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Social Mechanisms and Mobility: Buriti Palm (*Mauritia flexuosa*) Extractivism in Brazil

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Globalization often involves unseen processes that restructure rural economies, natural resource use (Hecht 2010), and the natural environment (Heffernan *et al*. 2014). These processes are particularly evident with the commercialization of non-timber forest products (NTFPs). Rising economic value for NTFPs often promotes intensive harvesting (Belcher *et al*. 2005; Marshall *et al*. 2006). Benefits gained from forest exploitation are generally distributed unevenly within a population and contribute to widening socioeconomic gaps (Ruiz-Perez *et al*. 2004). Market expansion into new areas has great implications on both forest and livelihood sustainability (Williams *et al*. 2000; Shackleton *et al*. 2009). Direct users of NTFPs are particularly vulnerable to large-scale economic processes, as their livelihoods depend on access to fixed resources.

This research addresses how people cope with changes in the market economy and natural resource access. In Barreirinhas, Maranhão, Brazil, a rapidly growing global market for buriti (*Mauritia fleuxuosa* L.f.) young leaf fiber handicrafts has challenged the sustainability of buriti resources and its associated livelihoods. I present a case study of the buriti palm fiber market in Barreirinhas and address the following questions: How does variability in resource access and socioeconomic status affect participation in the buriti fiber market? What social mechanisms are used to overcome obstacles to market participation? How are competing needs among user groups resolved?

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Buriti are single stem, dioecious, and arborescent palms reaching over 30 m tall, and associated with fresh water and swamp forests (Endress *et al*. 2013). Buriti palms are distributed across northern South America and considered a dominant plant species in the Amazon (Peters *et al*. 1989). In all areas of its occurrence, buriti palm parts are used economically (Lawrence *et al*. 2005), the palm itself offers habitat and food resources to wildlife (Bodmer 1991; Brightsmith 2005), and buriti swamp forests provide an important mechanism for carbon sequestration and exchange (Lähteenoja *et al*. 2009; Draper *et al*. 2014).

Some buriti products have developed high market value. Destructive harvesting of buriti palms for valuable products, such as by felling palms to collect fruit in the Peruvian Amazon (Ruiz *et al*. 2001), has been a concern since the late 1980s (Kahn 1988; Manzi and Coomes 2009; Mesa and Galeano 2013; Padoch 1988). Other buriti palm products, such as young leaves and oil, are rapidly growing in value and represent potential overexploitation challenges (Abreu *et al*. 2014; Sampaio *et al*. 2008). A buriti palm produces an average of one leaf per month (Sampaio *et al*. 2008). Unlike the collection of fallen fruit and extraction of mature leaves for subsistence, young leaves can more easily be overexploited and negatively affect buriti palm sustainability. In addition to commercial importance, buriti is one of the most important plant species for indigenous groups, who rely on the palm for such subsistence needs as food, shelter, construction material, and ornaments (Gilmore *et al*. 2013; Sosnowska *et al*. 2015).

In Maranhão, a growing external market for buriti handicrafts has made young leaf fiber one of Maranhão's most economically valuable forest products (IBGE 2015). Buriti young leaf fiber handicraft production is a complex process including: 1) young leaf extraction; 2) rendering fiber by stripping the epidermal layer, then boiling, dyeing, and drying the

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fiber; 3) knotting and joining fibers; and 4) making handicrafts like bags, tablecloths, and hammocks using macramé, crochet, and weaving techniques (Virapongse 2013) (Photo 1). Market value chains for buriti fiber handicrafts help guide the process from resource to market more efficiently. Different value chain roles include buriti palm owners, extractors, handicraft artisans, and vendors. Gender divisions and varying participation of children occur among these different roles (Fig. 1). There can be some overlap among roles. For example, artisans may extract their own leaves, as well as sell the finished product (see Virapongse *et al*. 2013 for further details).

Four districts of Maranhão harvest buriti fiber commercially, with Barreirinhas district as the highest producer; 95–125 metric tons were produced annually in Barreirinhas from 2004 to 2012. Buriti fiber in Barreirinhas district has increased in value from R$6165 (US$2097) per metric ton in 2004 (adjusted for inflation to 2013 values) to R$9961 (US$5031) per metric ton in 2013 (IBGE 2015). As with many forest product markets, it is difficult to accurately estimate the volume and monetary value of buriti products (Brokamp *et al*. 2011). Despite this, in 2005, buriti fiber handicrafts were considered the second most important source of income in Barreirinhas district (Barreirinhas 2005).

