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Papers

Influence of Tourism Centers on the Diversity of Uses, Management Practices, and Traditional Knowledge of the Buriti Palm (*Mauritia flexuosa*)

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Abstract
The sustainable use of non-timber forest products is essential for conserving biodiversity while supporting the livelihoods of traditional communities. The research was conducted in the Lençóis Maranhenses region (Maranhão State, Brazil), an area characterized by intense tourism activity and recognized as one of the main centers of buriti (*Mauritia flexuosa*) fiber extraction in Northeast Brazil. These features make the region a privileged setting to understand: how proximity to tourism hubs affects the diversity of uses, management practices, and the preservation of traditional knowledge associated with the buriti palm? Semi-structured interviews were conducted with extractives in municipalities with different levels of access to the tourism market. The municipality with the highest tourist influx showed lower diversity of uses (16 uses; $H = 60.07$; $p < 0.01$), a predominance of commercial applications (UDV for food = 0.645), a shorter interval between leaf collections (52 days), and a higher incidence of destructive harvesting practices (33%). In contrast, municipalities less integrated into tourism routes preserved a greater diversity of uses. Management practices were predominantly non-destructive, although signs of erosion of these practices were observed in areas with moderate tourism influence. Women play a central role throughout the production chain. It is concluded that tourism, although it enhances income generation and cultural visibility, promotes economic specialization and weakens traditional knowledge, increasing the risks of unsustainable resource use. Conservation strategies should integrate the strengthening of local economies with the recognition of traditional knowledge and the regulation of resource exploitation in territories under tourism pressure.

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INTRODUCTION

The term Non-Timber Forest Products (NTFPs) refers to all biological materials other than timber that are harvested from forests for human use, such as fruits, fibers, seeds, and resins (Belcher *et al.*, 2005; Shackleton *et al.*, 2018). The use and management of non-timber forest products (NTFPs) have played a central role in the subsistence strategies and income generation of traditional communities across various tropical regions (Rosenveld *et al.*, 2024; Shackleton *et al.*, 2018). Among the factors influencing the intensification of plant extraction, proximity to tourism markets stands out as a phenomenon that has reshaped traditional management practices and the socioeconomic dynamics of local populations (Berkes, 2018).

Tourism, especially in environmentally sensitive territories, increases the demand for handicrafts, regional foods, and other biodiversity-based products, thereby raising the economic value of NTFPs while simultaneously generating additional pressure on natural resources (Bachi; Carvalho-Ribeiro, 2023; Belcher *et al.*, 2020).

In this context, species such as the buriti palm (*Mauritia flexuosa*), whose exploitation involves fruits, fibers, and leaves, have gained prominence in tourism-oriented value chains, as observed in areas near the tourist hubs of the Lençóis Maranhenses region (Homma *et al.*, 2012).

Although the expansion of consumer markets can enhance household incomes and promote the cultural recognition of traditional knowledge, several studies warn that unplanned intensification of resource extraction compromises the ecological sustainability of these resources, especially when traditional management practices are replaced by short-term commercial strategies (Shanley *et al.,* 2011; Toledo; Barrera-Bassols, 2017). Furthermore, there is evidence that tourism can both strengthen and weaken local ecological knowledge (LEK), depending on how communities are integrated into the value chains (Berkes, 2018; Shackleton *et al.*, 2018). The term Local Ecological Knowledge (LEK) refers to the cumulative body of knowledge, practices, and beliefs held by traditional communities regarding local ecosystems, species behavior, and sustainable management practices (Berkes, 2018; Toledo; Barrera-Bassols, 2017).

In this context, it becomes essential to understand how proximity to tourism centers influences the management of NTFPs, particularly in territories where the exploitation of native species represents a direct interface between conservation, the local economy, and cultural heritage. Analyzing these relationships is crucial to supporting public policies and sustainable management initiatives that reconcile the strengthening of traditional economies with biodiversity conservation.

