Chapter

Bertholletia excelsa: Key Species for Sustainable Livelihoods and Forest Conservation

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Abstract

Brazil nut (*Bertholletia excelsa* Bonpl.) is vital for livelihoods in the Amazon region as a source of income and food, and since it is collected mainly from old-growth forests, it is also a cornerstone for forest conservation. This chapter presents socioeconomic and cultural characteristics of Brazil nut collectors, depicting their production systems and identifying individual perceptions about the effects of this activity on their livelihoods and on forest conservation. We interviewed 119 collectors, organized in associations, cooperatives, or autonomous informal organizations. Collectors live from agriculture, fishing, and forest extractivism, and reported the of use more than 30 forest products, highlighting their refined knowledge on forests. On the other hand, they have little access to formal education and information technology. The collection of Brazil nuts proved to positively impacts livelihoods' capitals, being a key species for forest conservation and maintenance of Amazonian livelihoods. Forests are plentiful in Brazil nut trees and collectors are much more likely to remain in forests, incentivizing their conservation. Moreover, the organization into associations or cooperatives is especially positive to broaden sales options and achieve better market prices, breaking historical cycles where middlemen played a preponderant role in Brazil nut commercialization processes across the Amazon region.

Keywords: non-timber forest products, Brazilian Amazon, traditional communities, sustainable livelihoods, Brazil nut tree

1. Introduction

Bertholletia excelsa Bonpl. (Brazil nut tree) is one of the most prominent species of the Amazon forests. It has called the attention to human populations since early occupation by the first Amerindians to the present day [1], since scientific evidence suggests that some dense *B. excelsa* stands have anthropogenic origins [2]. Its seeds are widely consumed and highly valued in regional, national and international markets. It is of great economic importance, especially across Brazil, Bolivia, and Peru [3, 4], being a source of income for thousands of local communities, as indigenous, riverine, and "*quilombola*" communities [5]. Brazil nuts are the only internationally marketed seed product collected exclusively from old-growth tropical forests [6, 7].

Management of Brazil nut groves is seen as an important strategy for forest conservation and local development [3, 6, 8, 9].

Brazil nut economic importance gained greater dimensions with the crisis in the natural rubber economy, starting from the 1930s. Commercialization of Brazil nuts was structured on the same basis as the commercialization of natural rubber, following the logic of the "*aviamento*," where the commercial relationship is based on the exchange of products, without the flow of money. In this system, extractivists provide products such as rubber and Brazil nuts to the "bosses," who, in return, provide basic subsistence products. Historically, in this exchange relationship, extractivists ended up indebted, characterizing themselves as social groups devoid of economic strength and political insertion, and presenting themselves as fragilely organized and distant from decision-making centers [10].

Most extractive forest products undergo economic cycles marked by three phases: growth in volumes extracted due to the awakening of economic interest; the limit of supply capacity in view of available stocks; and the decline in extraction with the start of commercial substitute plantations [11]. The commercial collection of nuts, through extractivism, has lasted for more than a century, making it an exception to this typical cycle of forest extractives. Between 1998 and 2017, Brazil nut production fluctuated between 23,000 tons and 42,000 tons per year, strongly linked to natural variation of annual fruit production and individual tree productivity [12]. Despite the high intensity of fruit collection, Brazil nut collection does not jeopardize the natural regeneration and maintenance of it populations [13]. Its total production has been increasing year after year, jumping from R$ 9.6 million in 1998 to R$ 105 million in 2017 [14].

The large number of people involved in collecting Brazil nuts and their economic importance underscore the need to unveil the impacts of this activity on the livelihoods of Amazonian extractivists. This chapter aims to present socioeconomic and cultural characteristics of Brazil nut collectors from three different regional contexts in the Brazilian Amazon, depicting their production systems and identifying individual perceptions about the effects of this activity on their livelihoods and on the conservation of forest ecosystems.

2. Extractivism of Brazil nut as a livelihood for Amazonian peoples

2.1 Methodology

The study was carried out in the Brazilian Amazon, in the municipalities of Almeirim, Manicoré and Cotriguaçu, in the states of Pará (PA), Amazonas (AM), and Mato Grosso (MT), respectively (**Figure 1**). The choice was due to the possibility of access to Brazil nut collectors, made possible through partnerships with local institutions. Data collection was carried out through in-depth interviews [15] with Brazil nut collectors, either men, women or young people directly involved in the activity.

