruit production: agriculture and NTFPs								x	x	x		
Hired to care-take a house	x	x	x	x	x	x	x	x	x	x	x	x
School related: students in school, workers in schools, and transportation for students			x	x	x	x		x	x	x	x	x
Gardening	x	x	x	x	x	x	x	x	x	x	x	x
<b>SPORADIC</b>												
Selling items from door to door	x	x	x	x	x	x	x	x	x	x	x	x
Selling leaves from buriti trees	x				x	x	x					x
Sewing	x	x	x	x	x	x	x	x	x	x	x	x
Collecting NTFP and shellfish	x	x	x	x	x	x	x	x	x	x	x	x

<sup>1</sup> "x" denotes the months of activity. <sup>2</sup> Full time: full days of work during months of activity; Some days: full days of work, but for short periods only during months of activity; Part-time: part of the day devoted to work throughout months of activity; Sporadic: work only some days, only when work is available.

Table 2-4. Combinations of activities based on required time investments

	Full time	Some days	Part-time	Sporadic
Full time	No	No	No	Yes
Some days	-	Same month but not same day	Same month but not same day	Same month but not same day
Part-time	-	-	Yes	Yes
Sporadic	-	-	-	Yes

No - activities not likely to combine; Yes - activities combine well.

Table 2-5. Means of socio-economic variables according to participation in buriti market

Socio-economic variables	Different means* (X)	Participation n=83	No participation n=51
<b>INDIVIDUAL DEMOGRAPHICS</b>			
Region	-	0.28	0.33
Age	-	41.25 (12.69)	42.29 (20.02)
Gender	X	0.81	0.64
Education	-	4.32 (3.02)	5.16 (3.98)
Total activities	X	2.46 (0.74)	1.85 (1.03)
<b>INDIVIDUAL HISTORY</b>			
Years in community	-	30.78 (15.14)	30.28 (17.41)
Individual >10 yrs buriti	X	0.85	0.70
Parent born community	-	0.50	0.54
Parent >10 yrs buriti	-	0.81	0.74
Buriti learned from parent	X	0.46	0.24
Planted buriti tree	-	0.53	0.53
<b>INDIVIDUAL PERCEPTION</b>			
Good health	-	0.71	0.77
Buriti trees threatened	-	0.67	0.54
Young leaf harmful	X	0.14	0.59
Affinity to buriti	X	0.85	0.47
Handicrafts lucrative	-	0.80	0.67
<b>HOUSEHOLD DEMOGRAPHICS</b>			
Home garden	-	0.68	0.70
Agricultural field	-	0.52	0.42
Household labor	-	0.44 (0.21)	0.37 (0.21)
Household size	-	4.89 (1.85)	4.82 (1.49)
Buriti household use	-	0.74	0.74
Consistent income	-	0.54	0.65
Wealth index	-	2.92 (1.79)	2.94 (1.89)
Access to credit	-	0.42	0.39
Outside assistance	-	0.16	0.27
Total income sources	X	3.29 (0.96)	2.50 (1.27)
<b>INDIVIDUAL ACTIVITIES</b>			
Bolsa Familia	X	0.70	0.56
Retirement	X	0.22	0.58
Studying	X	0.04	0.14
Housework	-	0.61	0.58
Fishing activities	-	0.16	0.18
Private business activity	X	0.22	0.06
Brick-making	-	0.11	0.06
Agricultural activity	-	0.18	0.27
Employed by gov't	-	0.07	0.11
Collecting palm leaves	X	0.07	0.00
<b>HOUSEHOLD INCOME</b>			
Bolsa Familia income	-	0.68	0.52
Retirement income	X	0.24	0.56
Handicraft income	X	0.84	0.08
Employed private co.	X	0.67	0.18
Fishing income	-	0.35	0.33
Brick-making income	-	0.16	0.14
Employed by gov't	X	0.10	0.21
Selling goods	-	0.11	0.11
Selling agricultural	-	0.19	0.12
Transportation	-	0.18	0.09
Selling palm leaves	-	0.08	0.03

\*According to T-Test and Wilcoxon rank sum test ( $p < 0.05$ ); dash denotes no significant difference

Table 2-6. Logistic regression results of participation in the buriti leaf market

Models	Coefficient (MLE)	Odds ratio	p-value, *p<0.05
Observations= 102			
Model evaluation: Likelihood ratio= 38.71 (p<0.0001)			
Percent concordant=82.8			
Gender – GENDER	0.555	1.75	0.490
Total activities – ATOTAL	1.252	3.50	0.002*
Individual >10 yrs buriti – LIVBUR	1.546	4.69	0.013*
Buriti learned from parent - LEAPAR	0.580	1.79	0.286
Affinity to buriti – LIKBUR	1.000	2.72	0.024*
Total income sources - ITOTAL	0.321	1.38	0.119
<i>Bolsa Familia</i> - BOLSAF	0.522	1.67	0.385

## CHAPTER 3 EFFECT OF BURITI RESOURCE ACCESS ON MARKET PARTICIPATION

### Chapter Summary

Access to NTFPs (non-timber forest products) can affect participation in forest markets and sustainability of resources. Distance to resources and systems of land tenure have been shown to affect peoples' access to resources. This study evaluated the impact of access to buriti (*Mauritia flexuosa*) palm leaf resources on market participation and resource use in Maranhão, Brazil. Interviews were conducted with individuals who had direct access to resources (n=65) and individuals with only indirect access to resource (n=41) to collect data on socio-economic patterns, livelihood strategies, oral histories, and perceptions regarding buriti use. To build context on regional history and resource governance, interviews were conducted with seven community experts of history and four governmental and non-governmental officials. Qualitative analysis was used to evaluate interview responses and socio-economic differences between groups. Regardless of having direct or indirect access to resources, people participated in the buriti market because it provided a good income source that fit well into their livelihood system. Contrary to expectations, poverty, tradition with buriti, and affinity to handicraft production did not ensure market engagement. Some people with direct access to resources did not participate in the buriti market because of lack of interest and skills, and changes in the household cycle. Other people with indirect access to resources were prevented from participating in the market because of lack of access to resources and other time commitments. Property regimes and ecological attributes of trees affected resource access among people close to forests. Competition and lack of social networks impacted resource access among people far from forests.

## Background

Access to NTFP (non-timber forest products) can impact participation in forest markets and sustainability of resources. Distance to resources and property regimes are two measures of access. Proximity to plants producing the raw materials has been suggested as a factor that can lead to overharvesting of NTFP resources (Murali et al., 1996; Sampaio et al., 2008; Uma Shaanker et al., 2004). Villages located at varying distances from the urban local market can be faced with different challenges (Shanley et al., 2002). People from distant villages who wish to market NTFPs in the urban markets are often poor, with little education, scant market expertise, and risk averse. These distant villages are more reliant on forest products to generate subsistence 'income' as a contribution to their health and nutritional welfare. In contrast to remote forest communities, villages close to city markets often have well-developed physical and social infrastructures, which can make the marketing of extractive products considerably less difficult. They have problems, however, with forest degradation, which is associated with proximity to urban areas. Some studies show that this obstacle can be overcome by more intense management of resources located close to urban areas (Anderson and Ioris, 1992).

Systems of land tenure and governance, such as private property, common areas, and open access can promote or discourage sustainable use of resources (Gibson et al., 2000). No single property regime, however, works efficiently and sustainably for all resources, because local management systems and use of NTFPs vary widely depending on the type of forest product and its ecological, political, socio-economic and cultural contexts (Berkes et al., 1998; Ghimire et al., 2004; Kusters et al., 2006; Ruiz-Perez and Byron, 1999; Ticktin, 2004). Where there are market induced or other

pressures on NTFPs, some type of secure ownership that allows users to enforce exclusive rights and control over the forest is essential for sustainable management (Crook and Clapp, 1998; Mendelsohn and Balick, 1995). Existing local management and governance over resources must be considered before imposing external laws or strategies for resource management (McKean, 2000).

As economic value and demand for NTFPs rises, commercialization of products often expands outside of regions with histories of traditional use (Shackleton et al., 2009). Expansion can have negative impacts on NTFP resources, because of more intensive and damaging harvesting and uncontrolled competition for resources (Belcher et al., 2005; Marshall et al., 2006). Most NTFPs provide a subsistence source for households through consumption or trade. Depending on the degree of integration into a cash-based economy in which food and other necessities can be purchased, forest-based households can concentrate their efforts in activities that offer the best financial opportunities and highest rewards (Shackleton and Shackleton, 2004). Changing consumer demands, such as to include urban-based consumers (Williams et al., 2000), can also attract new NTFP market participants. Although new participants in a forest market who respond directly to market opportunities can be more productive than traditional participants, they can have negative impacts on forest resources. One reason for this is their lack of knowledge regarding extraction and management of natural resources (Jensen and Meilby, 2008; Schmidt and Tickin, 2012). In contrast, people who have more intimate knowledge of their resources are more likely to practice sustainable harvesting.

Without a favorable context or appropriate technical support, some people may not be prepared or willing to participate in markets (Shackleton et al., 2007). Producers must have business and marketing capacity and access to capital, and be well organized to have successful enterprises. Lack of knowledge and skill (Arnold and Townson, 1998) and unavailability of household labor (Ruiz-Perez and Byron, 1999) can also limit an individual's participation in the NTFP market economy. Rapidly changing forest markets are often risky and present low prospects for reasonable returns (Scherr et al., 2004). Market incentives for forest conservation can be unsuccessful if they are culturally incompatible with traditional institutions, the resource base is not easily managed sustainably, or there is conflict between different groups (Richards, 1997; Schmink, 2004).

Growing NTFP markets can widen divisions between socio-economically disparate groups (Kusters et al., 2006). Poor people often experience difficulty in taking advantage of NTFP market opportunities because of low education, lack of social, financial, and physical capital, and diversified household strategies (Shanley et al., 2005). In contrast, wealthier and more powerful community members often control opportunities and resources. Poor people are more likely to intensify ways of generating income in order to use their available capitals as efficiently as possible (Ellis, 1999), as well as divert their subsistence resources towards new market opportunities, which increases their risk level (Arnold and Townson, 1998; Falconer and Koppell, 1990). Most poor people engage in extractive activities as part of a diversification strategy (Neumann and Hirsch, 2000). NTFPs prevent poverty by helping people fill seasonal or other cash flow gaps, cope with expenses and risks, and respond to unusual

opportunities; they also provide subsistence, insurance and a safety net (Angelsen and Wunder, 2003; Shackleton and Shackleton, 2004; Wunder, 2001).

This study evaluates the impact of access to buriti (*Mauritia flexuosa*) leaves on market participation and resource use in Barreirinhas, Maranhão state, Brazil. The following research questions were asked: How does resource access effect market participation and perceptions of sustainability of buriti leaf harvests? How do people with different resource access compare in regards to buriti market participation, livelihood strategy, historical ties to buriti, wealth, and perceptions about the impacts of buriti use? Research questions were addressed by evaluating socio-economic patterns, livelihood strategies, oral histories, and perceptions of participators and non-participators of the buriti leaf market.

## **Methods**

### **Study site**

Barreirinhas of Maranhão, Brazil is well known as one of the few regions to produce high-value and complex buriti palm fiber handicrafts. Buriti fiber, which is extracted from young leaves of buriti palm trees, has been recorded one of the top ten most economically valuable forest products in Maranhão. Barreirinhas municipality has produced 95 to 139 mt of buriti fiber annually from 2004-2011, which makes it the most productive municipality in Maranhão (IBGE, 2012). Barreirinhas District covers an area of 3,112 km<sup>2</sup> and has 54,930 inhabitants (IBGE, 2010) who are mostly *caboclos*, or mixed descendants of indigenous, European, and African people. Buriti palm trees grew naturally in swamp forests as one of the dominant tree species in the region. Buriti fiber handicrafts provide the second most important source of income in Barreirinhas

(Prefeitura Barreirinhas, 2005), and when buriti production grew in popularity as a way to earn income.

From 2010-2011, fieldwork was conducted among 12 communities (Figure 3-1), which were all administered by the township of Barreirinhas. Laranjeiras area communities were located within 30 km (<30 minutes travel) of Barreirinhas. Atins area communities were located 28-45 km (>2 hours travel) from Barreirinhas. Based on exploratory research, community members throughout the region engaged in young leaf exploitation to make and sell buriti fiber handicrafts to a rapidly growing tourism market (Lobato, 2008) stemming from the nearby Lençóis Maranhenses National Park. Participants in Laranjeiras area communities had direct access to buriti fiber through local extractors and resource rights. Atins area communities lacked direct access to buriti resources and depended on intermediaries to transport fiber from Laranjeiras. Variation of resource access within the study area provided an opportunity to evaluate the effect of resource access on market participation and sustainable resource use.

### **Sampling Strategy**

Purposive and respondent-driven sampling strategies were used to select individuals for the study group. Purposive strategy consists of selecting individuals based on specific criteria developed during the study (Coyne, 1997). Respondent-driven sampling is appropriate for making estimations about hidden populations (Salganik and Heckathorn, 2004). A sample group of 106 individuals was selected based on a quasi-experimental research design; the sample group consisted of a target group and control group with key demographic characteristics similar to the target group. To select both groups, community members were asked to name individuals who participated and did not participate in the buriti market. The target group consisted of artisans and vendors

of buriti handicrafts with direct and indirect access to buriti resources. The control group was individuals that did not produce and sell buriti handicrafts and had direct and indirect access to buriti resources; they were selected based on demographics of the target group (women aged 16-65 years). By categorizing individuals according to resource access, the two sub-groups compared in the study were 65 individuals with direct access to resources (Laranjeiras area) and 41 individuals with indirect access to resources (Atins area). To understand regional history and natural resource laws, seven community experts were selected based on their reputation as long-time residents of the study region, knowledgeable of local history, and lucid storytellers, and four representatives from ICMBio, Ministry of Education, Ministry of Environment, and Rural Workers Union in Barreirinhas were selected.