This study is grounded in the perspective of political ecology and ethnoecology, considering non-timber forest products (NTFPs) as central elements of socioecological systems where market pressures, cultural practices, and traditional knowledge interact under conditions of tourism expansion (Berkes, 2018; Toledo; Barrera-Bassols, 2017). By adopting this framework, we aim to reinforce the interpretative basis of the analysis, highlighting how tourism simultaneously generates economic opportunities and risks of knowledge erosion and resource overexploitation.

M. flexuosa markets in Brazil provide primary and supplemental income sources for vulnerable groups, especially in regions where income is irregular. The growing market for *M. flexuosa* young leaf fiber in the Lençóis Maranhenses region of Northeast Brazil is one example of how increasing demand for a particular forest product has led to different economic pressures on use and management to supply the local and national tourist market in Brazil (IPEA, 2016). Despite the growth in demand, communities in the region continue to preserve traditional characteristics of management, culture, and routine around the palm. Indeed, family networks can be an important predictor as to how local people access resources. The objective of our work was to analyze how proximity to tourism centers influences the use, and management of non-timber forest products derived from the buriti palm (*Mauritia flexuosa*), with emphasis on the socioeconomic dynamics and traditional practices of extractivist communities in the Lençóis Maranhenses region.

MATERIALS AND METHODS

Area of study

This study was conducted in municipalities (Barreirinhas, Paulino Neves, and Tutóia) located in the Lençóis Maranhenses region of the Maranhão state of Brazil (ICMBio, 2022).

The freshwater gallery forests are interspersed with swamp forests dominated by *M. flexuosa*, which is known locally as buriti (Brasil, 2002). The economy of the Lençóis Maranhenses region is based on general and agricultural services (IBGE, 2019).

Maranhão state produces the largest tons of extracted buriti fiber in the Northeast of Brazil (IBGE, 2019). The municipalities of Barreirinhas and Tutóia were the third and fourth largest fiber extractors respectively in Brazil in 2019, extracting 78 and 39 tons of buriti fibers respectively that year (IBGE, 2019). The municipality of Paulino Neves is located between Barreirinhas and Tutóia (39.6 kilometers from the center of Barreirinhas; 33 kilometers from the center of Tutóia), and the vegetal extraction of buriti is also a major source of family income in Paulino Neves (IPEA, 2016). These three municipalities have different marketing possibilities, although Barreirinhas presents the best market conditions because it is the governing center for the region and has the most developed tourism, transportation, healthcare, and economic infrastructure (IPEA, 2016). Tutoia has moderate tourism influence. In comparison to Barreirinhas and Tutoia, Paulino Neves receives a smaller proportion of tourists who might purchase products made with buriti fibers, so many of the products made in Paulino Neves are sold directly to merchants in Barreirinhas. Tutóia, on the other hand, sells most of their buriti fiber products to merchants in Barreirinhas (IPEA, 2016).

Collection of ethnobotanical data

The Ethnobotanical data refers to information that documents the diverse interactions between humans and plants, encompassing their uses, cultural significance, and management practices (Albuquerque *et al.*, 2014; Shanley *et al.*, 2011).

There is no existing data on the population of extractives and artisans in the study region. Therefore, a snowball sampling technique, which is often used to identify hidden populations, was used to identify our sample group. Snowball sampling consists of one respondent indicating another until informants who meet pre-determined selection criteria are found (Goodman, 1961). The selection criteria that we used in the snowball sampling where: individuals over 18 years old, individuals who extracted buriti fiber, and individuals living in communities involved in buriti fiber. Semi-structured interviews were conducted with all individuals of the sample group between August 2014 and December 2015. The interview was formulated to characterize the uses of the buriti palm: parts of the plant used, techniques and frequency of leaf collection, and other parts extracted by palm. The socioeconomic data of the respondents collected included sex, age, education, distance from home to the point of sale, type of residential area (rural or urban), monthly family income, and whether or now the owned or did not own the leaf collection area.

This study was approved by the Comitê de Ética em Pesquisa com Seres Humanos da Universidade Federal do Piauí (Ethics Committee of the Federal University of Piauí), under permit number 886.193 and Sistema Nacional de Gestão do Patrimônio Genético e do Conhecimento Tradicional Associado (National System for the Management of Genetic Heritage and Associated Traditional Knowledge) (AD0CB23).