In order to identify possible differences of livelihood outcomes, data collection was stratified in relation to their market-oriented organization levels: (i) collectors selling directly to middlemen, called informal; (ii) collectors organized in local associations; and (iii) collectors organized in local and regional cooperatives. In the municipality of Almeirim-PA, community associations have played an important role in organizing the collective commercialization of nuts, at the same time, many collectors still sell directly to middlemen. In Manicoré-AM, the collectors interviewed are part of a cooperative called Cooperativa Verde de Manicoré (COVEMA). In Cotriguaçu, the study included

Figure 1.
Location of the target cities of the surveys.

producers organized in the Associação dos Coletores de Castanha-do-brasil do PA Juruena (ACCPAJ), as well as indigenous people of the Rikbaktsa ethnic group from the Terra Indígena do Escondido, who sell nuts informally, although starting a formal association. In total, 119 collectors (n) were interviewed, of which 50 (42%) trade with middlemen, 39 (32.8%) trade through associations, and 30 (25.2%) through cooperatives.

Interviews were composed of two parts. The first part was designed to characterize the socioeconomic context of producers and their production and marketing systems. The second part aimed at identifying collectors' individual perceptions of the effects of extractive activities on their livelihood capitals, for which indicators related to five capitals (human, social, physical, financial, and natural) were developed based on the Sustainable Livelihood Framework [16, 17].

In addition to Brazil nut collectors, key informants were interviewed, such as members of the board of directors of community associations, community leaders, and/or former members of the community. These interviews were designed to raise general aspects of the communities in relation to their infrastructure, access to public services, population, main economic activities, collective institutions engaged in community organization, and a brief historical view.

Contextual data and overall information collected from key informants were analyzed using descriptive statistics and exploratory data analysis with graphical representations of the results and cross-referencing techniques. Interviews on collectors' individual perceptions of the effects of extractive activity on their livelihood capitals were analyzed using the "sustainable livelihoods approach" [16–18]. Each indicator was assessed through open-ended questions, from which the answers were subsequently categorized. The focus was on the impacts of each production stage until the commercialization. The answers translate the interviewees' perceptions of the existence, nature, and intensity of impacts on livelihood capital, being represented by ordinal scores as very negative (0), negative (0.25), neutral (0.5), positive (0.75), and very positive (1).

For each interview, a value was determined for each capital based on the simple arithmetic average of the indicators (questions) referring to that capital. From the value of each interview, the value of capital was determined, separating each of the situations studied. The averages referring to each indicator and each capital were compared using non-parametric statistics, as the Kruskal-Wallis followed by Wilcoxon Two-Sample Test, using R computation environment [19].

3. Results

3.1 Characterization of Brazil nut collectors

Brazil nut collectors can be considered as "people dependent on forests" [20], as they derive benefits from the forests where they live and work. Agriculture, extractivism, and fishing are the main livelihoods related to subsistence and income (**Figure 2A**). In addition to Brazil nuts, they also harvest more than 30 non-timber forest products (NTFPs), with emphasis on açaí (*Euterpe* spp.), piquiá (*Caryocar villosum*), and uxi (*Endopleura uchi*) (**Figure 2B**). In addition to serving for family use and consumption, these NTFPs are also a source of income for 62% of the interviewed collectors.

Brazil nut collection is carried out based on traditional knowledge, which is usually transmitted orally, from generation to generation. Most respondents (91%) reported that their parents already worked with nut extraction and other NTFPs, from whom they learned to carry out the activity. While on the one hand, Brazil nut collectors have good access to traditional knowledge, on the other hand, poor access to formal education is evident. Only 15.5% of respondents had completed elementary school (**Table 1**), and this percentage reaches 51% of the adult population in Brazil [21]. Another shortcoming of collectors was their low access to the internet, being only 26.4%, while the national average is 64.7% [22]. The lack of access to basic services also contrasts with the great access to government income programs.