### **Data Collection and Analysis**

To begin data collection, a Brazilian research visa was obtained and IRB process was completed through University of Florida (protocol #2010-U-003). A semi-structured livelihood interview was used to collect data on personal history, demographics, resource use, livelihood activities, and income sources from the sample group (Table 3-1). Oral histories were collected from buriti market participants and seven community experts of history to understand the historical context of natural resource use and expansion of the buriti market in the region. Semi-structured, open-ended interviews were conducted with governmental and non-governmental representatives to understand natural resource use laws.

First, regional differences among Atins and Laranjeiras such as history, livelihood system, and land and resource rights, were analyzed from data collected through oral histories with the sample group and interviews with governmental and non-

governmental representatives. Qualitative analysis of interview responses consisted of grouping together and cross checking interview responses in order to identify patterns.

Second, Laranjeiras and Atins sub-sample groups were described to identify socio-economic characteristics that were specific to region. Among non-participants from Laranjeiras and Atins, interview responses regarding buriti resource access and the market were analyzed to understand barriers to market participation.

Finally, to analyze socio-economic differences and impact of resource access among interviewees, quantitative means of socio-economic factors were compared between a) participants in the buriti fiber handicraft market from Laranjeiras (n=47) and Atins (n=22), and b) non-participants in the buriti fiber handicraft market from Laranjeiras (n=18) with Atins (n=19) (Table 3-2). Quantitative means of socio-economic factors were compared to identify statistical differences between sub-sample groups using two-sample t-test and Wilcoxon rank sum test ( $p < 0.05$ ). Quantitative analysis was conducted using Microsoft Excel and SAS 4.3 software.

## **Results**

### **Regional History**

According to oral histories, the city of Barreirinhas was established over 200 years ago because of abundant fresh water, arable land, and easy access to the coast via the Preguica River. Inland Laranjeiras area provided agricultural staples, such as manioc and rice, and building construction material, such as clay and palm resources. Coastal Atins area provided marine resources, such as fish, shellfish, and mangrove wood for construction. Many inhabitants of Laranjeiras and Atins area were descendants of fishing migrants, who travelled along the coast and settled around the mouth of the Preguiça River. Some residents were descendants of migrants who moved from inland

to the coast, such as in Mandacaru where people migrated to the coast to commercially extract mangrove bark to make boat sails. Although some communities were founded by indigenous groups and African slave plantations owned by European patrons, few interviewees recognized these ethnic differences in the region.

As settlements have become more permanent over the last generation, families have become extended across Laranjeiras and Atins areas. Regional natural resources defined the cultural identity of people who lived there. Atins was the “land of the coconuts” and Laranjeiras was a region of buriti palms. The two regions were linked by dependence on common natural resources and a tradition of trade. Both Atins and Laranjeiras relied on manioc flour (*farinha*) and fish. Because neither region produced both staples in abundance, food and goods were exchanged between regions through market intermediaries and extended social networks. At the time of the study, some Laranjeiras households still traveled seasonally to the Atins coast to fish; they built and maintained temporary housing on beaches to base fishing operations. Atins households, of whom many fished year-round, relied on the Laranjeiras area for inland goods and access to urban resources and services in Barreirinhas. Atins and Laranjeiras were accessible by river and roads, although Atins was more isolated, with less access to goods and fresh water. There were no fully self-sufficient households in either site; all households relied on urban markets for some essential goods.

Over the past fifty years, the population in the region grew tremendously. Barreirinhas, for example, has grown from thirty households to a large urban center with over 3063 households (records from City Department of Health, 2010). In the past, people worked almost entirely with subsistence-based activities, such as fishing and

agriculture, and earned little income. Interviewees reported that more recently, much fewer natural resources were available, such as fish and forest resources, and there was more land development and pollution. Coastal residents also noted changes in sea level, which has begun to invade new areas, such as in Cabure community. Due to a rising population and increasing development, concerns regarding dwindling resources and increasing popularity of the Lençóis Maranhenses National Park (founded in 1981), there has been more recent stringent enforcement of existing laws regarding land development and resource use. Today, people have become less willing to engage in subsistence activities. Instead, they focused on income-earning activities, such as working for petroleum companies and the government.

### **Buriti use**

Buriti leaves have always helped people in the region meet their subsistence. For example, mature leaves were used for house construction. Making handicrafts from the fiber of young leaves was recognized as a traditional skill, as one interviewee noted, “When god made the world, he created knowledge for stripping fiber.” Artisans reported learning to make traditional buriti fiber handicrafts, such as hammocks, for household use from older generations. Newer handicrafts for external markets required different skills. Some female artisans from Laranjeiras and Atins reported being invited to enter the handicraft market around fifty years ago, when male vendors offered training opportunities and market access outside of Barreirinhas, such as in the state capital of São Luis. Other women learned new skills through artisan cooperatives, although external vendors may have also stimulated these cooperatives. In those early years, the new handicrafts provided important household cash income. As one interviewee

remarked, “We worked in agricultural fields during the day. At night, we gathered around candlelight to make handicrafts (for sale).” Some women also reported entering the market because handicraft production looked interesting. Having the desire to learn and affinity to work with buriti were, and continued to be, important qualities of working with handicrafts.

With the growing population in the region, intensified subsistence and market use of mature and young buriti leaves led to overharvesting. According to interviewees, enforcement of laws to control access to natural resources, as well as increased access to industrial substitutes for roof thatch, have helped to revive buriti forests over the last fifteen years. In 1975, a Barreirinhas municipal law (no. 161) was enacted to restrict buriti collection to nearby residents. Community members were prohibited from selling raw buriti leaf derivative outside of the municipality, although sale was allowed if the derivative was in a processed form, such as rendered buriti fiber. According to the Brazilian Forest Code (4.771/1965), land within 50 m from river edges was protected from development. Because buriti trees often grew on riverbanks, they were also protected under these laws (N. Lisboa, Ministry of Environment, July 8, 2011). At the time of the study, local residents could collect buriti leaves for subsistence purposes, as long as trees were not permanently damaged, such as by felling trees or collecting the apical meristem, or palm heart (E. Macedo, ICMBio, Oct 13, 2010). A representative from the Ministry of Environment (N. Lisboa, July 8, 2011) estimated that 80% of the Barreirinhas population relied on buriti for at least part of their livelihood needs.

Both study regions had similar access to the tourism market, although Laranjeiras was more integrated into the market economy due to its proximity to Barreirinhas.

Barreirinhas was the main handicraft market for the region, but Mandacaru provided a secondary market because of high tourism in the community. At the time of the study (2010), the older handicraft cooperatives that helped early artisans join the handicraft market no longer existed. New cooperatives supported by SEBRAE (Brazilian micro and small businesses support service), however, dominated the market for high-quality handicrafts. SEBRAE was a government-supported organization that sought to improve income-earning opportunities for buriti fiber artisans in Barreirinhas (SEBRAE, 2007). They provided artisans with infrastructural support, skills training, equipment and access to new markets. Recognizing the benefits of handicraft cooperatives, some artisans tried to unsuccessfully to start community-based cooperatives. These cooperatives failed because members lacked marketing skills, distrusted each other, and lacked confidence that they could compete with other handicraft sources. The only successful cooperatives identified in the study that had managed without the support of SEBRAE were in Mandacaru (Atins area), where artisans were new participants with less than five years in the market. Lacking a tradition working with buriti, their entry into the market would have been very difficult without the social structure of the cooperatives. In addition, cooperatives helped Mandacaru artisans to overcome intra-community competition for buriti fiber and sale to tourists who demanded a diverse range of handicrafts.

For Atins area residents, buriti resources have always been distant, but in earlier times they still could be accessed directly. At the time of study, Atins' interviewees could no longer extract resources because buriti forests had become privately owned and enclosed with fences. Barreirinhas municipal laws, as described previously, also legally

prohibited Atins community members from extracting buriti derivatives, and law enforcement had recently become more stringent. Still dependent on buriti resources, however, Atins residents accessed buriti leaf fiber through intermediaries who transported goods from the Laranjeiras region. These intermediaries purchased buriti fiber from Laranjeiras artisans. Laws stipulated that fiber must be processed (boiled and dried) before being transported, but it also served a practical purpose because young leaves and raw fiber spoiled quickly. Surprisingly, Atins artisans paid similar prices for buriti fiber as Laranjeiras artisans (R\$20-25/kg), because they usually purchased fiber through family and acquaintances in the Laranjeiras area, showing the importance of social networks in providing indirect access. Of the Atins study area, the Mandacaru community was an exception. Their residents cited higher prices for purchasing fiber (R\$25-30) because they had high intra-competition for fiber and fewer social ties with people living in regions with buriti. More stringently enforced laws and protection by private landowners had restricted peoples' access to buriti resources, but Atins participators believed that buriti trees were better conserved today.

Laranjeiras area residents had legal rights to access nearby buriti resources, but access varied among community members due to different types of land tenure. Buriti grew on private land, government-owned land, or communally managed land, of which only members of specific communities had rights to use resources (C. Farias, Rural Workers Union, July 8, 2011). In the Laranjeiras area, only Baixão and Cantinho communities relied on buriti resources from community-managed forests. People lacking ownership of buriti trees purchased or asked for rights to collect from tree owners, or collected without permission. Although there were no immediate open

access buriti forests in the study region, large forest areas with absent owners were often treated as open-access. Increasing land development also restricted access to buriti trees, such as in Cantinho where most riverside land had been sold to outsiders. Interviewees in Cantinho reported that production of handicrafts in the community had reduced over the years, in part because of lack of access to buriti trees. At the same time, they reported that trees in Cantinho had become healthier because of restricted access. As additional restrictions, buriti swamp forests and trees were also often physically difficult and dangerous to access. Mud flats could be inaccessible depending on tides and seasons. When the trees became very tall, only the most experienced and skilled extractors could reach the young leaves. Some people reported planting buriti trees so they could have access to shorter trees.

At the household level, extraction restrictions varied depending on the type of buriti derivative collected. From a local perspective, fruit and mature leaves were necessary for meeting subsistence needs and could be sustainably harvested, so land managers were more willing to negotiate access rights for collecting these resources. In contrast, young leaf collection was used for meeting income needs through a new external market and had more potential for overharvesting, due to the biological vulnerability of young leaves. Because most landowners refused to sell rights to collect young leaves, extractors collected most young leaves from forests with absentee owners, from government owned land, and sometimes without permission from privately owned land. Many private owners reported that young leaf theft was a problem that threatened the sustainability of their small, young, and more accessible buriti trees.

Laranjeiras artisans usually obtained young leaves from relatives (68% of

Laranjeiras interviewees) who collected on family-owned land or riverside forests with unrecognized ownership. Infrequently, young leaves were unavailable, so processed fiber was purchased for R\$25-30/kg. Recognizing that young leaves and fiber were once easier to find and buy, interviewees reported that lack of resources was due to population growth, higher market demand, increasing number of people joining the market, reluctance of people to cultivate trees, and overharvesting. Sustainable harvest rules were widely known, but often ignored. Community members reported that it was important to collect from trees over 3 meters tall, to allow time for the tree to recuperate after harvesting, and to collect young leaves without injuring the apical meristem. According to participants, newcomers to the market lacked knowledge about sustainable harvesting practices, so they were more likely to injure trees and overharvest. Although interviewees expressed interest in exploring sustainable harvesting strategies and had community meetings to discuss these issues, they often found it difficult to attract more men, who were the extractors, to their discussions.

Contrasts between local perspectives on resource rights and the viewpoints of government officials affected harvesting strategies and created conflicts between stakeholders. Interviewees believed that young leaves had become scarce due to high demand and competition for resources, but they also believed that it was unlikely that they would run out of buriti in the future. Interviewees believed that private ownership and planting trees was the solution to overcome lack of resources because then they could manage their own resources without government interference. In contrast to existing government laws that were discussed previously, community members believed that adjacent property owners owned resources on riverbanks and that removing young

leaves in any form was prohibited by law. It was unclear who enforced these restrictions (E. Machado, ICMBio, Oct 13, 2010), although it was suspected that it was representatives of community-managed buriti resources who sought to protect their resources (N. Lisboa, Ministry of Environment, July 8, 2011). Miscommunication between law makers/enforcers and community members could be an obstacle to sustainable management of buriti resources.

Within a generation, peoples' movement between Atins and Laranjeiras regions had become more restricted, so that people had become permanent residents in one of the regions. Although there were few apparent historical differences in terms of buriti use between both regions, increased law enforcement had restricted access to buriti resources, so that Atins community members could no longer directly collect their own resources. At the time of the study, Atins participators relied on intermediaries, and most importantly, their social network to ensure lower prices and dependable access to buriti fiber. Increasing demand for buriti young leaf and stricter enforcement of resource access could lead to use conflicts within the region. To understand the impact of resource access on participation in the buriti handicraft market, the next section compared participants and non-participants of the market with direct and indirect access to buriti resources.

### **Participation in Buriti Fiber Handicraft Market**

To examine if access for leaf collection presented a barrier for participating in the buriti market, socio-economic characteristics of people from Laranjeiras, which had direct access to buriti trees, and Atins, which only had indirect access to buriti trees, were evaluated. The first section describes the socio-economic characteristics that distinguish sub-sample groups from Laranjeiras and Atins sites. In the second section,

socio-economic factors are statistically compared between participants and non-participants of the buriti fiber handicraft market from Laranjeiras and Atins (Table 3-3).

**Laranjeiras sample group.** Laranjeiras interviewees included non-participants (n=18) and participants (n=47). Almost all Laranjeiras interviewees were women (91%). Due to a sampling bias, non-participants were about ten years younger and better educated than participants. Interviewees of both groups demonstrated similar dependence on subsistence-based agriculture and homegardens, and household use of buriti. Non-participants were more likely than participants to have personal and parental ties to their community of residence. Both groups had similar personal and parental exposure to buriti, including learning a buriti leaf craft from their parents. A surprisingly high number of non-participants (about 75%) reported that they would like to work with buriti, that working with buriti was worth the invested time and energy, and that it was easy to learn to make buriti products. These results suggested that having a strong history related to the community and buriti resources, buriti skills, affinity to buriti, and belief that engaging in the market was worthwhile did not ensure Laranjeiras peoples' engagement in the market.