Data analysis

The importance of *M. flexuosa* to extractives was determined by the use-diversity value (UDV) index, which measures the importance of use categories and how they contribute to the local use value. It is obtained from the number of recorded citations in a use category divided by the total number of citations in all categories (Silva *et al.*, 2014); a higher value indicates more importance of a use category. The uses cited by respondents were divided into seven categories: food, handicraft, home utensils, construction, cosmetic, regional culture and others. The plant part value (PPV) index, which measures the degree of consistency among informants about the parts used, was also evaluated. It was obtained from the total number of citations reported for each part of the plant divided by the total number of citations for all plant parts (Silva *et al.*, 2014).

Generalized linear model (GLM) analysis was used to examine whether the independent variables (gender, age, schooling, residential distance from the commercial area, residence place [rural or urban], and monthly household income [total value in Brazilian Real (R$) of the

income from all household members per month]. The exchange rate of dollars during the period of data collection fluctuated between R$ 3.39/US$ to around R$ 3.87/US$], and income from sale of products derived from *M. flexuosa* per month) were correlated with the dependent variable (number of uses and collection practices frequency and quantity of leaves extracted per palm). The explanatory power of each independent variable (R^2) was verified by forward stepwise linear regression.

Differences between communities regarding the number of uses, number of leaves extracted per palm and frequency of collection per palm were examined by the Kruskal-Wallis's test (H), followed by the student-Newman-Keuls test. Differences between the strategies to obtain buriti fruit were tested using the Chi-square goodness-of-fit test. Statistical tests were performed using BioEstat 5.0 software and $p < 0.05$ was considered to indicate statistical difference.

The Kruskal–Wallis test, Student–Newman–Keuls test, and Chi-square goodness-of-fit test refer to non-parametric and parametric statistical methods commonly used in ethnobotanical and ecological research to assess group differences and compare observed frequencies (Silva *et al.*, 2014; Zar, 1999).

RESULTS

Socioeconomic characterization of extractives and uses of M. flexuosa

In the study area, 274 extractives of *M. flexuosa* were identified. In Barreirinhas, we interviewed 146 women (76 %) and 45 men (24%). The age of these informants ranged from 18 to 77 years. The monthly household income ranged from R$ 30.00 to R$ 5,000.00. The minority (27.16%) received more than one minimum monthly salary (R$ 788.00 per month). The monthly income from the sale of handicrafts ranged from R$ 10.00 to R$ 5,000.00, of which only 4.52% earned more than one minimum wage. Barreirinhas extractivists provided 465 citations of use and identified 16 different uses for *M. flexuosa* (Table 1). Knowledge about uses and extractives techniques was acquired from ancestors (90%) or from neighbors through the oral transmission of knowledge

A total of 51 extractives were identified in Paulino Neves, 33 women (65%) and 18 men (35%). Their ages ranged from 18 to 73 years, and their monthly household income ranged from R$ 40.00 to R$ 1,500.00, with only 11.76% receiving above a minimum wage. The monthly income obtained from the sale of handicrafts ranged from R$ 10.00 to R$ 300.00, values below the minimum wage. These extractives provided 169 citations and identified 22 different uses for buriti palm (Table 1).

In Tutóia, we interviewed 32 extractives, 26 women (81%) and 6 men (19%). Their ages ranged from 18 to 89 years, and the monthly household income ranged from R$ 50.00 to R$ 2,201.00. Among which, 9.37% receive above a minimum wage. The monthly income from the sale of handicrafts ranged from R $ 40.00 to R $ 250.00, less than the minimum wage. The Tutóia extractives provided 242 citations and identified 45 different uses (Table 1). Both in Tutóia and in Paulino Neves, knowledge about the uses and techniques of extractives was acquired only with parents and grandparents by 99% of the informants and the others with neighbors.

In these municipalities, the fiber extracted from the leaf blade was the main use, followed by consumption of candy and raw fruit (Table 1). Significant pairwise differences were found between the numbers of uses cited in the three municipalities. Barreirinhas informants presented a lower diversity of uses (16) than Paulino Neves (22) and Tutóia (45) ($p < 0.01$; $H = 60.07$) and Tutóia was greater than Paulino Neves ($p < 0.0001$; $H = 60.07$).