Study Site

Fieldwork was conducted in Barreirinhas district among 12 communities along the Preguiça River, from the river mouth to 35 km inland (Fig. 2). Barreirinhas district covers an area of 3112 km^2 and has 54,930 inhabitants (IBGE 2010), who are mostly *caboclos*, people of mixed ethnic heritage. The main urban center for Barreirinhas district is the town of Barreirinhas, which is the main market for buriti handicrafts. Mandacaru Community provides a secondary market for coastal communities. Study communities that can legally collect buriti young leaves are referred to here collectively as Laranjeiras. These communities are located in the interior, about 10 km (<30 min travel) of Barreirinhas town, and are adjacent to buriti palm swamp forests. The group of study communities that lack legal access to buriti resources is referred to here as Atins. Atins is located on the coast, about 35 km from Barreirinhas town. As buriti forests are located in the freshwater - rich interior, most owners and extractors reside in Laranjeiras; artisans and vendors are found in both areas.

Photo 1 Examples of buriti young leaf fiber handicrafts

Research Approach

A livelihood approach offers an analytical structure to address the complexity of livelihoods by assuming that people draw on a range of assets (natural, financial, human-made, physical, and social capital) to pursue a variety of activities and livelihood outcomes (Ashley and Carney 1999; Berkes and Folke 1994; DFID 2000). 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. A livelihood approach assumes that resources are used as efficiently as possible and in different combinations depending on the constraints, goals, opportunities, and composition of the household.

Data Collection

A quasi-experimental research design was used for quantitative data analysis, so that the sample group consisted of a target group and a control group with similar demographic characteristics. Purposive sampling and respondent-driven sampling were used to select a sample group of 106 individuals from Laranjeiras and Atins. This sampling strategy was used because it was not feasible to predefine all categories relevant to the study (e.g., roles in the handicraft value chain). Purposive sampling strategy entails selecting individuals based on specific criteria (Coyne 1997). Respondent-driven sampling identifies hidden but relevant populations (Salganik and Heckathorn 2004), such as extractors of NTFPs.

The target group consisted of artisans and vendors of buriti handicrafts (market participants). Control group individuals did not produce or sell buriti handicrafts (non-participants in the market), although they were demographically similar to the target group (women aged 16–65 years). Using these