The non-participants sampled had younger households (less household labor and more household members) than participants, when women often lacked time and energy to participate in income-earning activities. In comparison to participants, non-participants were less financially stable because of lower wealth index (measured by the presence of material goods, including tile roof, bathroom inside the house, well-made floor and walls, water plumbing, and vehicle ownership and less access to credit), which suggested that participation in the buriti market was not necessarily stimulated by

financial need. An analysis of household income sources and activities showed that non-participants had few other livelihood activities, including those that brought in cash income. Participants dominated the more lucrative and dependable income sources such as *Bolsa Familia*, working for private companies, and owning shops. In comparison to participants, non-participants were more engaged with housework.

**Atins sample group.** Atins interviewees, which included non-participants (n=19) and participants (n=22), were all women who had similar education, age, engagement in subsistence level activities (homegarden and agriculture), and household composition. Participants had more people in the household and higher labor index than non-participants. Non-participants had more household income sources than participants. Non-participants received lucrative and dependable household income from such sources as retirement pensions and selling goods. In contrast, handicraft production and sale through owning shop were the main income sources for participants, which demonstrated the importance of buriti handicraft production as part of a livelihood strategy. At an individual level, however, non-participants had little engagement in income-earning activities; almost all participated in housework. Non-participants were generally wealthier than participants, as measured by having assistance from outside of the household, a high wealth index, and access to credit. These results suggested that non-participants were financially stable, due to another member in their household earning the main household income.

Both participants and non-participants of Atins had similar personal and parental histories related to their current community of residence, as well as similar rates of buriti household use. Although participants had greater personal and parental exposure to

buriti resources and more learned buriti skills from their parents, at least a quarter of non-participants demonstrated these same characteristics. Both groups were also equally likely to report that working with buriti was worth the invested time and energy, it was easy to learn, and they liked or believed they would like working with buriti, so personal preference did not prevent people from participating in the buriti market.

Overall, Laranjeiras interviewees who did not participate in the buriti market failed to do so because they lacked time and because their place in the household cycle was not conducive to market participation. In contrast, strong history, exposure to buriti resources, and financial needs increased the likelihood for Atins interviewees to engage in the buriti market.

**Resource access comparison of participants.** Socio-economic characteristics of participants in the buriti market from Laranjeiras (n=47) and Atins (n=22) were compared to assess how access to buriti trees shaped market participation. Laranjeiras participants were 77% artisans, 19% vendors, and 4% vendor/artisan. Atins participants were 64% artisans and 36% vendors. A few interviewees reported owning (n=6) and extracting (n=4) buriti resources.

Laranjeiras and Atins participants were socio-economically similar. Out of the 45 socio-economic factors evaluated in the analysis, only 9 were statistically different. These significantly different factors are specified in the following discussion. Participants were similar ages (38-43 years old) and had similar levels of education and number of livelihood activities. Most household demographics, such as household size, labor, and number of income sources were similar for participants of both regions. In comparison to Atins households, Laranjeiras households were more engaged with homegardens

and agriculture, which contributed towards meeting subsistence goals, although only engagement in homegardens was significantly different between the two regions. Interviewees from Laranjeiras had a statistically significant higher wealth index than Atins interviewees, although all other wealth measurements including consistent sources of income, help from outside sources, and access to credit were similar between both regions.

Participants from both sites had similar profiles of livelihood activities and sources of income. The only household income sources that demonstrated significant differences between regions were employment by a private company, which was greater in Laranjeiras because of their close proximity to Barreirinhas, and income earned through fishing, which was more common among Atins interviewees because of their close proximity to the ocean. Collection of buriti leaves and brick-making were more common in Laranjeiras, whereas fishing activities were common to Atins, because of ecological characteristics of the natural resources. Participants in both sites were more likely to receive *Bolsa Familia* than retirement pensions because interviewees were of an age group with young dependents in the household.

There were almost no statistically significant differences between the factors used to measure participants' "individual history" from Laranjeiras and Atins. The only exception was that Laranjeiras participants had significantly higher personal exposure to buriti resources. Almost all Laranjeiras participants were originally from the Laranjeiras region and had learned their buriti craft there. They also had higher rates of personal exposure to buriti than parental ties to buriti. In contrast to Laranjeiras participants, Atins participants had weaker historical ties to their current community of residence. About

50% of Atins participants were originally from the Laranjeiras area, which explained why over half of Atins participants reported having personal exposure to buriti and parental ties to buriti trees. About 55% of Atins participants had learned buriti skills as children living in Laranjeiras or from their mother who came from Laranjeiras and taught buriti skills to their children upon migrating to Atins. Nevertheless, Atins participants reported greater parental ties than personal exposure to buriti, and they were also more likely than Laranjeiras participants to learn their buriti trade from their parents. In contrast, many Laranjeiras participants reported learning new handicraft skills from people around them. History with buriti was a major factor that influenced peoples' participation in the buriti fiber market. People who lacked direct access to buriti were more reliant on their parental ties to buriti to gain the skills that they needed to participate in the market. In contrast, people with direct access to buriti could rely on their own personal and current experiences with buriti.

Almost half of participants from both regions had planted buriti in the past, which demonstrated a shared interest in buriti resources. Participants also had similar frequencies of earning a main household income source from buriti. In comparison to Laranjeiras, Atins participants were more likely to report that engaging in the buriti market was worth the invested time and energy. More isolated than Laranjeiras participants, Atins participants were more dependent on income from handicraft production. An equal number of participants in both regions reported liking to work with buriti and that it was easy to learn. Although household use of buriti was statistically significantly greater in Laranjeiras, about 40% of Atins participants also built with buriti leaves. In comparison to Atins, participants in Laranjeiras had a statistically significant

higher number of household members who engaged in buriti activities, which demonstrated high household integration in the buriti market and greater involvement in the full production chain, including extraction, production, and sale. Both sites reported difficulty in obtaining buriti fiber and leaves.

In summary, participants of both sites had a shared interest and dependence on buriti derivatives, although Atins demonstrated more reliance on handicrafts as an income source. Participant households of both sites were in an early stage of the household cycle that had growing dependents. History with buriti influenced peoples' participation in the buriti fiber market. Laranjeiras participants relied on their personal and on-going experiences with buriti to engaged in the market, but Atins participants relied on their parents to teach them the craft. Laranjeiras participants were involved in all parts of the buriti market chain, while Atins participants were limited to the market end of the value chain because of their lack of access to buriti resources. Both sites reported difficulty in obtaining buriti fiber and resources, which suggested that participants from both regions were affected by different types of resource controls.

**Resource access comparison of non-participants.** Non-participant groups from Laranjeiras (n=18) and Atins (n=19) were compared to determine if resource access prevented Atins' interviewees from engaging in the buriti market. According to statistically comparison, most of the socio-economic factors were similar between Laranjeiras and Atins non-participants. Out 46 socio-economic factors included in the analysis, only 13 were statistically different between the regions.

Due to a sampling bias, Laranjeiras non-participants were statistically significantly younger (average 29 years old) than Atins non-participants (average 41

years old). Because younger age was correlated to higher education (lack of access to educational institutes in the past), Laranjeiras non-participants were also statistically significantly more educated than Atins non-participants. Most factors used to measure “household wealth,” including wealth index, consistent source of income, and access to credit, were similar between both groups. An exception was having assistance from outside of the household, which was statistically significantly higher among non-participants in Atins than in Laranjeiras. The only factor used to measure “household demographics” that was statistically different between regions was buriti household use, which was higher in Laranjeiras.

There was no statistically significant difference between Laranjeiras’ and Atins’ engagement in livelihood activities and number of household income sources, although Atins non-participants had a higher number of household income sources. Both groups had similar profiles of engagement in different livelihood activities. Non-participants from both regions, as women, engaged overwhelmingly in housework (95%). There were statistically significant differences between Laranjeiras’ and Atins’ interviewees in obtaining household income from brick-making and shellfish, which were both region-specific. Laranjeiras households obtained statistically higher household income from government employment, which was a consistent and often lucrative source of income.

About 30% of non-participants from both regions had learned a buriti craft from their parents, so they had skills to engage in the buriti market but did not. Participants and non-participants also demonstrated similar affinity to buriti products; about 75% of non-participants believed that engaging in the buriti market was worth the invested time and energy and that they liked working with buriti. Laranjeiras non-participants were

more likely than Atins non-participants to report lack of interest to work with buriti handicrafts. Non-participants from Atins (100%) were more likely than Laranjeiras non-participants to believe it was easy to learn to work with buriti. As previously pointed out, these differences were most likely because of Laranjeiras' additional engagement in the resource end of the handicraft production chain, which was complex, labor intensive, and required more skill.

In comparison to Laranjeiras non-participants, Atins non-participants showed statistically higher interest to join the buriti market and higher beliefs that handicraft production was a lucrative activity. Atins non-participants believed that participating in the buriti market could bring greater personal independence. Non-participants from both regions, who were interested in joining the buriti market, cited that they lacked skills and time availability due to commitments with other income sources and raising children. Only 20% of Atins non-participants and 5% of Laranjeiras non-participants listed lack of young leaves and fiber as a reason to not participate in the market. Contrary to expectations, wealth did not affect peoples' interest to join the market. Laranjeiras non-participants who chose not to engage in the market were poorer (averaged 1.33 wealth index) than people who were interested in engaging in the market but lacked time and skill (averaged 3 wealth index).

About 33% of Laranjeiras and 72% of Atins non-participants had engaged in the buriti market in the past. Although some Atins non-participants had made handicrafts while living in Laranjeiras, most had worked with handicrafts while in Atins. There were no significant differences among the factors used to measure "individual buriti participation" between regions. Surprisingly, however, Atins non-participants reported

higher frequencies than Laranjeiras non-participants of having made buriti products in the past and knowing how to process buriti fiber, which hinted at their strong background with buriti. Non-participants from both regions reported that they stopped working with buriti because of lack of free time. In addition, Atins non-participants cited that access to buriti fiber and bad health were their main reasons for stopping their work with buriti. Laranjeiras non-participants had left the market because they believed buriti production was not worth their invested time and energy and that they had lacked sufficient skills to transition into making new products in a changing market. Both groups equally had experience with sales (about 70%), which could help them to participate in the buriti market as a vendor. About 75% of Laranjeiras and Atins non-participants had no interest in participating as vendors, although lack of money to invest was the main reason for not participating. Laranjeiras non-participants also listed lack of time and opportunity as a reason.

In summary, non-participants from both regions were limited from participating in the buriti market because of conflicting time commitments and household responsibilities. Laranjeiras non-participants had less interest to join the buriti market than Atins non-participants. Laranjeiras non-participants perceived the buriti handicraft process to be difficult and time-consuming, because Laranjeiras artisans were usually involved in the full buriti production chain. Although some Atins interviewees were prevented from participating in the market because of lack of access to buriti resources, resource access was not the main factor that affected their participation.

### **Discussion**

People within the study area once shared common access to the same natural resources by moving throughout the region to take advantage of different resources

available inland and on the coast. With population growth and increased pressure on natural resources, movement became restricted and most people became permanent residents in one region or another. At the time of the study in 2011, only immediate residents had rights to direct access of forest resources through enforced laws and property regimes. Despite having direct access to buriti trees, however, Laranjeiras users did not have the advantage of resource access over Atins users that was expected. In Laranjeiras, property regimes prevented trees from being legally available to all Laranjeiras interviewees. Among Atins users, legal restrictions had less impact because young leaves were traditionally transported to their region as processed fiber and continue to be legally traded in this way. Both sites reported difficulty in obtaining buriti fiber and resources, although different types of resource controls affected interviewees from both regions.

Atins were more reliant on handicrafts as an income source, because they had fewer options for income. Located closer to Barreirinhas, Laranjeiras interviewees were wealthier, had access to more subsistence sources, and had more options for income, so they could decline to work with buriti even if they had the skills and opportunities. Although it was expected that poor people were most likely to engage in NTFP commercialization, wealth was negligible for predicting participation in the buriti market, as some other studies have shown (Cocks et al., 2008; Paumgarten and Shackleton, 2009; Shackleton and Shackleton, 2006). Poverty did not ensure that people who had all of the necessary skills and access to resources participated in the buriti market. In addition, history with buriti, affinity to buriti, and beliefs that entry into the market was feasible and worthwhile did not ensure that Laranjeiras interviewees engaged in the

market. Regardless of the region, the buriti market helped interviewees meet their income needs through a diversified livelihood strategy, which helps households to be more resilient, reactive, and opportunistic (Marschke and Berkes, 2006). Participants used buriti handicrafts as a major income source in their livelihood strategy, while non-participants were more diversified in their household income sources.

Some recommendations can be made from the results of this study. The buriti case study demonstrated that legally limiting the use of NTFP resource to immediate residents did not prevent the resource from being used by outsiders. Although Atins participants were legally prevented from directly collecting buriti derivatives, they gained access to these resources by relying on their social networks. As more Atins-based artisans have joined the market, however, competition has made access to buriti resources more difficult. Mandacaru community, for example, responded to buriti market opportunities even though they lacked historical and family ties to areas with buriti. Mandacaru participants, therefore, paid higher prices for buriti fiber, reported more difficulty than other participants in the Atins area to gain access to fiber, and depended on social cooperation to learn buriti skills and compete for buriti fiber. In addition, interviewees from both regions obtained their knowledge and skills of buriti from different sources. Most Laranjeiras interviewees relied on their own personal and current experiences with buriti to learn how to make buriti products. In contrast, Atins interviewees were more reliant on their parental ties to buriti to overcome barriers to gaining the skills and knowledge that they needed, without immediate access to the buriti forests. Social organization is a common strategy for making NTFP value chains more efficient and sustainable (Padoch and De Jong, 1992; Velde et al., 2006), which

ensures better returns to participants by providing more negotiating power (Ghimire et al., 2004). Social networks, which provided people outside of the forest area with the means to overcome barriers to obtaining NTFP resources, knowledge, and skills, should be recognized in resource sustainability strategies that depend on limiting the use of forest to nearby residents.