Table 1- Uses of *Mauritia flexuosa* L. f. cited by extractivists residing in Barreirinhas (B), Paulino Neves (PN), and Tutóia (T) in the Lençóis Maranhenses region of Maranhão, Brazil

Category	Uses	Part of the plant	Number of citations			
			B	P N	T	Total
Food	Candy	Fruit	99	35	22	156
	Raw Fruit	Fruit	84	18	9	111
	Raspa[1]	Fruit	5	8	7	20
	Juice	Fruit	54	18	3	75
	Liquor	Fruit	37	4	3	44
	Ice cream /suquinho[2]	Fruit	22	-	-	22
	Pudding	Fruit	3	3	-	6
	Cake	Fruit	-	1	4	5
	Oil	Fruit	-	1	-	1
Handicraft	Fiber	Leaf blade	140	33	10	183
	Bag	Leaf blade	8	8	23	39
	Slippers	Leaf blade	1	-	2	3
	Necklace	Leaf blade	1	-	-	1
	Cap	Leaf blade	-	-	1	1
	Earring	Leaf blade	-	-	1	1
	Bracelet	Leaf blade	-	-	1	1
Home utensils	Basket	Petiole	3	2	8	13
	Bench / chair / stool	Petiole	-	4	7	11
	Tapiti[3]	Leaf blade	-	4	6	10
	Sieve	Petiole	-	3	6	9
	Toys	Petiole	-	1	8	9
	Trough	Steam	-	-	9	9
	Embira[4]	Leaf blade	-	3	1	4
	Bird cage	Petiole	-	1	3	4
	Vasculhador[5]	Leaf blade	1	1	2	4
	Shelf	Petiole	-	-	4	4
	Hammock	Leaf blade	-	1	2	3
	Hat	Leaf blade	-	1	2	3
	Duster	Leaf blade	-	-	3	3
	Saddle pads for horse	Leaf blade	-	-	3	3
	Washboard	Petiole	-	-	2	2
	Wardrobe	Petiole	-	-	2	2
	Hand fan[6]	Leaf blade	-	-	1	1
	Giral[7]	Petiole	-	-	1	1
	Loom	Petiole	-	-	1	1

Construction	Cover of house	Leaf blade	-	14	26	40
	Rafters, lath, and columns	Steam	-	8	29	37
	Fencing	Petiole	-	4	5	9
	Door	Petiole	-	-	7	7
	Window frame	Petiole	-	-	6	6
	Pigsty	Petiole	-	2	2	4
	Boat	Petiole	-	-	1	1
	Ceiling	Petiole	1	-	-	1
	Bridge	Petiole	-	-	1	1
	Chicken hutch	Petiole	-	-	2	2
Cosmetic	Skin cream	Fruit	6	-	-	6
	Bath soap	Fruit	3	-	-	3
	Shampoo	Fruit	1	-	-	1
Regional culture	Traditional dance clothes	Leaf blade	-	-	2	2
	Mats to give birth	Leaf blade	-	-	1	1
Others	Fertilizer	Leaf blade	-	-	2	2
	Animal food	Leaf blade	-	-	1	1
	Snooker cues	Petiole	-	-	1	1
Total	53		469	178	243	890

[1]Grated fruit; [2]Frozen juice in narrow plastic bag; [3]Type of sieve; [4]Type of rope; [5]Type of broom; [6]Artifact used for fanning; [7]Container for drying dough extracted from *Manihot esculenta*.

Source: The authors (2024).

Considering the diversity of uses (UDV), the categories of handicraft and human food were most important in Barreirinhas and Paulino Neves compared to the other categories (Table 2).

In Tutóia, the construction category was the most important, followed by home utensils. Use for cosmetics was an important category only in Barreirinhas, while regional culture was unique to Tutóia.