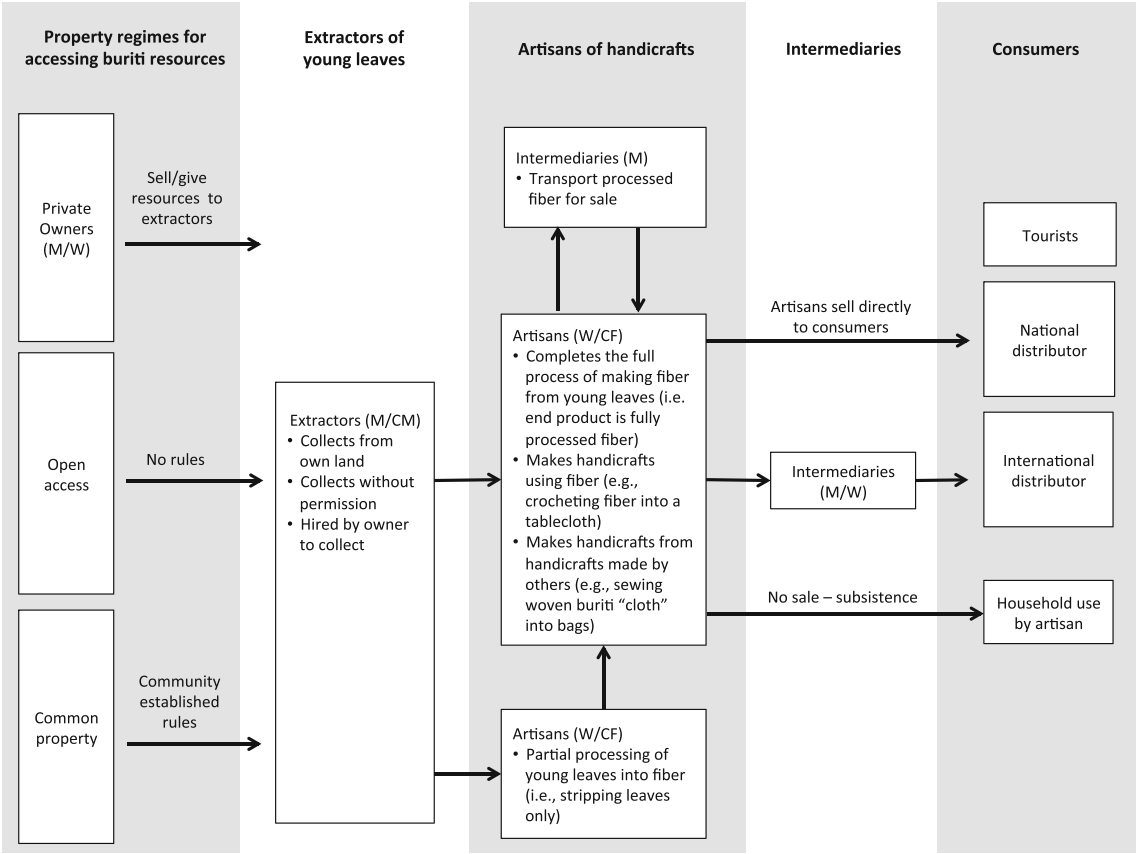

Fig. 1 Value chain for buriti young leaf fiber handicrafts. Gender participation in the value chain roles are represented by *M* Men, *W* Women, *CM* Children-Male, *CF* Children-Female. *Squares* represent actors. *Arrows* depict the movement of buriti young leaf resources between actors

sampling techniques, there were 65 individuals from Laranjeiras (participants $n = 47$; non-participants $n = 18$) and 41 individuals from Atins (participants $n = 22$; non-participants $n = 19$) included in the sample. The purpose of the control group was to understand characteristics that might discourage participation in the buriti market, such as resource access.

Laranjeiras interviewees were mostly women (91%) with similar levels of personal and parental exposure to buriti, including learning their handicraft skills from their parents. Within the Laranjeiras sub-sample group, in comparison to participants, non-participants were younger (about 10 years) and better educated, and had younger households with less available household labor, more household members, fewer household wealth indicators, fewer livelihood activities, and longer personal and parental length of time in their current community of residence. Atins interviewees ($n = 41$) were all women with similar household-level engagement in subsistence use of buriti and historical association to their community of residence. Within the Atins sub-sample group, in comparison with participants, non-participants had less personal and parental exposure to buriti resources, and fewer learned buriti skills from their parents.

To understand regional history, seven community experts were selected based on their reputation in the community as long-time residents in the region, as knowledgeable about local history, and as lucid storytellers. To collect data about local natural resource laws and policy, four agency representatives in Barreirinhas from the Chico Mendes Institute of Biodiversity Conservation (ICMBio), the Ministry of Education, the Ministry of Environment, and the Rural Workers Union were interviewed. To understand processes for collecting buriti leaves, 28 owners of buriti palms and 12 active extractors of buriti leaves were interviewed. Owners and extractors were not included in the sample group for quantitative analysis because almost all were found in Laranjeiras.

Fieldwork was conducted during 18 weeks from June 2009 to November 2011. Semi-structured interviews were used to collect data from the sample group about individual and household level socioeconomics (e.g., demographics, history, household wealth, buriti participation, perception about buriti, individual activities, and household activities; Table 1) and from local agency representatives about natural resource management. Oral histories were collected from buriti market participants and community experts on history.