The buriti case study demonstrates that women located closer to the NTFP resource had greater involvement in the overall handicraft production system. Handicraft production by women in Laranjeiras involved extracting and preparing the fiber, which was the most difficult, strenuous, and time-consuming part of the handicraft process. In contrast, most interviewees in Atins only participated in the market end of the buriti value chain. As a result, women in Atins may have shown more interest in the buriti market than women in Laranjeiras because buriti production appeared to be an easy way to earn cash. Women are often disproportionately more reliant on local trade of NTFPs (Neumann and Hirsch, 2000) because local NTFP trade is one area where women are often free to earn income with little interference or threat of take over from men (Schreckenberget al., 2006). Their participation in NTFP markets can also lead to greater intrahousehold equity (Kusters et al., 2006). Women's roles in NTFP production, however, tend to be poorly visible and inadequately acknowledged (Shillington, 2002), often because their activities are carried out at home between family responsibilities (Marshall et al., 2006; Shackleton et al., 2011). To encourage NTFP commercialization as an effective conservation and development strategy, divisions of labor within NTFP value chains by men and women and different labor requirements that must be invested by women should be considered.

Lack of skills, time commitments and place in the household cycle were the main reasons that Laranjeiras interviewees, who had access to buriti forests, did not participate in the buriti market. Skills training is a main capacity-building strategy used by SEBRAE (Brazilian micro and small businesses support service) to help women gain access to the buriti market in Barreirinhas (SEBRAE, 2007). Most interviewees had young growing families, so they were limited by conflicting time commitments and household responsibilities. Unfortunately, younger families are more vulnerable than more established families because they have not yet have time to accumulate capital (Perz, 2001). Forests resources can provide them with a way to weather shocks and avoid risk (Ellis, 1998). Participation in buriti markets can be encouraged among women with young families by providing more local access to resources and markets, such as a market point or vendor located in their community. People who enter the buriti market may also leave the market as their socio-economic situation changes, such as household cycle, which can contribute to forest sustainability by reducing use pressures on forest products.

Finally, local people suggested that cultivating buriti trees and stronger ownership of trees was the key to access problems. They did not perceive that resources were becoming limited, however. Instead, they viewed government management as a barrier to their use. By owning their own resources, they believed that their access would improve because the government would have less rights to decide how they should manage their resources. This helps to illustrate the divide between local and governmental managers and users of buriti resources. Better partnerships between

local forest users and stakeholders from other sectors have been suggested as a way to improve governance of NTFP resources (Mayers and Vermeulen, 2002).

### **Final Comments**

In conclusion, resource access was listed more by Atins interviewees than Laranjeiras interviewees as a barrier to participation in the buriti market. Interviewees from both regions, however, felt the impacts of increasing restrictions on resource use. Although Atins interviewees were expected to represent an expanding market, the study showed that Atins interviewees were part of an extended traditional local market and subsistence use of buriti. Atins participants were able to rely on intermediaries to gain access to buriti resources. These intermediaries were part of a traditional system for transporting natural resources between both regions. In contrast, Laranjeiras participants' access to buriti resource had become restricted because few interviewees owned buriti resources. Instead, they depended on resources collected by extractors, who were rarely permitted by owners to collect young leaves from their property. As demands for resources continues to grow, it is expected that enforcement of property and resource use laws will intensify and restrict access to buriti even further. Although Atins users may continue to gain access to buriti resources through their traditional social networks, they will ultimately feel the effects of restrictions on buriti resources as Laranjeiras extractors have more difficulty gaining access to resources.

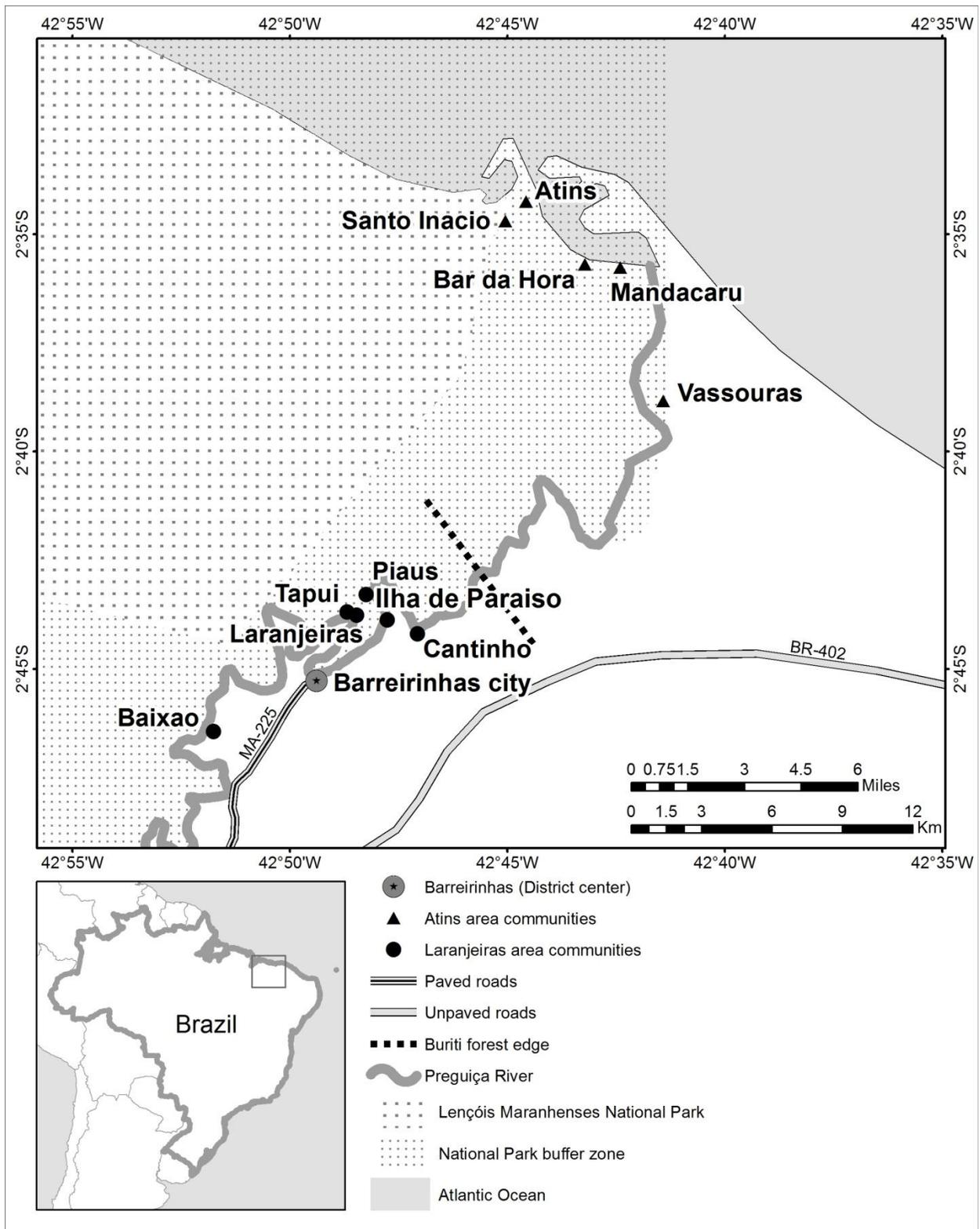


Figure 3-1. Map of the study site (created by Mariano González Roglich)

Table 3-1. Definitions of socio-economic variables

Variable name	Description	Range
<b>INDIVIDUAL DEMOGRAPHICS</b>		
Education	Education (years)	1-13
Age	Age (years)	13-66
Gender	Gender; male (0) or female (1)	0,1
<b>INDIVIDUAL HISTORY</b>		
Born community	Interviewee was born in current community	0,1
Individual >10 yrs buriti	Individual >10 years close to buriti	0,1
Parent born in community	At least one parent born in interviewee's community	0,1
Parent >10 yrs buriti	At least one parent lived >10 years close to buriti	0,1
Buriti learned parent	Learned current buriti trade from a parent	0,1
Planted buriti tree	Has planted a buriti tree	0,1
<b>HOUSEHOLD DEMOGRAPHICS</b>		
Main income buriti	Buriti provides a main source of household income	0,1
Buriti household use	Buriti leaf derivative used for household subsistence	0,1
Household size	Number of members in the households	1,10
Household labor	Number of household members earning income / number of household members	0-1
Home garden	Active home garden present	0,1
Agricultural field	Active agricultural field present	0,1
Household member buriti	Number of household members participating in buriti activities	0-5
<b>HOUSEHOLD WEALTH</b>		
Consistent income	Receives consistent income each month	0,1
Outside assistance	People outside of household contribute cash/goods	0,1
Wealth index	Index based on presence of tile roof, inside bathroom, well-made floor and walls, water plumbing, and vehicle ownership	0-6
Access to credit	Interviewee believes has access to borrow money	0,1
<b>INDIVIDUAL BURITI PARTICIPATION</b>		
Association	Has participated in association of artisans or vendors	0,1
Family member collects	Young leaves collected by family member	0,1
Experience selling	Has worked with selling things (not buriti products)	0,1
Made handicraft past	Has made buriti fiber handicraft in the past	0,1
Knows strip fiber	Knows how to strip fiber and has done it before	0,1
Independence	Feels that working with buriti offers more independence	0,1
No access buriti	Has had difficulty accessing buriti resources	0,1
<b>INDIVIDUAL PERCEPTION</b>		
Handicrafts lucrative	Invested time and energy worth income for making handicrafts	0,1
Affinity to buriti	Likes or would like working with buriti	0,1
Easy learn buriti	Believes it is easy to learn to work with buriti	0,1
Interest buriti	Has interest in participating in buriti market	0,1
<b>INDIVIDUAL ACTIVITIES</b>		
<i>Bolsa Familia</i>	Interviewee receives <i>Bolsa Familia</i>	0,1
Retirement	Interviewee receives retirement pensions	0,1
Housework activity	Housework is a main activity	0,1
Handicrafts activity	Handicrafts production is a main activity	0,1
Business owner activity	Business owner or cooperative member	0,1

Table 3-1. Continued

Variable name	Description	Range
Studying	Interviewee attends school	0,1
Number of activities	Number of livelihood activities reported	1-5
HOUSEHOLD INCOME		
Retirement income	Retirement for household income source	0,1
<i>Bolsa Familia</i> income	<i>Bolsa Familia</i> for household income	0,1
Brick-making	Bricks and ceramic making for household income	0,1
Handicrafts income	Handicrafts for household income	0,1
Employed private co. income	Private company employment for household income	0,1
Business owner income	Household income from owning private business or as a cooperative member	0,1
Selling goods	Selling goods without a shop for household income	0,1
Employed by government	Government employment for household income	0,1
Fishing income	Fishing activities for household income	0,1
Care takes house	Care takes a house for household income	0,1
Shellfish income	Sells shellfish and other NTFPs (aside from buriti)	0,1
Number of income	Average number of household incomes	0-7

Table 3-2. Sub-sample groups compared in the study

	Laranjeiras area – direct access to buriti trees	Atins area – indirect access to buriti trees	Total
Non-participants	18	19	37
Participants	47	22	69
Total individuals	65	41	106

Table 3-3. Means of socio-economic factors among market participants and non-participants in Laranjeiras and Atins study areas

	Participators (n=69)			Non-participants (n=37)		
	Different means*	Laranjeiras (n=47)	Atins (n=22)	Different means*	Laranjeiras (n=18)	Atins (n=19)
<b>INDIVIDUAL DEMOGRAPHICS</b>						
Education	-	4.80 (3.01)	4.55 (3.31)	X	7.78 (4.15)	4.68 (2.60)
Age	-	38.72 (11.5)	42.91 (11.4)	X	28.50 (10.67)	40.53 (13.52)
<b>INDIVIDUAL HISTORY</b>						
Born community	-	0.51	0.36	X	0.78	0.42
Individual >10 yrs buriti	X	0.96	0.55	X	0.83	0.32
Parent born in community	-	0.51	0.32	X	0.69	0.39
Parent >10 yrs buriti	-	0.84	0.63	X	0.88	0.47
Buriti learned parent	-	0.43	0.55	-	0.31	0.28
Planted buriti tree	-	0.43	0.45	-	0.50	0.53
<b>HOUSEHOLD DEMOGRAPHICS</b>						
Main income buriti	-	0.68	0.73	-	-	-
Buriti household use	X	0.89	0.41	X	0.83	0.58
Household size	-	4.66 (1.68)	5.05 (2.15)	-	5.17 (1.42)	4.79 (1.58)
Household labor	-	0.46 (0.22)	0.45 (0.21)	-	0.32 (0.15)	0.35 (0.20)
Home garden	X	0.76	0.50	-	0.72	0.42
Agricultural field	-	0.48	0.36	-	0.44	0.26
Household member buriti	X	1.70 (1.01)	0.82 (1.60)	-	-	-
<b>HOUSEHOLD WEALTH</b>						
Consistent income	-	0.64	0.41	-	0.72	0.47
Outside assistance	-	0.14	0.27	X	0.22	0.42
Wealth index	X	3.08 (1.75)	2.36 (1.59)	-	2.56 (1.89)	2.68 (1.86)
Access to credit	-	0.46	0.36	-	0.22	0.47
<b>INDIVIDUAL BURITI PARTICIPATION</b>						
Association	X	0.22	0.71	-	-	-
Family member collects	X	0.68	0.16	-	-	-
Experience selling	-	-	-	-	0.67	0.76
Made handicraft past	-	-	-	-	0.53	0.79
Knows strip fiber	-	-	-	-	0.14	0.44
Independence	-	-	-	-	0.73	0.81
No access buriti	-	0.73	0.72	-	-	-
<b>INDIVIDUAL PERCEPTION</b>						
Handicrafts lucrative	-	0.71	0.91	X	0.71	0.87
Affinity to buriti	-	0.93	0.90	-	0.76	0.76
Easy learn buriti	-	0.88	0.92	-	0.79	1.00
Interest buriti	-	-	-	X	0.33	0.56
<b>INDIVIDUAL ACTIVITIES</b>						
<i>Bolsa Familia</i>	-	0.68	0.47	-	0.44	0.56
Retirement	-	0.04	0.15	-	0.06	0.26
Housework activity	-	0.64	0.82	-	0.94	0.95