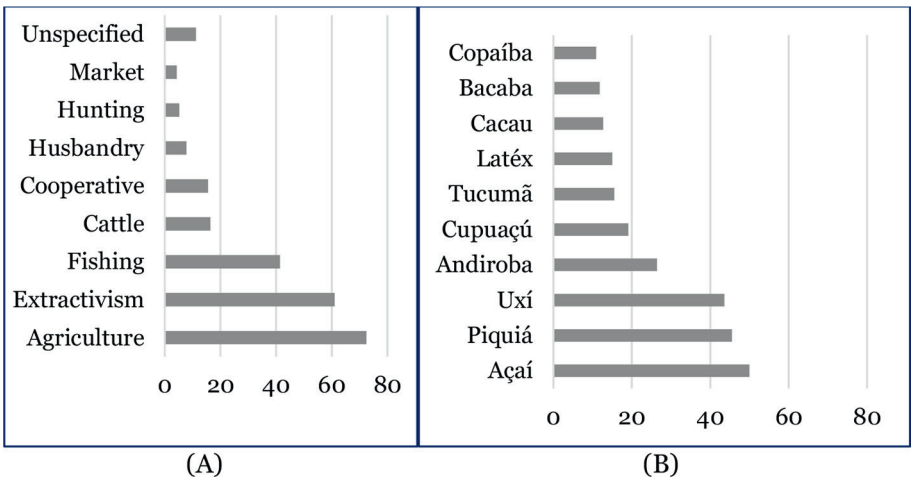

Figure 2.
(A) Main activities carried out by the interviewees in addition to collecting Brazil nuts (a) and main NTFPs used and/or sold (b). Source: Prepared by the authors, 2022. (B) Copaifera spp.; Oenocarpus baacaba; Theobroma cacao; Rubber (Hevea brasiliense); Astrocaryum spp.; Theobroma grandiflorum; Carapa guianensis; Endopleura uchi; Caryocar villosum; Euterpe oleracea and Euterpe precatoria.

Level of formal education	%	Attributes of collectors	%
Did not study	10.3	Use computer	11.7
Incomplete elementary school	74.1	Access to internet	26.4
Complete elementary school	4.3	Access to government programs	59.2
Complete high school	9.5	Benefit from government income transfer (*Bolsa Família*)	49.2
Higher	1.7	Benefit from Ecosystem Service Payment scheme (*Bolsa Floresta*)[1]	17.5
		Fisheries protection insurance	4.2

[1]*Specific program for residents of Protected Areas in the State of Amazonas, such as a REDD+ scheme. Source: Prepared by the authors, 2022.*

Table 1.
Personal characteristics of nut collectors expressed as a percentage of respondents.

Approximately 59% of collectors, more than double the national average of 22% [23], have their income complemented by social programs, such as the Bolsa Família program (**Table 1**).

Average interviewees' age was 43 years old (±13.24), which may indicate low involvement of young people (under 30 years old) with this activity. Likewise, only 7.4% of the interviewees were women, which could point to low participation of women in the collection of Brazil nuts.

3.2 Productive processes and commercialization of Brazil nuts

Brazil nut production is basically characterized by the collection of fruits, popularly known as "*ouriços*" (**Figure 3**), straight from the forest floor. Fruits have a rounded shape, about 20 cm in diameter, and with a very resistant shell, inside which there are approximately 15 seeds. The seeds, in turn, are composed of a hard woody coat, and the almonds are the edible and the main commercialized part.

Dispersion of *B. excelsa* fruits occurs in the rainy season, from December and July, most concentrated in February, March, and April throughout the Amazon basin. To carry out the collection, extractivists need to enter the forest, either by land or river, which are usually located far away from their homes, taking from a few hours to more than a day to arrive to reach *B. excelsa* groves. Aiming at greater efficiency and effectiveness collection, most of the interviewed collectors (76%) make temporary camps, staying for up to 14 days in the forest, some of the interviewees remain in the camps for up to 3 months. While still in the forest the seeds are extracted from the fruits and stored until they can be taken to the communities. An interesting partnership between one association of Brazil nut producers and farmers who own large tracts of forests was reported. In Cotriguaçú-MT, some of these farmers, who often carry out legal logging, make their forests available for extractivists during the rainy season, (especially when Brazil nuts fruits are available), and in some cases, they even provide accommodation or support structures to extractivists.