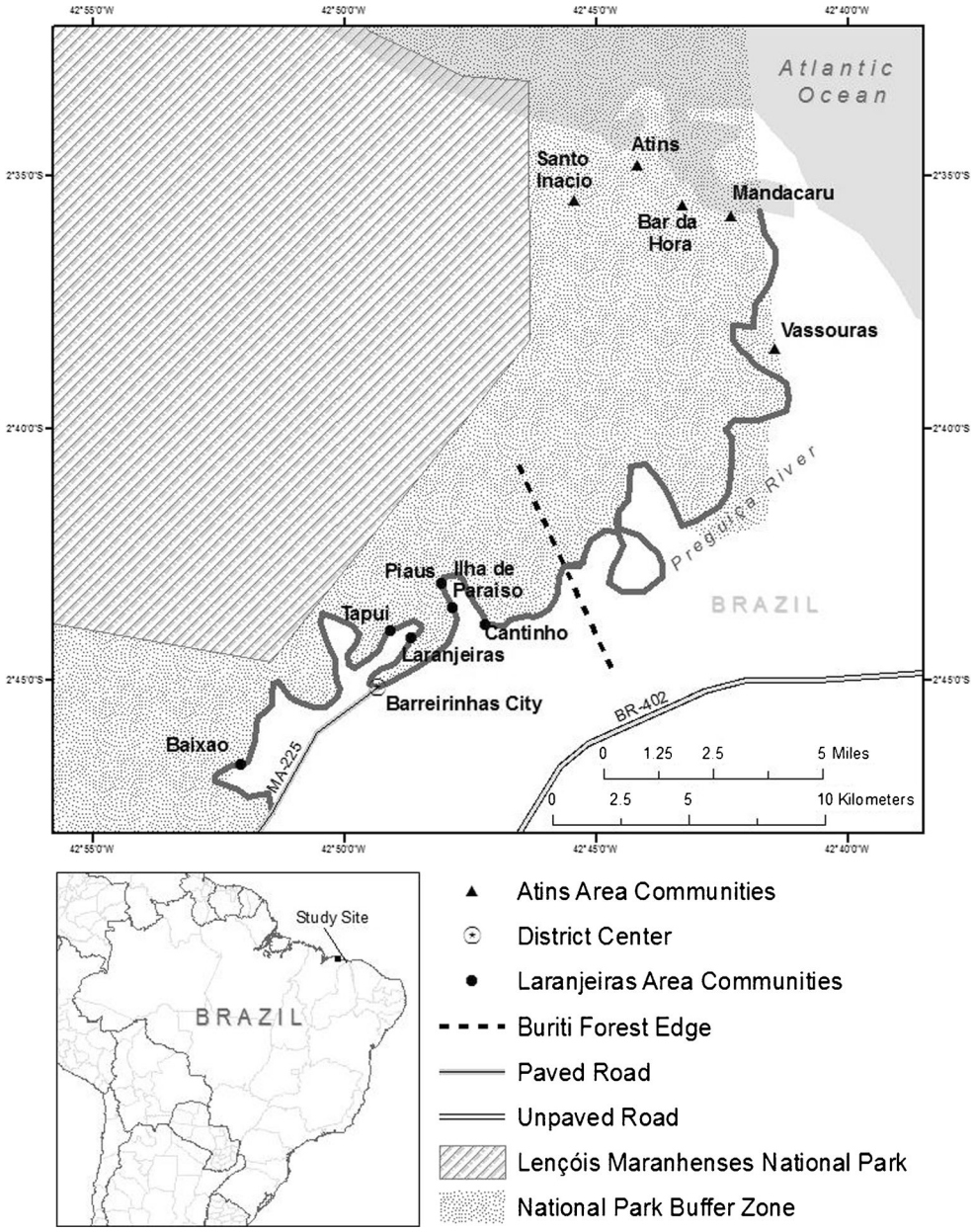

Fig. 2 Map of the study site (Image by Chelsie Romulo, adapted from Virapongse *et al.* 2013)

Analysis

First, qualitative interview responses from all interviewees were analyzed in order to construct the regional history of the study sites. Secondly, to understand socioeconomics associated with participating or not participating in the buriti market, exploratory statistics were used to identify 32 potentially significant socioeconomic variables from interviews with the sample group (Table 1). Two-sample t-test and Wilcoxon rank sum test ($p < 0.05$) were conducted to statistically compare the socioeconomics between subsample groups from Laranjeiras and Atins (dependent variable "legal access to buriti"). Statistical analysis was conducted using SAS 4.3 software (2010, v 4.3, SAS Institute Inc.). Finally, results were synthesized from the two analyses to identify the social mechanisms used to overcome challenges to buriti handicraft market participation. Qualitative information were used to interpret results from the quantitative analysis. Results from the quantitative analysis were used to understand the socioeconomic differences among subsample groups from Laranjeiras and Atins, and how these differences affect their market participation.