\* "X" denotes statistically significant different means according to T-Test and Wilcoxon rank sum test ( $p < 0.05$ ); dash signifies that the factor was not significantly different

Table 3-3. Continued

	Participators (n=69)			Non-participants (n=37)		
	Different means*	Laranjeiras (n=47)	Atins (n=22)	Different means*	Laranjeiras (n=18)	Atins (n=19)
Handicrafts activity	-	0.94	0.95	-	0.06	0
Business owner activity	-	0.23	0.27	-	0.00	0.16
Studying	-	0.04	0.05	-	0.17	0.05
Number of activities	-	2.43 (0.85)	2.55 (0.86)	-	1.56 (0.62)	2.05 (0.85)
<b>HOUSEHOLD INCOME</b>						
Retirement income	-	0.17	0.18	-	0.22	0.37
<i>Bolsa Familia</i> income	-	0.76	0.53	-	0.56	0.56
Brick-making	-	0.21	0.05	X	0.22	0.00
Handicraft income	-	0.91	0.91	-	0.11	0
Employed private co. income	X	0.21	0.05	-	0.06	0
Business owner income	-	0.25	0.36	-	0.11	0.21
Selling goods	-	0.11	0.14	-	0.06	0.32
Employed by government	-	0.13	0.09	X	0.50	0.05
Fishing income	X	0.23	0.55	-	0.22	0.53
Selling palm leaves	-	0.02	0	-	0.11	0.00
Shellfish income	-	0	0	X	0.00	0.21
Number of income	-	3.62 (1.29)	3.68 (1.25)	-	2.94 (1.63)	3.37 (1.46)

\* "X" denotes statistically significant different means according to T-Test and Wilcoxon rank sum test ( $p < 0.05$ ); dash signifies that the factor was not significantly different

## CHAPTER 4 LIVELIHOODS AND RESOURCE MANAGEMENT BY BURITI VALUE CHAIN ACTORS

### **Chapter Summary**

Participation in NTFP markets is a popular conservation and development strategy used among communities with subsistence-based livelihoods and access to natural resources. Interventions to encourage the growth of NTFP markets, however, often succeed at reaching only specific sub-sets of the population. To address impacts of changing NTFP markets on livelihoods and perceptions regarding sustainable forest management, value chain and livelihood systems analyses were used to evaluate the impact of a new buriti (*Mauritia flexuosa*) handicraft market on users in Maranhão, Brazil. Purposive and respondent-driven sampling strategies were used to select a sample group of 97 individuals. Data were collected through semi-structured interviews over 18 weeks from 2009-2011. Buriti value chain diagrams were constructed by identifying patterns among interview responses. Socio-economic characteristics of actors were identified using frequency tables, means comparisons, correlation analysis, and logistic regression analysis. Results showed that the new market has introduced actors who interact with pre-existing buriti users. Actors differ by livelihood strategy, socio-economic factors, and perceptions regarding sustainability of leaf collection. Historical exposure to buriti and household cycle both shape participation. Social heterogeneity in NTFP value chains should be considered by initiatives that seek to influence participation in NTFP markets, evaluate effects of commercialization on livelihoods, and effectively design and implement resource management strategies.

## Background

Growth and development of local non-timber forest product (NTFP) markets is a popular development strategy for poor communities with subsistence-based livelihoods and access to rich natural resources. Although participation and financial returns from forest markets can be improved when favorable contexts and appropriate support are available, such as accessible market information or improved harvesting and processing techniques (Shackleton et al., 2007), specific sub-sets of the population are often better prepared to take advantage of new market opportunities. Forest markets are not for everyone. To have successful enterprises, people must have good business and marketing capabilities, and access to capital and resources, and be well-organized (Scherr et al., 2004). For many rural communities and farmers, rapidly changing forest markets are too risky (Belcher and Schreckenberg, 2007), culturally incompatible with traditional institutions, ecologically unsustainable, or there is high level of conflict between different groups (Schmink, 2004).

Despite the risks and obstacles to participating in NTFP markets, most people in forest areas will use NTFPs to generate income. Increasing commercialization of NTFPs has led to concerns regarding benefit distribution, socio-economic divisions, and overharvesting. Due to social heterogeneity, market benefits can be unevenly distributed across forest users (Ruiz-Perez et al., 2004b; Wynberg et al., 2002), as well as widen divisions between socio-economically different people, such as poor and wealthy groups (Kusters et al., 2006). These social dynamics have been well described in other parts of Brazil among wild rubber harvesters of the Amazon (Schwartzman, 1992) and babassu collectors in Maranhão (May, 1986), where less privileged groups were excluded from benefits of growing lucrative global markets. Increased

commercialization of NTFPs can also lead to overharvesting (Godoy et al., 1993), as people intensify extraction activities to take advantage of market opportunities. Long-term NTFP markets depend on resource sustainability (Homma, 1992) in which use does not exceed the population capacity to replace individuals (Hall and Bawa, 1993). Better understanding of NTFP market dynamics and social actors who participate in markets (Neumann and Hirsch, 2000) can help to predict impacts of using NTFPs as a conservation and development tool.

Value chains offer a way to provide insights on NTFP markets and livelihood dynamics, distribution of benefits, and sustainable management of forest resources. Value chains are composed of different activities required to bring a product from conception, through phases of production, and to final delivery to consumers (Kaplinsky and Morris, 2001). The structure and functioning of value chains, and relationships between actors and their defined roles, can be highly dynamic according to time, locale, and different points along the marketing chain (Neumann and Hirsch, 2000). Actors' roles are affected by shifts in market structure, relationships between actors, actors' available livelihood assets, market proximity to end-consumers (Jensen, 2009), and changing populations, such as new consumer groups or rapidly urbanizing populations (Cunningham, 2001; Williams et al., 2000). Value chain dynamics impact how benefits are distributed in a market. For instance, the financial value of NTFPs that actually reach extractors is often much less than values cited by consumers or intermediaries (Angelsen and Wunder, 2003; Neumann and Hirsch, 2000). Relationships among actors in the value chain are not always economically exploitative. Value chains can help lead to more successful enterprises for all actors (Belcher and Schreckenberg, 2007).

Intermediaries, for example, often have important roles linking local production systems and potential buyers (Jensen, 2009; Keys, 2005).

As a complement to value chains, livelihood strategies provide a lens to assess how different actors respond to environmental changes. Livelihood strategies refer to long-range goals (Sutton and Anderson, 2004), in which resources are used as efficiently as possible and in different combination depending on constraints, goals, opportunities and composition of the household. Households retain freedom of choice, although their decisions are made within the confines of structural social constraints (Guyer and Peters, 1987; Schmink, 1984). Households may not always have control over their assets and environment and instead react opportunistically to make decisions based on their circumstances (Rakodi, 2002). Most NTFPs provide a subsistence source for households through consumption or trade. Degree of integration in the cash economy also affects how households use forest resources (Shackleton and Shackleton, 2004). In a cash-based economy in which food and necessities can be purchased, households often concentrate their efforts in activities that offer the best financial opportunities and rewards. Typologies of forest-based livelihood strategies have been defined based on availability of assets, risk management (Belcher et al., 2005; Jensen, 2006), and involvement in NTFP commercialization. A coping strategy is dependent on forest products for household subsistence; few products are sold in markets (Belcher and Kusters, 2004). People who use a diversified strategy utilize forest products as a supplement to other household activities (Arnold and Townson, 1998) and safety net (Shackleton and Shackleton, 2004). A specialized strategy depends on specific forest products as a major income contribution; the household is

highly integrated into the cash economy (Belcher and Kusters, 2004). Livelihood strategies change depending on household condition, available assets, and opportunities, so livelihood strategies should be conceived as one moment in an evolving long-term process.

Demonstrating a complexity common in human-forest relationships (Berkes et al., 1998), peoples' responses to NTFP markets are shaped by socio-economic characteristics of the population, such as wealth, education, gender, and history, and environmental context, such as governance, resource abundance, development level, livelihood system, and supply and demand dynamics (Kanji et al., 2005; Ruiz-Perez et al., 2004a). Harvesting strategies and intensity, which are a response to NTFP markets, vary according to ecological, political, socio-economic and cultural aspects of NTFPs (Ghimire et al., 2004; Kusters et al., 2006; Ticktin, 2004), such as the species, ecosystem, and adopted management practices (Ghimire et al., 2005; Runk et al., 2004; Ticktin and Johns, 2002). Overharvesting has been linked to specialization of NTFP products (Ruiz-Perez et al., 2004a), governance systems and policies (Gibson et al., 2000), population and cultural pressures, and access to resource (Sampaio et al., 2008; Uma Shaanker et al., 2004). As economic value and demand for NTFPs rise, commercialization of the product often expands outside of regions with a history of traditional use (Shackleton et al., 2009), which can lead to more intensive and damaging harvesting and uncontrolled competition for resources (Belcher et al., 2005; Marshall et al., 2006). New participants, who often lack knowledge regarding extraction and management of natural resources, can have more negative impacts on forest resources (Jensen and Meilby, 2008; Schmidt and Ticktin, 2012). In contrast, people

with extensive exposure to resources have more intimate knowledge of their resources, and therefore are more likely to practice sustainable harvesting. Perspectives from people with exposure and tradition using natural resources can be used to help create sustainable management plans (Ruiz-Perez et al., 2004a; Ticktin and Johns, 2002).

This study examines the relationship between NTFP commercialization and social heterogeneity of forest users by looking at a case study of buriti (*Mauritia flexuosa* L.f.) palm leaf users in Maranhão, a northeastern state of Brazil. Value chain and livelihood analysis are used to evaluate the impact of a growing market for young leaf fiber handicrafts on livelihood strategies and sustainable use of buriti by comparing between different actors of the buriti value chain. The following questions are asked: How does a new market for young buriti leaves affect livelihood strategies of buriti value chain actors and their perceptions regarding buriti sustainability?

## **Methods**

### **Analytical Framework**

Value chain and livelihood systems analyses were used to evaluate the structure of buriti markets and dynamics between markets and livelihoods. Value chain analysis is a methodological tool for identifying important actors and their activities, trade routes, and attributes of supply and demand (Kaplinsky and Morris, 2001; Marshall et al., 2006; Wilsey, 2008). Rather than focusing on competitiveness among actors in the NTFP chain, value chain analysis evaluates chains as a whole (Velde et al., 2006) by considering relationships between actors and transmission of benefits and costs along the chain (Kanji et al., 2005). As a complement, livelihood systems analysis is used to examine strategies and decision-making by people within a common livelihood system (Collinson, 2000). Reaching beyond monetary measurements, and assumptions that

people prioritize income, livelihood analysis considers the importance of alternative outcomes, such as food and income security, or sustainable use of natural resources (Kanji et al., 2005). Policies, institutions, and processes are also recognized for influencing opportunities and constraints that people face while pursuing strategies in different contexts.

### **Study Site**

Buriti fiber has been recorded as one of the top ten most economically valuable forest product in Maranhão (IBGE, 2012). Buriti fiber is extracted from young leaves of buriti trees, which are single stem, dioecious, and arborescent palms reaching up to 25 m tall. According to IBGE, only four districts of Maranhão harvest buriti fiber commercially, and Barreirinhas was the highest producer. Barreirinhas has produced 95 to 139 metric tons of fiber annually from 2004-2011. Value for fiber in the district has increased over the years; adjusted for inflation rates of 2011, one ton of fiber was worth R\$7,178 (US\$3460) in 2004 and R\$10,791 (US\$5200) in 2011 (IBGE, 2012). Although accurate values of NTFP production are notoriously difficult to obtain, these figures demonstrate federal recognition of an increasingly important NTFP in the region.

Fieldwork was conducted in Barreirinhas among 12 communities along the Preguiça River, ranging from the river mouth to 35 km inland (Figure 1). Barreirinhas district covered an area of 3,112 km<sup>2</sup> and had 54,930 inhabitants (IBGE, 2010), who were mostly *caboclos*, or mixed descendants of indigenous, European, and African people. Buriti palm trees grew naturally in swamp forests as a dominant tree species. According to exploratory field research conducted in 2008, local people exploited all parts of buriti trees, but fruit, mature leaves, and young leaves were most popular. In contrast to fruit and mature leaves, which were used to meet subsistence needs, the

young leaf market has changed considerably in the previous fifteen years. Traditionally used to make hammocks and cordage, young buriti leaf fiber has been increasingly exploited by community members to make handicrafts for a rapidly growing tourism market (Lobato, 2008) associated with the nearby Lençóis Maranhenses National Park. In 2005, buriti fiber handicrafts were considered the second most important source of income in Barreirinhas (Prefeitura Barreirinhas, 2005). In comparison to buriti fruit and mature leaf markets, increasing demands and production of fiber handicrafts have great potential to effect dynamics of buriti use.