B. excelsa collectors require a high level of traditional knowledge regarding the local forests, their historically established limits, their ecological and geographic characteristics, and use of traditional techniques and tools. As an example, we can cite: (i) the use of the *paneiro*, a handmade basket from *titica* vine (*Heteropsis flexuosa*) used to

Figure 3.
(a) Brazil nut tree; (b) breakage of the fruits; (c) Fruits and almonds. Source: (a) authors, (b) Embrapa Portal and (c) OPA health blog.

carry the fruits and seeds, as well as the *câmbito*, a tool made of a wooden stick used to grab the fruits from the ground without having to bend down to catch them; (ii) geographical knowledge of the *B. excelsa* groves location, which includes recognition of trails and access paths, clusters and their main productive trees; (iii) prior determination of the production potential of each year through the systematic observation of flowering; and (iv) opening the fruits by cutting them with a machete, ax or sickle, which requires high technical and manual skills. In addition to several other indirect knowledge indispensable to carrying out the work in the forest, such as hunting and gathering forest products for subsistence during the harvesting period; moving and flow of production through rivers, knowledge about vessels, among others.

Management practices of *B. excelsa* groves identified among collectors' responses were: (i) cleaning, which consists of mowing the trails traveled by people and eliminating competition from the surroundings of individuals of *B. excelsa* and (ii) cutting of vines established in productive individuals, which aims to increase the individual production of Brazil nut trees (**Table 2**). Such practices can promote improvements in work, reducing waste and increasing productivity. No practices were identified to establish collection limits.

The climatic conditions of the forest (heat and humidity) and contact with the soil favor aflatoxin contamination. In order to reduce the risk of this contamination, some procedures called "good practices" can be adopted in the collection and storage of seeds, which basically consist of separating good quality seeds, washing, drying, and storing them properly. It was found that collectors established in organized groups (associations and cooperatives) are more prone to adopting good practices than informal collectors (**Table 2**).

The commercialization of Brazil nuts, at least in the regions studied, is still influenced by the old *aviação* system and the historical changes that this system has

Activities		Manicoré Coop. (%)	Almerim Assoc. (%)	Cotriguaçu Assoc. (%)	Informal (%)
Stand Management practices	Cleaning	52	81	nc[1]	60
	Liana thinning	17	72	nc	74
	Inventory	4	3	nc	3
Best processing practices	Fully application	60	72	0	22
	Partial application	40	22	0	10
	No	0	6	100	68
Primary buyer	Middleman	47	63	57	100
	Industry	0	56	57	0
	Cooperative	93	0	0	0
	Special commercial partnership	40	19	14	0
Receive technical assistance		71	88	18	23
Know Prog. of government		73	69	nc	23

[1]*Data not collected.*
Source: Prepared by the authors based on data collected in the field, 2022.

Table 2.
Activities and characteristics related to Brazil nut productive process according to the percentage of citations by collectors in each location and marketing organization.

undergone, where middlemen play an important role. Middlemen are present, even when associations and cooperatives work (**Table 2**). Eventually, when it proves to be more advantageous, collectors who participate in an association or cooperative may choose to sell to the middleman.

In Almeirim-PA, there is only one out of four communities studied, that interviewees declared they sell straight to the industry. This sale is due to the action of the community association whose main objective is to organize the sale of the *B. excelsa*. Through this association, collectors access the Banco do Brasil credit line for Sustainable Rural Development and other federal public policies such as the National Forestry Program (PRONAF). The Association stood out for accessing credit for the collection of Brazil nuts for 9 years without default, a rare occurrence for community associations. Access to funding lines was identified in just one other community.

In Manicoré - AM, the collectors interviewed are part of the Cooperativa Verde de Manicoré (COVEMA) founded on June 5, 2006. The cooperative has a processing plant where Brazil nuts are processed, until the final product, which is a dried Brazil nut vacuum packaged. The Cooperative established partnerships with government and private institutions in order to guarantee the purchase and quality. Despite the great socioeconomic importance of the Cooperative, it was identified that 47% of the cooperative members interviewed also sell their production to middlemen.

In Cotriguaçu - MT, the study included producers organized in the Associação dos Coletores de Castanha-do-brasil do PA Juruena (ACCPAJ), as well as indigenous people who sell nuts informally, both groups sell their production to middlemen, or directly to the small and large industries that carry out the final processing.

3.3 Commercialization and livelihoods

The survey results show that collecting Brazil nuts is an activity that contributes positively to the five livelihood capitals of collectors (**Figure 4**).

Two indicators of physical capital, acquisition of household goods and acquisition of work materials were made possible by the income from marketing Brazil nuts, had the highest scores in the survey. And these were followed by the natural capital indicator: forest conservation. Strengthening and expansion of the communities' external relations; income regularity; and acquisition of new knowledge, were the main highlights in social, financial, and human capital, respectively (**Table 3**).