Table 1 Definitions of socioeconomic variables categorized by individual and household level

Variable name	Description	Range
Individual level variables		
Individual demographics		
Education	Education (years)	1–13
Age	Age (years)	13–66
Gender	Gender; male (0) or female (1)	0,1
Individual history		
Born community	Interviewee was born in their current community	0,1
Personal exposure to buriti	Interviewee has lived >10 years with close contact to buriti	0,1
Parent born in community	At least one parent was born in the interviewee's community	0,1
Parental exposure to buriti	At least one parent has lived >10 years with close contact to buriti	0,1
Learned buriti from parent	Interviewee learned their current buriti trade from a parent	0,1
Individual buriti participation		
Association	Has participated in an association of artisans/vendors	0,1
Family member collects	Young leaves used by the interviewee are collected by a family member	0,1
Experience selling	Has worked with selling goods (not buriti products)	0,1
Made handicraft past	Has made buriti fiber handicraft in the past	0,1
Knows strip fiber	Has knowledge and experience to strip buriti fiber	0,1
Independence	Believes buriti market participation offers more independence	0,1
No access buriti	Has difficulty accessing buriti resources	0,1
Individual perception about buriti		
Handicrafts lucrative	Believes that invested time and energy is worth making handicrafts	0,1
Affinity to buriti	Likes/would like working with buriti	0,1
Easy learn buriti	Believes it is easy to learn buriti skills	0,1
Interest buriti	Is interested to participate in the buriti market	0,1
Individual activities		
Handicrafts activity	Handicraft production is a main activity	0,1
Number activities	Number of livelihood activities reported	1–5
Household level variables		
Household demographics		
Household size	Number of household members	1,10
Household labor	Number of household members earning income / number of household members	0–1
Main income buriti	Buriti provides main source of household income	0,1
Buriti household use	Buriti leaves used for household subsistence	0,1
Household member buriti	Number of household members participating in buriti activities	0–5
Household wealth		
Wealth index	Index including presence of tile roof, inside bathroom, well-made floor and walls, water plumbing, and vehicle ownership	0–6
Consistent income	At least one household member receives a monthly salary	0,1
Outside assistance	People outside of the household contribute cash/goods	0,1
Access to credit	Interviewee can borrow money	0,1
Household income		
Handicrafts income	Buriti handicrafts generate household income	0,1
Number income sources	Average number of household incomes	0–7

Regional History

According to the oral histories, Barreirinhas was established over 200 years ago because of its abundant fresh water, arable land, and easy access to the coast via the Preguiça River. Inland Laranjeiras provided agricultural staples (e.g., manioc, rice) and natural construction material (e.g., clay, palm resources). Coastal Atins provided important marine resources, such as fish. Many inhabitants of Laranjeiras and Atins were descendants of fishing migrants, who had travelled north along the coast from today's Ceará State and settled around the Preguiça River mouth. People moved along the river between Laranjeiras and Atins to extract and collect both inland and coastal resources. Coastal Mandacaru Community (of Atins) was an exception, as many people had migrated from the interior to the coast to commercially extract mangrove bark for finishing boat sails or for work associated with the government supported Mandacaru lighthouse (est. 1940). Although some communities were founded by indigenous groups and by African slaves that worked on plantations owned by European patrons, few interviewees recognized these ethnic differences.

Over the last generation, the regional population increased and restrictive property rights were more stringently enforced. As spatial mobility reduced, families became extended across Laranjeiras and Atins in permanent settlements. Because neither region produced important food resources (e.g., manioc flour and fish) in equal or adequate abundance, extended social networks developed. Atins households relied on Laranjeiras for access to goods, urban services, construction materials (e.g., bricks and forest products), and freshwater. At the time of the study, there were remnants of movement between regions as some Laranjeiras households still maintained informal housing on Atins beaches for seasonal fishing operations. In contrast, few Atins households were able to continue accessing buriti leaves from Laranjeiras due to restrictive property rights there. Atins and Laranjeiras are both accessible by river and roads, although Atins is more isolated.

Over the past 50 years, the population of Barreirinhas expanded from 30 households to over 3063 households (City Department of Health 2010). Due to increased population, development, and tourism from the Lençóis Maranhenses National Park (est. 1981), competition over land and resources grew. Today, people have increasingly left subsistence activities in order to specialize in income-earning activities, such as intensified exploitation of buriti.

Buriti leaves have been long used for subsistence needs, such as roof thatching with mature leaves and loom-woven hammocks from young leaf fiber, and these are recognized by most interviewees as traditional skills. The external market for young leaf fiber handicrafts, which requires a different skill set (e.g., crocheting tablecloths, weaving cloth), was introduced in the region within the past 50 years when female artisans from Laranjeiras and Atins were trained by male vendors and non-local artisan cooperatives in the state capital of São Luis. At that time, the handicraft market provided important household income. One artisan remarked, "We worked in agricultural fields during the day. At night, we gathered around candlelight to make handicrafts (for sale)."