### **Sampling Strategy**

The sample group consisted of 97 individuals who participated in different roles of the buriti value chain. A purposive sampling strategy was used to select individuals based on criteria developed during the study (Coyne, 1997). Respondent-driven sampling, which is appropriate for making estimations about hidden populations (Salganik and Heckathorn, 2004), was applied by asking community members to name individuals who participated in the buriti market in different ways. Individuals were private and communal owners of buriti resources (n=28), extractors of buriti derivatives (n=12), artisans (n=52), and vendors (n=19) of buriti handicrafts. Consumers and representatives of government-managed land were not included in the sample group, although their impact on the value chain was considered. It was beyond the scope of this study to include consumers because they were a very diverse group. Representatives of government-managed land, such as ICMBio, were interviewed. As outsiders to the region, however, their demographics and experience with buriti represented outliers in the data analysis. Instead, data from these interviews were used to build context for the study.

## Data Collection and Analysis

A Brazilian research visa was obtained and Institutional Review Board (IRB) process completed (protocol #2010-U-003) prior to beginning data collection. Data were collected during 18 weeks from June 2009 to November 2011. Unstructured interviews were used to collect ethnographic data from community members and stakeholders of buriti leaf resources, such as governmental representatives and tour guides. Semi-structured interviews conducted with the sample group generated data that were analyzed qualitatively and quantitatively, using Microsoft Excel and SAS 4.3 software.

As a first step of the analysis, buriti value chain diagrams were constructed, which included actors and production activities (Kaplinsky and Morris, 2001; Velde et al., 2006), based on results from qualitatively grouping, cross checking, and identifying patterns among interview responses. Value chains were used to identify actors and their importance in the chain, relationships between actors, differences between value chains of different types of buriti derivatives, and their potential impact on buriti forests.

The next step in the analysis consisted of identifying socio-economic factors (explanatory variables) that characterized value chain actors by comparing means between actors. Socio-economic variables were elicited from interview responses to represent individual and household demographics, wealth, personal history, perceptions regarding sustainable buriti harvesting, participation in livelihood activities, and household income sources (Table 4-1). Variables demonstrated normal and non-normal data distribution, so both ANOVA and Kruskal Wallis statistical tests were used to identify variables that showed statistically significant differences between means of actors ( $p < 0.05$ ). For these analyses, socio-economic factors were dependent variables,

and means of the factors as categorized by actors' roles were the explanatory variables. To identify specific socio-economic differences among actors, variables were examined using Pearson's Correlation analysis (significance determined as  $p < 0.0001$ , correlation coefficient "r" reported) and qualitative comparison of means (Table 4-2).

As the last step in the analysis, socio-economic factors identified in the previous section were used to build models for logistic regression analysis. Dependent variables for the models were actor roles (eg. owner, extractor, artisan, vendor), and explanatory variables were socio-economic factors. Maximum parsimonious models were used, so that as many explanatory variables as possible were included in the models, although a simpler model was chosen over more complex models. Variables that demonstrated low frequencies and collinearity, or close correlation to other explanatory variables, were not included in models. Preliminary models were tested until models with the lowest Akaike Information Criterion (AIC), as a measurement for best-fit models, were attained (Table 4-3). All logistic models were determined to have good fit of data based on the likelihood ratio ( $p < 0.05$ ) and high percent concordant value ( $> 86$ ). Statistical significance of factors was measured at a 10% level or better.

## **Results**

### **Buriti Value Chains**

The production system and actors involved in buriti value chains are depicted in Figure 4-1. The figure shows property regimes for buriti extraction and different roles of landowners, buriti extractors, intermediaries, artisans and vendors to different consumer groups in the three existing value chains for buriti fruits, mature leaves, and young leaves. Market chains for fruit and mature leaves shared a focus on household use and sale within the community. Fishermen and homeowners used mature leaves for

construction when they needed to build temporary structures, could not afford or access ceramic roof tiles, or built on federally protected land in which laws prevented the use of industrial construction material. The newly emergent market for young leaves used for making handicrafts (top level in the figure) contrasted in important ways from the other two chains. First, access to the resource was more difficult because most owners were reluctant to allow harvesting of young leaves on their property; they perceived harvesting of young leaves to be unsustainable. Secondly, artisans and intermediaries were two new actors present in the young fiber value chain. Artisans added value to buriti fiber by making handicrafts that could be sold for higher prices than raw buriti leaf derivative. Intermediaries provided a way for artisans in areas without buriti forests (Atins area communities) to gain access to young leaf fiber, which were processed from the leaves by artisans in Laranjeiras area communities, where buriti forests were located. Vendors, which were a type of intermediary, provided market access for artisans by regularly buying and re-selling their handicrafts to consumers. Thirdly, and most importantly, the market for handicrafts was oriented solely to outside, not local, markets. Consumers were visiting tourists and national and international intermediaries.

**Production system.** Almost all buriti forests were found in low-lying inland (>18 km from the coast) areas with abundant fresh water. Most buriti derivatives were extracted from native populations where regeneration was a natural process; trees were rarely cultivated in plantations. Local cultivation usually consisted of discarding seeds in wet areas conducive to germination, and transplanting healthy seedlings. Buriti trees were considered to thrive naturally, so management was often minimal. Landowners, for

example, removed mature leaves and cleared areas around trees to facilitate fruit collection, access the tree trunk, and benefit the tree's vitality.

Fruit and mature leaf collection was low-impact and non-intense. Community members collected mostly fallen fruit for consumption or sale from August to December, although the tree population only produced large quantities of fruit every other year. Both mature and young leaves were collected by extractors who climbed trees to cut leaves during favorable weather (no rain or wind; July-October) and according to demand. Mature leaves were in highest demand for building temporary fishing huts before the fishing season began in February. Collection of mature leaves was considered by interviewees to be low-impact because the most valued leaves for construction were leaves that had passed their most biologically productive stage. Overall demand for mature leaves was decreasing due to increased use of industrial substitutes, such as roof tiles.

Young leaves were in demand throughout most of the year and particularly for the tourist season that was highest during June-July. Young leaves most valued by artisans were collected as leaf spikes >2 m long and from mature trees with trunk height over 3 m. According to interviewees, one young leaf per tree was produced each month, and leaf harvesting was sustainable if at least 2-3 leaves remained on the tree and two subsequent young leaves were never harvested from the same tree. Overharvested trees along riverbanks, however, provided evidence that extractors did not always follow harvesting rules. In comparison to fruit and mature leaf value chains, increasing demand, production, and value of fiber handicrafts could have negative impacts on buriti resources.

**Principal actors.** Data were analyzed from 97 individuals of the sample group, who were owners, extractors, artisans, and vendors. Most individuals participated directly in the buriti market (n=81). Individuals who did not participate in the buriti market, or sell buriti derivatives, were buriti tree owners (n=16). Individuals could fill multiple roles in the value chain (24% of sample group), although they usually specialized in one role over others. Individuals took on additional roles as livelihood opportunities changed. Owning buriti resources was often a secondary role because land was inherited or purchased for other uses. Artisans and vendors commonly overlapped (13% of sample group), because some artisans transitioned to vendors as markets became more accessible; 32% of vendors were artisans prior to becoming vendors. Buriti tree owners and extractors lived in Laranjeiras area communities, where buriti forests were located because of ecological characteristics. About 27% of artisans and 42% of vendors were from coastal Atins area communities.

Most owners valued buriti trees for their current or potential economic value, so they rarely cut or removed trees. Although 59% of buriti tree owners did not participate in the buriti market, they were considered part of the value chain because they managed buriti resources that they gave away upon request or that were taken by extractors without permission. Most owners in the sample group actively managed their land, but others became absentee managers (18% of owners) because they inherited land or became too elderly. Owners participating in the buriti market often optimized for fruit production, which could be dried and sold for R\$5/kg (US\$3) in the Barreirinhas market. Mature leaves were harvested once every 2-3 years for R\$80/100 leaves (US\$46). Hiring a leaf extractor cost R\$25/100 leaves (US\$14). No owners sold young

leaves, mostly because they believed that intensely harvesting young leaves harms trees. In fact, about half the owners who regularly needed young leaves collected them from unmanaged buriti forests (private land with absentee owners) in order to conserve their own trees. There were also potential use conflicts between actors. For example, owners often managed for buriti fruit by conserving leaves on productive female trees. In contrast, artisans favored young leaf fiber collected from female trees, which could reduce fruit production.

Extractors were young men, athletically fit to climb even the tall >3m buriti trees. Leaf collection was considered a risky activity that did not pay well; extractors often discouraged their sons from climbing trees. Upon request by a buyer, extractors collected mature leaves from privately owned land, by paying the owner R\$25/100 leaves (US\$14), or from unmanaged open access land at no cost. Although collecting from unmanaged land ensured greater profit, these forests were considered physically challenging to enter and there was more potential for causing land rights conflicts. Regardless, most young leaves were collected from these unmanaged lands. Extractors earned R\$95/100 mature leaves (US\$54) and R\$0.5-2/young leaf (US\$0.29-1).

Artisans were usually young women with good eyesight and the dexterity needed to make handicrafts. Almost all handicrafts were made for sale rather than household use. Women prepared young leaf fiber by stripping off the epidermal layer of the leaf blade (the fiber), and then boiling, dyeing, and drying the fiber in the sun, and painstakingly knotting fibers together into a single fiber. Women made complex products such as hats, bags, and tablecloths via crochet, macramé, and weaving techniques. Most male artisans made simple fiber handicrafts, such as cordage, or assisted their

artisan wives. Women without skills (15% of artisans) or time to process young leaves into fiber depended on the help of other women or purchased fiber for R\$25-30/kg (US\$14-17). Artisans in the Atins area depended on intermediaries to transport fiber from the Laranjeiras area; unprocessed young leaves could not be transported between regions because of their delicate nature and regional laws that prohibit exportation (Barreirinhas municipal law no. 161/1975). These intermediaries were local men who traditionally carried resources, such as fish and manioc flour, between regions. Artisans considered their earned income for their handicrafts to be low, when compared to the higher prices that vendors obtained by selling the same product to consumers. A tablecloth requiring 20 hours to make was sold by artisans to vendors for R\$25-30 (US\$14-17). For comparison of earnings, a governmental salary of R\$540/month (US\$260) was considered a good income source in the communities. Although most artisans produced no more than one major handicraft a week, handicrafts provided one of the few income sources available for women. Some artisans sold handicrafts to different vendors in order to maintain availability of different market outlets. Artisans who made higher quality handicrafts could also demand better prices from vendors who competed to purchase their wares. It was relatively easy for a vendor to be an artisan. In contrast, it was more difficult for an artisan to transition into a role as a vendor because they needed to have good market skills and access to cash to invest in stock. Many vendors owned businesses or shops, where they sold handicrafts to consumers, but few artisans owned shops. Not all artisans were willing to move closer to the consumer end of the chain, however. Some artisans enjoyed the process of making

handicrafts and identified culturally as artisans. Artisans also associated greater proximity to the market end of the value chain with more stress and responsibility.

Vendors bought handicrafts from artisans to re-sell to other vendors or consumers for at least 25% profit. Although 53% of vendors were skilled artisans, they often preferred to purchase products from other artisans because handicraft production was too time consuming. To make unique products or save time and money, some vendors purchased uncompleted handicrafts and finished the product themselves or through a hired tailor. Vendors took on risks by investing into handicrafts that could potentially not be sold and earning delayed returns from their investments. Overall, however, most vendors were financially successful; many of their shops had year-round market access.

The new young leaf market had high potential for leading to overharvesting of resources. Although owners were resistant to participating in the buriti handicraft market, extractors, artisans, and vendors had strong roles in the value chain.

### **Socio-economic Factors Affecting Value Chain Actors**

**Socio-economic characteristics of actors.** Means of socio-economic factors among actors were compared to identify factors that could be used to distinguish actors (Table 4-2). The majority of socio-economic factors demonstrated statistically significant differences between actors, according to ANOVA and Kruskal Wallis tests (significance measured at  $p < 0.05$ ). Results of pair-wise correlation analysis and mean comparisons of factors with statistically significant differences are reported. Factors that showed no statistically significant differences are noted.

According to correlation analysis, owners ( $r = -0.44$ ) and extractor ( $r = -0.58$ ) were usually men, and artisans ( $r = 0.48$ ) were usually women. Actors most closely associated with buriti resources (owners and extractors) had less education and wealth, and fewer

livelihood opportunities in comparison to actors more closely associated with the emergent buriti handicraft market (artisans and vendors). Progressively higher education was apparent from owner to vendor in the value chain, which suggested that education helped prepare or encourage people to work in markets. Age and education were significantly correlated ( $r=-0.66$ ). Older people, such as owners, had low education partly because widespread secondary education was established only within the previous decade.

Wealth was measured using an index based on the presence of household goods (tile roof, bathroom inside the house, well-made floor and walls, water plumbing, and vehicle ownership), access to consistent sources of income, availability of household labor, and earning income from *Bolsa Familia*, which was a governmental subsidy awarded to women of poor households with school aged children. The wealth index and having a consistent source of income were positively correlated ( $r=0.45$ ). Extractors were the poorest actors, as they had a low wealth index, few consistent sources of income, and lacked access to credit, which was often dependent on formal property ownership. Among all actors, extractors also had the most diverse livelihood strategy because they participated in the highest number of household income sources and livelihood activities. In contrast, vendors were the wealthiest group, as they had a high wealth index, consistent income, and high integration in the market economy. Owners were also relatively wealthy because they had high access to consistent income and few income sources (average 2.96 income sources), and their households were most likely to receive retirement payments, which were considered a lucrative income source within the communities. Vendors and owners both demonstrated high livelihood stability.

*Bolsa Familia* was received mostly by extractor and artisan households and considerably less by owner and vendor households. Household labor was calculated based on the number of household members earning income / number of household members. Although the number of household members was not significantly different among actors, household labor was highest among actors on the market end of the value chain, such as vendors, who had few dependents in their household.