Table 2 - Use-diversity values (UDV) for use categories of *Mauritia flexuosa* L.f. based on citations of use identified by extractives in Barreirinhas, Paulino Neves, and Tutóia, Lençóis Maranhenses region, Maranhão, Brazil

Use category	**Use-diversity values (UDV)**		
	Barreirinhas	**Paulino Neves**	**Tutóia**
Food	0.645	0.610	0.174
Handicraft	0.323	0.210	0.161
Home utensils	0.008	0.050	0.301
Construction	0.002	0.130	0.335
Cosmetics	0.022	0.000	0.000
Regional culture	0.000	0.000	0.013
Others	0.000	0.000	0.016

Source: The authors (2024).

The interviewed extractives demonstrated knowledge of four different parts of *M. flexuosa* (Table 3). Fruits were most cited in Barreirinhas and Paulino Neves. In Tutóia, leaf blade of immature leaves and petiole of immature and mature leaves were the most used parts. Trunk was not mentioned in Barreirinhas.

Table 3 - Useful plant part values (PPV) for *Mauritia flexuosa* L.f. determined by the uses of extractivists of this resource from Barreirinhas, Paulino Neves and Tutóia, Lençóis Maranhenses region, Maranhão, Brazil

Part of the plant	Useful plant part values (PPV)		
	Barreirinhas	Paulino Neves	Tutóia
Fruit mature	0.667	0.467	0.173
Leaf blades from immature leaves	0.325	0.385	0.383
Petiole from mature and immature leaves	0.009	0.101	0.284
Trunk of adult palms	0.000	0.047	0.160

Source: The authors (2024).

Monthly household income for respondents had a linear correlation with the number of known uses in Barreirinhas ($R^2 = 0.366$, $p = 0.0005$), suggesting that people with higher monthly income use more buriti products. In Paulino Neves ($R^2 = 0.077$, $p = 0.818$) and Tutóia ($R^2 = 0.266$, $p = 0.436$), the variables evaluated did not influence the number of *M. flexuosa* uses.

Collection and management of M. flexuosa

One hundred and thirteen extractives, corresponding to 62% of the respondents in Barreirinhas, reported extracting young leaves and fruits. The remaining 78 (38%) preferred buying these items instead of collecting them. In Paulino Neves, 45 (88%) respondents reported extracting immature and mature leaves, fruits, and trunk and 6 (11.2%) preferred buying the leaves, trunk and fruits for their own use. In Tutóia, 24 (75%) respondents collect young and mature leaves, fruits, and trunk, although 8 (25%) of these respondents stated they extract these plant parts only when not having money to buy them. In the three study municipalities, all women collected leaf blades and petiole of immature palms, while the men collected the leaves, fruits and steam of tall adult and immature palms. The collection of the leaves occurs throughout the year.

In Barrerinhas, 93 (49%) respondents mentioned extracting young leaves and fruits only along the margins of Preguiça River, which runs through the municipality and serves as the main waterway for the region. The other informants reported traveling to Paulino Neves to obtain the needed leaves. The extractives in Paulino Neves and Tutóia extract on private lands where they live.

Barreirinhas respondents noted that they remove one immature leaf (1.02 ± 0.19) from each palm, performing the next collection on the same plant after a time interval of 52 days (52.0 ± 26.7). In Paulino Neves, one leaf (1.09 ± 0.30) per plant is collected on average every 63 days (63.3 ± 37.0). In Tutóia, one (1.03 ± 0.20) leaf is extracted per palm and the time interval for the same plant is 61 days (61.9 ± 21.5).

No statistically significant differences between the average number of leaves collected per palm among the municipalities were found ($p > 0.05$; $H = 7.71$). On the other hand, the leaf collection time interval presented statistically significant differences ($p < 0.05$; $H = 6.77$). The time interval for exploiting the same palm in Barreirinhas is lower than in Tutóia ($p = 0.025$; $H = 4.69$) and Paulino Neves ($p = 0.075$; $H = 3.59$). No differences were observed between Tutóia and Paulino Neves ($p = 0.520$; $H = 0.26$).