In 1975, Barreirinhas municipal law no. 161 was enacted to restrict buriti product collection to residents living in communities adjacent to buriti swamp forests, and they were prohibited from selling raw young leaves to outsiders, although sale of processed products (e.g., rendered buriti fiber) was permitted. The Brazilian Forest Code (Law 12.651/2012; est. 1965) also indirectly supported buriti conservation by mandating protection and state ownership of riparian zones in unconsolidated areas within 50 m of the river edge, where buriti palms were most abundant. Prior to these laws, most buriti forests were open access. As the area developed and was claimed, open access forests became scarcer and more distantly located from the communities.

At the time of the study, buriti palms were found on private land, government-owned land, open access, or common areas used and managed by specific communities in Laranjeiras (C. Farias, Rural Workers Union, July 8, 2011). From the agency perspective, buriti forests required protection from commercial overharvesting, although subsistence use of buriti leaves was supported. A representative from the Ministry of Environment (N. Lisboa, July 8, 2011) estimated that 80% of the Barreirinhas district population relied on buriti for at least part of their livelihood needs, a number supported by my (unpublished) survey of Laranjeiras community. Immediate residents could collect buriti leaves for subsistence if trees were not permanently damaged (E. Macedo, ICMBio, Oct 13, 2010). Regardless of the Brazilian Forest Code, community members believed that resources on riverbanks within governmental authority belonged to the private owners of adjacent land. Private owners represented a small minority of the community; they rarely supported collection of buriti young leaves, because it competed with other buriti uses (e.g., fruit, mature leaves) (Virapongse *et al.* 2013). The few communities that succeeded in organizing common areas for buriti leaf collection did so after many years of social organization and negotiation with the government. Overall, few extractors had legal and communal rights to collect buriti young leaves.

Market directed production of handicrafts has intensified over the last two decades due to the increasing popularity of the Lençóis Maranhenses National Park. Interviewees from Laranjeiras and Atins had conflicting views about the current availability of young leaves and fiber. Some believed that these resources have become more difficult to locate and access than in the past when forests were open access. Others believed that overharvesting had been threatening buriti forests, and

that over the last 15 years buriti trees have become healthier because of increased law enforcement and increased use of industrial substitutes (e.g., replacement of buriti leaf roof thatching). Overall, most interviewees regarded buriti palms as a natural part of the landscape - plentiful overall and regenerating easily if allowed. Instead, the issue of concern was declining access to buriti resources, which interviewees attributed to competing market demand among artisans, lack of buriti palm ownership, and legal restrictions to extraction.

At the time of study, Atins interviewees could no longer extract buriti resources in Laranjeiras because of an enforced combination of the Barreirinhas municipal law no.161, the Brazilian Forest Code, and private and community-based land ownership. However, Atins artisans continued accessing buriti fiber through intermediaries who customarily transported goods from Laranjeiras. In fact, most Atins artisans paid similar prices for buriti fiber as Laranjeiras artisans (R$20–25 or US$9–11/kg) by purchasing fiber through family and acquaintances in Laranjeiras, who collected the leaves themselves. Interviewees without strong social connections to Laranjeiras, such as those from Mandacaru community, paid higher prices for fiber (R$25–30 or US$11–13/kg).

Although Laranjeiras residents have legal rights to extract nearby buriti leaf resources, their access is limited by diffuse ownership and the physical challenges associated with buriti swamp forests. Most Laranjeiras artisans (68%) obtain young leaves from relatives who extract leaves from family-owned land (purchase or through permission) or riverside forests with unrecognized or unenforced ownership (e.g., absent owners) that they treat as open access. Others purchase rendered fiber. Buriti swamp forests and palms can be physically difficult and dangerous to access (e.g., mud flats; quickly changing seasonal tides). Only the most experienced and skilled extractors can collect the most valued leaves from tall, adult buriti palms. Overall, for both study areas, buriti leaf access is complex and dependent on social mechanisms.