Buriti activities provided a main income source for extractors, artisans, and vendors. In comparison, owners earned little household income from handicraft production or other buriti-related activities. Although household use of buriti was not identified as statistically different between actors, household use of buriti was highest among actors closest to the forest. Actors closest to the forest were associated with having home gardens and agricultural plots, which were indicators of higher integration with subsistence level activities. In contrast, few vendors had home gardens and agricultural fields; few artisans had agricultural fields. Vendors were particularly reliant on purchased food.

Facing similar livelihood pressures, extractors and artisans often cooperated together to meet livelihood goals. Both extractors and artisans had high numbers of household income sources and earned household income from similar sources, such as *Bolsa Familia* and fishing activities. In comparison to other actors, artisans and extractors had more household members who worked with buriti derivatives, which helped increase efficiency for completing the labor-intensive handicraft process. In comparison to artisan households, however, extractor households depended more on household income from selling palm leaves. Extractors used two different strategies to

gain benefits from leaves: half of extractors sold buriti leaves to other artisans for direct income and the other extractors collected leaves for a household-based artisan to sell handicrafts for household income. Because handicrafts were sold for higher prices, extractors could indirectly earn more household income by collecting leaves for a family artisan rather than selling leaves. Extractors had the largest household sizes of all actors. Palm leaf sale formed part of their diversified livelihood strategy to meet income demands of a large young family with low labor availability.

To evaluate the impact of history and tradition regarding buriti on actors' participation in the buriti market, actors' personal history and parental ties with buriti were analyzed. Statistically, actors had similar rates of being born in their current community and having a parent with extensive exposure to buriti. All interviewees had more parental ties to buriti resources than to their current community of residence. In comparison to other actors, actors closest to the forest end of the value chain were more likely to have had extensive exposure to buriti trees. Owners, as expected, had the high rates of having planted a buriti tree in the past. Extractors, of all actors, had the strongest historical ties to their current community of residence, and exposure and history with buriti. They were also likely to be born in their current community; all extractors and at least one of their parents had spent over ten years close to buriti. Although there was no statistical difference among actors in terms of their reporting that they had learned buriti skills from their parents, extractors had the lowest rate among all actors. Instead, extractors reported being self-taught; they relied on their extensive exposure to buriti to learn to climb trees. Responding to livelihood pressures, extractors often harvested because they lacked other income-earning options.

Perceptions about sustainability of buriti use were measured based on individuals' perceptions that buriti trees were threatened and collection of young leaves was harmful. There was little variability among actors in regards to their general perception that buriti forests were threatened (not statistically different), but actors closer to the forest end of the value chain were more likely to believe that the collection of young leaves was harmful to buriti trees. In contrast, few artisans and, interestingly, no vendors believed that collecting young leaves was harmful. Reflecting familiarity with the green market discourse, vendors often defended the sustainability of their craft to tourists, or researchers, by asserting their contribution to buriti sustainability (64% of vendors reported having planted a buriti tree in the past) and tradition of buriti use.

**Predicting actors.** Logistic regression was used to identify the probability that specific socio-economic factors determined peoples' role in the value chain (Table 4-3). With the actors' role as a dependent variable, socio-economic rates were compared between individuals who were of a certain role (eg. owner) and individuals who did not participate in the role (eg. non-owners). Socio-economic factors identified in the previous section were used to build separate models for each actor, which were designed to be maximum best-fit models. Statistical significance of factors associated with that role was measured at a 10% level or better. Logistic regression models for each actor were as follows:

Predicted logit of (owner)=  $-2.479 + (-1.829)*GENDER + (-0.008)*EDUCAT + (-0.667)*MFAMBA + (2.222)*PLABUR + (0.503)*WEALTH + (0.091)*BORCOM + (0.620)*LEAPAR + (-0.124)*ATOTAL$

Predicted logit of (extractor)=  $3.443 + (-0.113)*AGE + (-0.647)*EDUCAT + (-1.663)*HOMEGA + (0.475)*MFAMBA + (0.966)*PLABUR + (-0.351)*WEALTH + (3.129)*BORCOM + (-1.017)*LEAPAR + (0.571)*ATOTAL + (-0.627)*MINCBU$

Predicted logit of (artisan)=  $6.200 + (-0.048)*AGE + (0.628)*MFAMBA + (-0.594)*WEALTH + (-0.966)*BORCOM + (0.896)*LEAPAR + (-0.873)*ATOTAL + (-0.420)*MINCBU$

Predicted logit of (vendor)=  $-16.509 + (0.008)*AGE + (0.675)*GENDER + (0.457)*EDUCAT + (-0.254)*HOMEGA + (-0.607)*MFAMBA + (1.684)*WEALTH + (2.403)*LEAPAR + (1.721)*ATOTAL + (2.276)*MINCBU$

For owners, three out of eight variables were significant. The positive coefficient indicated that individuals who were men, had planted buriti, or wealthier were more likely to be owners than other actors. For extractors, three out of ten variables were significant. Negative coefficients indicated that individuals who were younger or had less education were more likely to be extractors. A positive coefficient indicated that individuals who were born in their community were more likely to be extractors. For artisans, four out of eight variables were significant. A positive coefficient indicated that individuals with more family members working with buriti were more likely to be artisans. Negative coefficients indicated that individuals who were younger, poorer, or engaged in fewer livelihood activities were more likely to be artisans than other actors. For vendors, five out of nine variables were significant. Positive coefficients indicated that individuals who had more education, were wealthier, had learned buriti skills from their parents, were involved with more livelihood activities, or depended on buriti as a main source of household income were more likely to be vendors than other actors.

### **Discussion**

Although NTFP markets are often based on existing knowledge and use of forest resources, growing new markets can have different social and ecological impacts than traditionally used NTFPs. In comparison to traditional fruit and mature leaf markets, buriti fiber handicraft markets introduced new social and ecological challenges that can

have implications for developing policies regarding NTFP commercialization and sustainability. Fruit and mature leaves usually have higher harvest limits than young leaves (Ticktin, 2004), so young buriti leaf collection had greater potential for overharvesting. Because resource owners resisted participating in the handicraft and young leaf market, buriti users relied on resources collected furtively or from unmanaged lands. Buriti users often treated unmanaged land, such as the large swaths of buriti forests in the region with absentee owners, as open access land to be overexploited because the trees' future was uncertain and their own claim nonexistent. Another consequence of lack of resource access were extractors who were unwilling to discuss their extraction activities, which could hinder collection of information on harvesting dynamics that is vital for formulating resource management strategies (Ticktin, 2004). Secure property rights for NTFP users are considered to be one of the first steps for achieving poverty reduction and sustainable resource management through commercialization of NTFPs (Ros-Tonen and Kusters, 2011).

As main decision-makers for harvesting, extractors' social and economic vulnerability can have dire consequences for sustainability of buriti leaf resources. In comparison to other actors, extractors were at greater risk to be influenced by market pressure to engage in overharvesting practices. Extractors were also likely to leave the trade as their socio-economic situation improved. The gaps they left in the value chain could be filled by less skilled extractors who often collected from more fragile smaller trees. Studies have suggested that experienced and knowledgeable extractors are more likely than inexperienced extractors to leave forest populations intact by more carefully selecting resources for extraction (Jensen and Meilby, 2008; Schmidt and Ticktin, 2012)

NTFP users are often erroneously considered as a homogeneous group, which can have implications for the effectiveness of conservation and development interventions. As shown in other case studies (McSweeney, 2004), social heterogeneity can lead peoples' receptivity of external initiatives and programs to be uneven within a community. A value chain perspective can help to reveal the roles of different, and often hidden, groups in the market (Shillington, 2002). Buriti actors at the market end of the value chain, and particularly privileged groups, are the most common recipients of external assistance. Global export markets, of which buriti fiber handicraft markets can be classified, are often socially and geographically foreign to most NTFP users (Philip, 2002). Privileged groups tend to dominate over other users in export NTFP markets, which can have implications for the equitable distribution of benefits from NTFP commercialization (Belcher and Schreckenber, 2007; Shackleton et al., 2007). Actors at the forest end value chain, such as owners and extractors, often had extensive exposure and contact with natural resources. Having more influence over harvesting practices and investment in protecting resources, tree owners and extractors would be good candidates as subjects for conservation efforts.

Actors employed different strategies for overcoming challenges in the buriti market. Extractors that collected for artisans in the household, rather than selling the leaves for direct income, participated in value-added dynamics, which can contribute to sustainable use of buriti resources. Long term capacity-building programs in Barreirinhas by SEBRAE (Brazilian micro and small businesses support service) have helped women artisans gain new skills and better access to existing and new markets, and to organize handicraft cooperatives (SEBRAE, 2007). Although cooperative

members represented a more privileged group, their expensive handicrafts filled a niche market for exports and higher-paying clients that other artisans were unprepared to reach. Higher quality products have been shown to reduce the destructive impact on the forest (Varghese and Ticktin, 2008) as well as increase artisans' market advantage (Belcher and Schreckenberg, 2007). Other skilled artisans had high enough market potential that they disregarded opportunities to join cooperatives or undergo extra training. As markets grow to favor more high-quality products, market differentiation can reconfigure value chains by excluding people who cannot meet product standards (Kanji et al., 2005; Velde et al., 2006). These people, however, may have opportunities to establish different roles in the value chain. In the buriti case study, for example, more skilled artisans often purchased fiber or parts of handicrafts, such as straps and cords, from less skilled artisans.

Through greater education, income, and skills, female artisans found an avenue of upward mobility by working as vendors of buriti handicrafts. Women played an important role in the buriti handicraft market, which was one of their most important sources of income. Indeed, NTFP trade tends to be one area where women are free to earn income with little interference or threat of take over from men (Schreckenberg et al., 2006). More men entering the market as vendors, however, could pose a problem in the future as men often dominate the most lucrative forest market opportunities (Ruiz Perez et al., 2002).

### **Final Comments**

This study has analyzed the changing market for buriti in Maranhão, Brazil and impacts of new buriti handicrafts markets on diverse actors in value chains. The market oriented to handicraft production and sale from young buriti leaves has introduced new

actors, such as artisans and vendors, and resource demands that compete with pre-existing local and subsistence uses of buriti fruits and mature leaves. Buriti markets contribute to livelihood security among users, who use buriti as part of diverse livelihood strategies and for market entry. The handicraft market provided important income earning opportunities for women, who could also earn greater financial stability by moving closer to the market end of the chain. Great care must be taken, however, when aiming to optimize or reduce participation of specific roles in the value chain because of potential repercussions on peoples' livelihood stability and resource sustainability. New market demand poses a threat to sustainability of buriti harvesting as young leaf extraction takes place primarily on unmanaged public or open access land, and extraction intensity is growing. Greater understanding of buriti harvesting dynamics and careful management of resources can help to alleviate impacts of increased and changing use. An analysis of buriti fiber value chains contributes to our understanding of the complex relations between growing markets and natural resources, which can be used to inform and guide policy and development interventions that seek to influence livelihoods and sustainable resource management in an equitable way, through participation in NTFP markets.

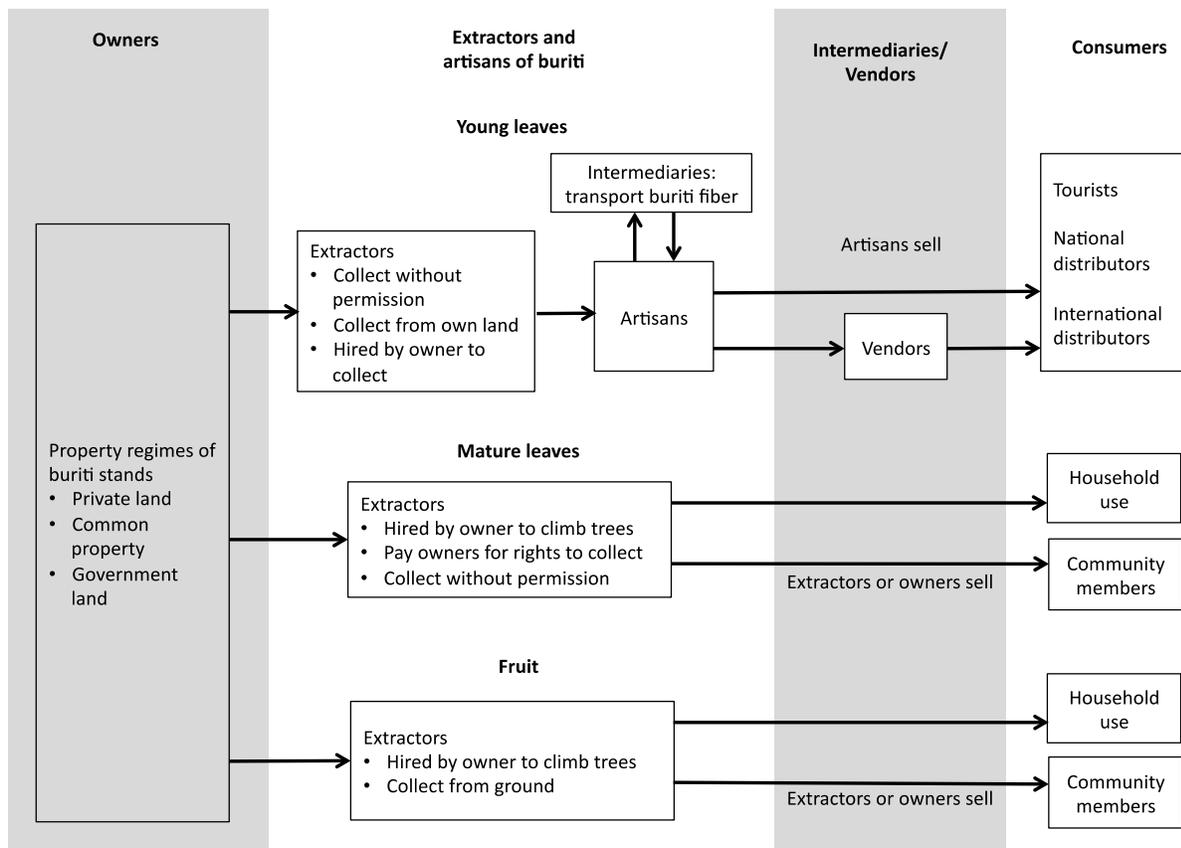


Figure 4-1. Schematic model of the buriti handicraft value chain showing different options and scenarios for property regimes, extractor and artisan relationships, intermediaries, and consumers