The respondents of the three study municipalities mentioned they use nondestructive collection, removing the immature leaves only after the petiole is exposed. However, 33% (36) of respondents in Barreirinhas, 4% (2) in Paulino Neves and 4% (1) in Tutóia reported they also perform destructive collection, before the petiole is

fully exposed. In the three study municipalities, the collection of trunks was reported to occur only after the natural death of the palm.

Statistically significant differences were observed in the strategies that respondents adopted to obtain fruits in the municipalities ($X^2 = 25.32$; df = 2; $p < 0.0001$). Two fruit collection strategies were identified by respondents from Barreirinhas, with no statistically significant differences between them ($X^2 = 1.96$; df = 1.69; $p = 0.1615$). Collecting fruits from the ground that had naturally fallen (57%) was the most frequent strategy, followed by buying the fruit (43%). In Paulino Neves and Tutóia, extractives indicated two strategies to obtain fruits. In Paulino Neves, collecting fruits from the ground that had naturally fallen (88%) was the most common practice, followed by buying fruits (12%) ($X^2 = 57.76$; df = 1; $p < 0.0001$). In Tutóia, 75% of respondents collected the fruit on the ground and 25% preferred to buy them ($X^2 = 25.00$; df = 1.02; $p < 0.0001$). Finally, only in Tutóia did gender influence leaf (young and mature leaves) management ($R^2 = 0.520$; $p = 0.0430$), where it was observed that women collect leaves more frequently than men ($p < 0.05$). However, the number of leaves collected was independent of any studied socioeconomic factors for all municipalities ($R^2 = 0.062$; $p > 0.05$).

DISCUSSION

Traditional Knowledge

As the demand for non-timber forest products (NTFPs) increases, there's a tendency for communities to specialize economically often at the expense of broader traditional knowledge. In places with more market influence, for example, greater market integration has been linked to fewer known uses of the plant. This trend has been discussed in literature, where market-driven economies push extractives to focus on high-value uses, potentially narrowing their broader ecological understanding (Belcher *et al.*, 2005).

However, the relationship with markets is not always straightforward. Some studies suggest that market access may also enhance knowledge, especially in wealthier communities (Campos *et al.*, 2015). But in places with less market influence, where commercial demand is low, knowledge appears to be equally distributed regardless of income possibly due to daily, hands-on contact with the resource.

This suggests that lower market pressure may help preserve a more diverse body of traditional knowledge. Remote communities often serve as strongholds of biocultural memory (Davidson-Hunt; Berkes, 2003), where the daily use of plants strengthens the passing of knowledge across generations. It highlights the importance of protecting cultural landscapes where ecological wisdom is still alive and well (Gómez-Baggethun *et al.*, 2013).

The prominent use of *M. flexuosa* for construction and household utensils in Tutóia also illustrates its versatility in rural, low-income settings. Similar patterns are observed in other traditional societies, where plants are not only sources of food or craft materials but form part of the built environment, contributing to more resilient ways of living (Dawson, *et al.*, 2024).

Notably, differences in the way people acquire the resource also reveal important dynamics. Around 38% of respondents in places with more market influence reported buying buriti rather than collecting it themselves, while in Tutóia, place with less market influence, this number was just 25%. Outsourcing extraction like this can weaken local ecological knowledge (LEK) as people become removed from the natural cues and traditional techniques that guide sustainable use (Moura *et al.*, 2024).

Environmental Impacts of Harvesting

Several authors point out that easier access to tourism markets tends to intensify the exploitation of non-timber forest products (NTFPs), leading to increased pressure on plant species with high commercial value, such as fibers, fruits, seeds, and palm-derived handicrafts (Bachi; Carvalho-Ribeiro, 2023; Shanley *et al.*, 2011). In areas near tourist hubs, the demand for souvenirs, typical foods, and traditional crafts stimulates large-scale harvesting, often without proper management planning, which may compromise the regeneration of natural resources. For example, in Amazonian communities close to established markets, there has been an increase in the exploitation of species like *Mauritia flexuosa*, with reports of overharvesting of fruits to meet tourist demand, especially during peak periods (Barros *et al.*, 2021). While many extractives follow responsible harvesting practices, signs of overexploitation are evident in areas with high market demand, like

Barreirinhas. When the time between harvests becomes too short, palm regeneration is at risk, which can lead to long-term population declines (Sampaio *et al.*, 2008).