Socioeconomic Comparison between Laranjeiras and Atins (Table 2)

Laranjeiras and Atins sub-sample groups were compared in order to determine how people with and without legal access to buriti young leaves participate in the market. Laranjeiras (n = 47) and Atins (n = 22) market participants had similar individual histories, with the exception that Laranjeiras participants had a longer history of personal exposure to buriti resources than Atins participants. Atins participants also had weaker historical ties to their current community of residence, as 50% of them are originally from Laranjeiras. Likewise, 55% of Atins participants had learned buriti preparation skills as children living in Laranjeiras or from their mother who came from Laranjeiras. Atins market participants reported greater parental exposure than personal exposure to buriti, and more frequently learned buriti handicraft skills from their parents. In contrast, Laranjeiras participants more frequently learned these skills from people around them.

Household wealth was similar between market participants of both regions. Although household use of buriti was greater in Laranjeiras, 40% of Atins participants used mature buriti leaves to meet subsistence needs. In comparison to Atins, Laranjeiras participants had more household members engaged in buriti activities. In comparison to Laranjeiras, Atins participants were more likely to report that engaging in the buriti market was a worthwhile time investment. Interviewees from both sites reported difficulty obtaining buriti fiber and leaves.

Most socioeconomic factors, including household wealth, were similar for Laranjeiras (n = 18) and Atins (n = 19) non-participants in the buriti market. Thirty percent of all non-participants had learned buriti crafts from their parents as children, so they could engage in the buriti market if they desired. More than 75% of non-participants reported that participating in the buriti market was a worthwhile and enjoyable activity. In comparison to Laranjeiras, Atins non-participants demonstrated more interest in joining the buriti market and reported that handicraft production was a lucrative, easy-to-learn activity that could bring greater personal independence. Non-participants interested in joining the buriti market reported that lack of skills and time were obstacles. Few non-participants (20% of Atins, 5% of Laranjeiras) listed lack of young leaves and fiber as a reason to not participate in the market. Laranjeiras non-participants perceived that buriti production was not a worthwhile cost-benefit investment and they lacked sufficient skills to transition into making new products for a changing market.

Thirty-three percent of Laranjeiras and 72% of Atins non-participants had engaged in the buriti market sometime in the past. Although some Atins non-participants had made handicrafts while living in Laranjeiras, most had worked with handicrafts while living in Atins. Both Atins and Laranjeiras were similar in regards to their individual buriti participation. More Atins non-participants than in Laranjeiras reported having the expert skills of rendering buriti fiber from raw young leaves, which hinted at their strong background with buriti. Both groups equally had experience with sales activities (70%), but most Laranjeiras and Atins non-participants (75%) reported having no interest in selling buriti handicrafts because they lacked of money, time, and opportunity. Overall, most Atins interviewees (participants and non-participants) perceived that working with buriti was a worthwhile investment.

Table 2 Means of socioeconomic factors among market participants and non-participants in Laranjeiras and Atins study areas

	Participants (n = 69)			Non-participants (n = 37)		
	Different means[a]	Laranjeiras (n = 47)	Atins (n = 22)	Different means[a]	Laranjeiras (n = 18)	Atins (n = 19)
Individual level variables						
Individual demographics						
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)
Individual History						
Born Community		0.51	0.36	X	0.78	0.42
Personal exposure to buriti	X	0.96	0.55	X	0.83	0.32
Parent Born In Community		0.51	0.32	X	0.69	0.39
Parental exposure to buriti		0.84	0.63	X	0.88	0.47
Learned buriti from parent		0.43	0.55		0.31	0.28
Individual buriti participation						
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			
Individual perception						
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
Individual activities						
Handicrafts activity		0.94	0.95		0.06	0
Number of activities		2.43 (0.85)	2.55 (0.86)		1.56 (0.62)	2.05 (0.85)
Household demographics						
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)
Main income buriti		0.68	0.73			
Buriti household use	X	0.89	0.41	X	0.83	0.58
Household member buriti	X	1.70 (1.01)	0.82 (1.60)			
Household wealth						
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
Household income						
Handicraft income		0.91	0.91		0.11	0
Number of income sources		3.62 (1.29)	3.68 (1.25)		2.94 (1.63)	3.37 (1.46)

[a] "X" denotes statistically significant different means according to T-Test and Wilcoxon rank sum test ($p < 0.05$)

Discussion

The Atins group might be expected to represent an expanding market for buriti handicrafts given external market opportunities, but the results showed otherwise. Instead, it was found that Atins was part of an extended system of traditional buriti use, where social mechanisms allowed them to access buriti, while setting limits on their market participation.