Table 4-1. Definitions of explanatory variables

Variable name	Description	Range
<b>DEMOGRAPHICS</b>		
Region	Region where interviewee lived; Laranjeiras (0) or Atins (1)	0,1
Age	Age (years)	13-88
Gender	Gender; male (0) or female (1)	0,1
Education	Education (years)	1-13
Home garden	Active home garden present	0,1
Agricultural field	Active agricultural field present	0,1
Household size	Number of members in the households	1,10
Household labor	Household labor: number family members earning income/number of people in household	0-1
Household members buriti	Household members participating in buriti activities	0-5
Buriti household use	Buriti leaf derivative used for household subsistence	0,1
<b>WEALTH</b>		
Consistent income	Receives consistent income each month	0,1
Wealth index	Index based on presence of tile roof, inside bathroom, well-made floor and walls, water plumbing, vehicle ownership	0-6
<b>HISTORY</b>		
Born in community	Born in current community of residence	0,1
Individual >10 yrs buriti	Individual >10 years close to buriti	0,1
Parent born in community	At least one parent born in interviewee's current community	0,1
Parent >10 yrs buriti	At least one parent has lived >10 years close to buriti	0,1
Buriti learned from parent	Learned current buriti trade from a parent	0,1
Planted buriti tree	Has planted a buriti tree	0,1
<b>PERCEPTIONS</b>		
Buriti trees threatened	Buriti trees threatened	0,1
Young leaf harmful	Young leaf collection harmful	0,1
<b>ACTIVITIES</b>		
Handicrafts activity	Handicrafts production is a main activity	0,1
Private business activity	Business owner or cooperative member is a main activity	0,1
Number of activities	Number of livelihood activities reported	0-5
<b>HOUSEHOLD INCOME</b>		
Main income buriti	Buriti provides a main income source	
Handicrafts income	Handicrafts provide household income	0,1
Bolsa familia income	Bolsa familia provides household income source	0,1
Retirement income	Retirement provides household income source	0,1
Fishing activities income	Fishing activities provide household income source	0,1
Selling palm leaves	Selling palm leaves provides household income	0,1
Number of income sources	Number of household income sources reported	0-6

Table 4-2. Means of socio-economic variables for different value chain actors (n=97).

	Owner n= 28	Extractor n= 12	Artisan n= 52	Vendor n= 19
<b>DEMOGRAPHICS</b>				
Region	0.04	0	0.27	0.42
Age	57.70 (17.0)	36.25 (12.5)	39.90 (10.9)	38.37 (14.4)
Gender	0.36	0	0.90	0.89
Education	2.60 (2.71)	3.67 (3.42)	4.71 (2.98)	5.88 (4.01)
Home garden	0.86	0.58	0.75	0.44
Agricultural field	0.96	0.67	0.44	0.50
Household labor	0.38 (0.26)	0.42 (0.25)	0.42 (0.19)	0.57 (0.26)
Household size	4.68 (1.44)	5.67 (1.82)	4.98 (1.78)	4.32 (2.00)
Household members buriti	0.46 (0.93)	1.75 (1.54)	1.50 (1.50)	1.05 (1.13)
Buriti household use	0.86	0.91	0.77	0.60
<b>WEALTH</b>				
Consistent income	0.79	0.17	0.52	0.79
Wealth index	3.82 (1.54)	2.42 (1.83)	2.42 (1.56)	4.42 (1.43)
<b>HISTORY</b>				
Born in community	0.61	0.75	0.45	0.56
Individual >10 yrs buriti	0.96	1.00	0.88	0.65
Parent born in community	0.54	0.91	0.44	0.47
Parent >10 yrs buriti	0.81	1.00	0.79	0.71
Buriti learned from parent	0.50	0.25	0.45	0.58
Planted buriti tree	0.77	0.60	0.38	0.64
<b>PERCEPTIONS</b>				
Buriti trees threatened	0.68	0.75	0.68	0.67
Young leaf harmful	0.57	0.20	0.05	0.00
<b>ACTIVITIES</b>				
Handicrafts activity	0.25	0.17	0.94	0.89
Private business activity	0.14	0.08	0.08	0.79
Total activities	2.11 (1.04)	2.75 (0.75)	2.33 (0.71)	2.53 (0.77)
<b>HOUSEHOLD INCOME</b>				
Main income buriti	0.18	0.67	0.69	0.68
Handicrafts income	0.29	0.83	0.92	0.84
<i>Bolsa Familia</i> income	0.48	0.70	0.78	0.29
Retirement income	0.43	0	0.15	0.21
Fishing activities income	0.15	0.33	0.37	0.16
Selling palm leaves	0.04	0.50	0.02	0
Total income sources	2.96 (1.37)	3.83 (0.67)	3.67 (0.97)	3.26 (1.27)

Standard deviation listed in parentheses for continuous variables

Table 4-3. Results from logistic regression models for different value chain actors reporting coefficients, odds ratio, and p-value in parentheses.

Variables	Owner	Extractor	Artisan	Vendor
Model statistics				
Observations	54	54	65	75
Model Evaluation:				
Likelihood ratio	16.62(0.0343)	21.93(0.0155)	23.20(0.0031)	43.24(<0.0001)
Percent concordant	85.1	89.5	82.8	93.0
Age	-	-0.113	-0.048	0.008
AGE		0.893 (0.048)*	0.953 (0.094)**	1.01 (0.880)
Gender	-1.829	-	-	0.675
GENDER	0.161 (0.066)**			1.97 (0.583)
Education	-0.008	-0.647	-	0.457
EDUCAT	1.00 (0.957)	0.524 (0.033)*		1.58 (0.065)**
Home garden	-	-1.663	-	-0.254
HOMEGA		0.189 (0.186)		0.776 (0.812)
Household members buriti	-0.667	0.475	0.628	-0.607
MFAMBA	0.513 (0.117)	1.61 (0.254)	1.88 (0.021)*	0.545 (0.158)
Planted buriti tree	2.222	0.966	-	-
PLABUR	9.22 (0.029)*	2.63 (0.401)		
Buriti trees threatened	-	-	-0.285	-
THREAT			0.752 (0.681)	
Wealth index	0.503	-0.351	-0.594	1.684
WEALTH	1.65 (0.040)*	0.704 (0.320)	0.552 (0.007)*	5.39 (0.001)*
Born in community	0.091	3.129	-0.966	-
BORCOM	1.10 (0.923)	22.84 (0.027)*	0.381 (0.164)	
Buriti learned from parent	0.620	-1.017	0.896	2.403
LEAPAR	1.86 (0.468)	0.362 (0.406)	2.45 (0.186)	11.05 (0.052)**
Total activities	-0.124	0.571	-0.873	1.721
ATOTAL	0.884 (0.798)	1.77 (0.419)	0.418 (0.019)*	5.59 (0.031)*
Main income buriti	-	-0.627	-0.420	2.276
MINCBU		0.534 (0.604)	0.657 (0.534)	9.73 (0.089)**

\*p<0.05, \*\*p<0.10; Dash signifies that the factor was not included in the specific model

## CHAPTER 5 CONCLUSIONS

Since the 1990s, NTFPs have been explored as an avenue for reaching conservation and development goals to prevent poverty and maintain sustainability of resources. For local users, forest product commercialization offers a realistic entryway into the market because NTFP exploitation is often based on existent local knowledge and an accessible resource. Forest product markets can expand quickly, although the dynamic nature of NTFP markets means that it can be difficult to predict how market benefits are distributed and its impacts on sustainable harvesting of the resource. This study on an emerging buriti leaf handicraft market in Barreirinhas, Maranhão offered insight into the impacts of a growing new market on local livelihoods and resource sustainability, while considering social heterogeneity present among users by addressing three research questions:

- How do new markets for NTFPs affect peoples' livelihood strategies and perception of sustainable harvesting of forest resources?
- What is the impact of resource access and value chains on participation in the market and perception of sustainable harvesting?
- Does commercialization of buriti derivatives contribute towards increased livelihood security and sustainable use of forest resources among forest-based people in Barreirinhas?

The new fiber handicraft market presented a shift from subsistence use of NTFPs to market exploitation, which had consequences for peoples' livelihood strategies and sustainable harvesting of forest resources. Although mature leaves were historically more valued than young leaves, the young leaf market has overtaken the mature leaf market and continues to expand. Fitting well into diversified livelihood strategies, young buriti leaf activities had many of the preferred characteristics for livelihood activities,

such as being low-stress and low risk, allowing people to work from or close to home and have flexibility, provided fast cash, and required low responsibility. Among women, in particular, buriti leaf handicrafts was one of the only income earning activities that could complement their housekeeping activities. Contrary to expectations, poverty, direct access to buriti resources, tradition and affinity to buriti did not ensure that people participated in the market. Instead, personal preference, skills, time commitments, and historical exposure to buriti had greater influence. Position in the household cycle, which determined household needs and opportunities, was one of the most important factors that shaped market participation. Although buriti use was changing quickly, subsistence use of buriti still persisted due to cultural identity, perception of potential value, current utility and politics, and role of buriti within a traditional livelihood system. Buriti provided a security net of subsistence and income resources that could be used when needed. Residents of the study area had a diverse range of livelihood options at their disposal, and their social heterogeneity affected whether or not they participated in the buriti market.

Resource access was measured by physical distance and legal rights to the resource. As the buriti handicraft market has grown, people located close to buriti resources and with legal rights to directly access buriti forests had increasingly restricted access to resources by enforced laws and property regimes. In contrast, people located far from buriti resources who relied on intermediaries for access to buriti resources had increasingly restricted access due to higher competition for resources. For these people, social networks helped to smooth the way for access to buriti fiber and to overcome skill limitations, such as learning new techniques for making

handicrafts. Interestingly, people located far from the resource shared similar tradition and dependence on buriti resources with people located close to buriti trees. People located far from the resources had greater interest to join the new handicraft market in comparison to people located close to buriti trees. People located far from buriti trees participated only in the market end of the buriti value chain, because they did not have direct access to the forests. In contrast, people located close to buriti trees were involved in all parts of the handicraft value chain, including extracting and preparing the fiber, which was the most difficult, strenuous, and laborious part of the handicraft process. People close to the trees were also in close proximity to the urban center, so they had more income earning options. For these reasons, people located near buriti trees were more likely to view buriti handicraft production negatively and choose other income earning activities.

The new market oriented to handicraft production and sale from young buriti leaves introduced new actors (eg. intermediaries, artisans, and vendors) and resource demands that competed with pre-existing local and subsistence uses of buriti fruits and mature leaves. Examining the buriti market through the lens of the value chain demonstrated that different actors engaged in different livelihood strategies. Users closer to the resource end of the value chain, such as extractors and artisans, were often involved in diversified livelihood strategies, which was typical among NTFP users who use forest products as a supplement to other household livelihood activities (Arnold and Townson 1998) and as a safety net (Shackleton and Shackleton 2004). In contrast, vendors were more likely to use a specialized strategy by optimizing for sale of buriti handicrafts. Actors closer to the forest end of the value chain suffered more social

stigma because of their association with subsistence use of resources. In contrast, vendors earned a higher social status as business owners. Through the value chain, female artisans also had an important avenue of upward mobility by working as vendors of buriti handicrafts. Livelihood strategies could change, however, as circumstances and household composition changed over time.

Based on perceptions by interviewees, new market demand for young leaves posed a threat to sustainability of buriti harvesting, as young leaf extraction took place primarily on unmanaged public or open access land and extraction intensity was growing. Most buriti market participants did not own buriti resources, and landowners were reluctant to grant people the rights to collect young leaves. Extractors, who were the most socio-economically vulnerable of all the actors, could also be easily pressured to overharvest buriti resources. People on the forest end of the value chain were particularly reliant on their history and prolonged interactions with buriti as important factors for participating in the buriti market. They were also most involved with subsistence activities and more likely to believe that young leaf collection was harmful. In contrast, actors on the market end of the chain were more dependent on the cash economy. It was no surprise that they were also more likely to defend their craft as ecologically sustainable.

There are a few potential scenarios for what the future of buriti may hold. First, higher frequency of entrants into the market can lead to more heterogeneity among buriti users, in which more privileged groups would have the advantage. Social cooperation, such as co-ops, can help pre-existing market participants to compete with new entrants into the market by filling specific niche market. As markets grow to favor

more high-quality products, product and market differentiation can reconfigure supply chains by excluding less skilled participants who cannot meet particular standards (Kanji et al., 2005; Velde et al., 2006). Second, peoples' socio-economic status may improve so that other income earning activities become more accessible. In this case, the buriti market would be left to those people who identify culturally to the buriti or enjoy the craft. If extractors become more reluctant to climb trees, people will have to develop new ways to collect the young leaves in a safer manner. With the lack of extractors, leaves may be increasingly collected from shorter and younger trees, which could have negative impacts on the trees and quality of handicrafts. Third, people may begin to intensify cultivation of buriti trees in order to increase their access to resources, which could affect land use and management in the region.

Secure property rights and enforcement of environmental laws are important for encouraging responsible management of natural resources. The buriti case study demonstrated, however, that limiting resource access to immediate residents impacted users differently, depending on their distance to the resource. Although peoples' movements have become restricted due to rapidly growing human populations, they may still be reliant on natural resources located outside of their immediate area.

Value chains help people overcome challenges of distance and restrictions on resources. They ensure peoples' access to resources and to the market, and provide a way for people to negotiate for better social positions. A shift from buriti-based subsistence to income earning activities within the Barreirinhas region demonstrated how people adapt their livelihood strategies to reflect an increasingly globalized economy.

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