Harvesting fruits can also reduce food sources for local wildlife, even when done non-destructively. There's a clear need for more research into the ecological consequences of such practices.

At the same time, the wide range of ways the plant is used in places with less market influence for tools, construction, and beyond highlights how traditional systems incorporate biodiversity into everyday life. This approach helps build more resilient livelihoods, particularly in communities facing economic vulnerability (Dawson *et al.*, 2024)

This highlights the need to view NTFP exploitation not only through an ecological lens but also as part of larger socio-ecological systems, where economic specialization can generate risks of ecological imbalance (Homma, 2012; Spash, 2024). Strengthening community-based management and aligning with national biodiversity frameworks remain essential for mitigating such impacts (Fariss *et al.*, 2022; Camillo, 2022).

Cultural Dimensions of Sustainability

Proximity to tourism markets can also generate positive effects by enhancing the cultural and economic recognition of NTFPs. Tourism can encourage traditional communities to maintain artisanal practices and adopt sustainable management strategies to differentiate their products and preserve cultural heritage, adding value to certified products or those associated with local identity (Belcher *et al.*,2020).

Studies in African and Latin American countries show that rural tourism and ecotourism create incentives for the sustainable use of NTFPs, provided they are integrated with public policies and technical training (Shackleton *et al.*,2018).

Cultural values, such as belief in guardian spirits, a sense of territorial identity, and the sharing of knowledge between generations influence how *M. flexuosa* is used and managed in Lençóis maranhenses in Paulino neves (Vieira *et al.* 2016). In places with less market influence, for instance, there is a clear respect for the plant's natural life cycle, suggesting a deep-rooted environmental awareness. This reinforces the idea that attributing cultural value to certain species can support their long-term conservation (Sawadogo *et al.*, 2022).

A striking example of this is the shared practice, across all communities, of only using palm trunks after the tree has died naturally. This unspoken rule reflects a community-based conservation ethic. Even in the absence of formal regulation, such behaviors resemble "cultural taboos" that exist in many traditional societies, where certain plant parts are not touched out of respect (Clement, 2006). These are part of a broader system of biocultural memory that regulates human–nature relations (Lévi-Strauss, 2024; Toledo; Barrera-Bassols, 2015). Such mechanisms reinforce community resilience and help sustain ecological practices under external pressures (Gómez-Baggethun *et al.*, 2013). These insights support the need for public policies that don't just tolerate traditional knowledge but actively integrate it as a pathway to sustainability and income generation (Posey, 1996).

Gender and Extractivism

Women play a central role in buriti extraction and in crafting products from its materials. Across all study sites, they are often the ones collecting, processing, and transforming the plant, helping to sustain household incomes and strengthen cultural traditions (Barros *et al.*, 2021).

Still, it's vital that this participation happens under fair conditions. Women must have proper access to support policies, training, and dignified working conditions. Recent studies also highlight the essential role women play in keeping artisanal knowledge alive, often through domestic-scale production, and emphasize the need for government and stakeholder engagement in preserving these cultural practices (Bridgewater State University, 2023).

FINAL CONSIDERATIONS

This study demonstrates that proximity to tourism hubs significantly reshapes the relationship between traditional communities and the buriti palm, fostering economic specialization while reducing the diversity of uses. Beyond confirming previously described patterns, our findings show that tourism in the Lençóis Maranhenses functions simultaneously as a driver of traditional knowledge erosion and as a source of income and cultural visibility. This

paradox calls for a critical stance in public policy: regulating buriti exploitation, strengthening traditional management practices, and implementing mechanisms to ensure resource sustainability are urgent priorities. We also highlight the central role of women in this process and argue for policies that expand their autonomy and working conditions. Finally, we emphasize the need for future research to integrate long-term ecological and socioeconomic approaches to better understand the cumulative effects of tourism and to support conservation and development strategies that combine local economies, cultural heritage, and biodiversity.

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