Atins' interviewees relied on market value chains, social networks, and social organization to ensure cheap dependable access to buriti fiber. Lack of spatial mobility can reduce access to natural resources (Sobreiro 2015), but market value chains can offset this deficit. As Atins households could not legally extract buriti products, their participation was restricted to the market end of the value chain, which was also the most financially rewarding (Virapongse *et al*. 2013). Atins participants acquired buriti fiber from Laranjeiras extractors, who were often relations offering reasonable prices for fiber. In comparison, Laranjeiras participants could access all parts of the value chain, but often remained closer to the forest end of the market chain.

The Mandacaru Community was an exception. Participants here lacked social network connections to extractors in Laranjeiras, as well as the knowledge of how to prepare fiber products (Mandacaru artisans had less than five years experience working with buriti). Mandacaru market participants, as a consequence, implemented social cooperation initiatives. No other study community succeeded in self-organizing in this way. Instead, other participants relied on SEBRAE (the Brazilian government micro- and small-businesses support service) based in Barreirinhas (SEBRAE 2007) for marketing and production assistance. For these communities, external assistance was needed to engage in global forest product markets. Social organization is essential for making NTFP value chains more efficient and sustainable (te Velde *et al*. 2006) as it ensures better returns by providing more negotiating power to participants (Ghimire *et al*. 2004).

The power relationships inherent within multiple governance structures has implications for sustainability (Berkes and Ross 2013). Neither the community-based (e.g., private owners) nor the legal governance levels supported collection of young buriti leaves, which is viewed as unsustainable. Extractors have the least power in this governance framework. They lacked ownership of buriti resources and are often unable to gain permission to collect leaves. Left with little choice, many extractors collected leaves in places difficult to access or without permission. These actions only furthered the social stigma associated with young leaf extraction.

A desire to participate in NTFP markets is as important as need (Cocks *et al*. 2008; Shackleton *et al*. 2007). Laranjeiras participants participated mostly on the forest end of the value chain – the most risky (e.g., physically challenging, potentially illegal) and labor-intensive portion of the process. In addition, both a man (extractor) and a woman (fiber processer) must work together towards the same goal. For these reasons, Laranjeiras interviewees often perceived the buriti handicraft process as difficult and time-consuming, and not worth the investment. In contrast, unable to directly access buriti leaves, Atins participants worked on the market end of the value chain, so handicraft production was perceived to be an easy, lucrative, and attractive activity for them. This perception was also fueled by the scarcity of other income opportunities. These results demonstrate that market value chain dynamics must be considered in development initiatives that seek to encourage NTFP commercialization as an income generator.

Most Laranjeiras interviewees relied on their personal, on-going experience to learn handicraft production skills. In contrast, Atins interviewees relied more on knowledge transmission through their parents. This demonstrates that local knowledge transmission about natural resources is particularly important outside the resource locale. In contrast, people with regular access to resources can learn and generate knowledge through direct contact with the environment.

Regarding the control group of non-participants, it is necessary to consider a larger time scale in regards to their market participation. Many non-participants had temporarily stopped participating in the market because of lack of time (e.g., an early phase of the household life cycle with small children; Perz 2001). Others sought to join the market, but lacked handicraft production skills. As other studies have shown (Cocks *et al*. 2008; Paumgarten and Shackleton 2009; Shackleton and Shackleton 2006), lack of wealth did not drive participation in the buriti market, as non-participants demonstrated less financial stability than participants. Even so, as other NTFP market studies show (Marshall *et al*. 2006; Shackleton *et al*. 2011), buriti handicraft production is an attractive, if hard to attain, income earning option because there are few income generating choices available to women in the region. The challenges cited by participants in the buriti market are often not evident to non-participants, as they see the benefits and not the obstacles of participating in the buriti market.

Increasing demands for young buriti leaf fiber, competition with other uses of buriti (e.g., fruit, mature leaves), and control of buriti resources by governmental agencies and private owners may lead to buriti use conflicts in the future. Secure ownership of NTFPs that allows for more diverse user groups to access buriti resources would help ensure that those who rely on its resources most can meet their livelihood needs, while supporting sustainable management of resources (Ghimire *et al*. 2004; Kusters *et al*. 2006). Multi-scale governance is needed to align governmental laws and policy through better partnerships with less powerful extractors, local resource managers (e.g., private owners), and agency stakeholders to create management plans that more closely reflects the reality of the resource and user base (Mayers and Vermeulen 2002).

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