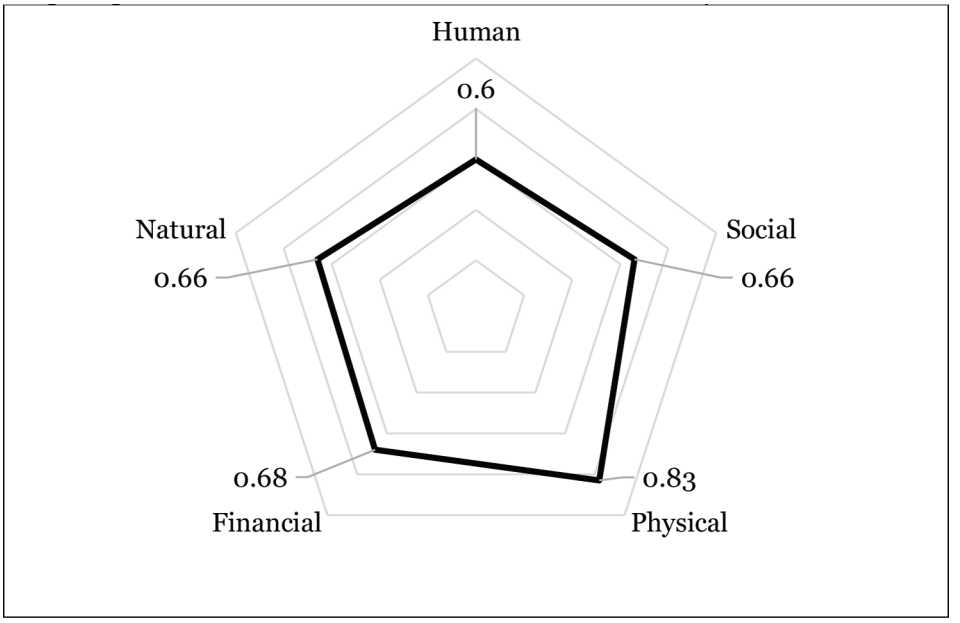

Figure 4.
Average score of each livelihood capital of collectors obtained through the perception of the collectors themselves in the three study areas. Source: Prepared by the authors, 2022.

(Capital) Indicator	General	Informal		Associations		cooperative	
	Ind.	Ind.	Cap.	Ind.	Cap.	Ind.	Cap.
(H1) Safety at work	0.41	0.32b –	0.53b –	0.60 to	0.68 to	0.30b –	0.58b –
(H2) Food safety	0.59	0.53b –		0.65 to		0.60 ab	
(H3) Traditional knowledge	0.69	0.66 to		0.74 to		0.67 to	
(H4) New knowledge	0.7	0.60b –		0.74 to		0.75 to	
(S1) Opportunity for young people	0.57	0.62 to	0.60b –	0.57 to	0.75 to	0.53 to	0.62b –
(S2) Participation of women	0.64	0.53b –		0.79 to		0.61 ab	
(S3) Social participation	0.68	0.66b –		0.79 to		0.58b –	
(S4) External relations	0.74	0.60c –		0.86 to		0.76b –	

(Capital) Indicator	General	Informal		Associations		cooperative	
	Ind.	Ind.	Cap.	Ind.	Cap.	Ind.	Cap.
(F1) Community infrastructure	0.76	0.65b –	0.80b –	0.78 to	0.89 to	0.84 to	0.81 b
(F2) Household goods	0.92	0.94 ab		0.95 to		0.87b –	
(F3) Working materials	0.82	0.80b –		0.94 to		0.71c –	
(Fin1) Price	0.68	0.49b –	0.58c –	0.77 to	0.77 to	0.78 to	0.69b –
(Fin2) Income regularity	0.73	0.79 to		0.82 to		0.59b –	
(Fin3) Put options	0.62	0.45b –		0.72 to		0.68 to	
(N1) Resource stock	0.61	0.59 ab	0.70 to	0.66 to	0.66 to	0.57 b	0.62 to
(N2) Access to the resource	0.63	0.76 to		0.63 ab		0.49 b	
(N3) Forest conservation	0.75	0.75 to		0.70 to		0.80 to	

H, S, F, Fin, and N refers to the capitals: human, social, physicist, financial, and natural. Values of the same letter did not show significant differences in t. by Mann–Whitney. Source: Prepared by the authors, 2022.

Table 3.
Average scores and comparisons of livelihood capitals and indicators according to the organization for commercialization: informal, association, and cooperative.

These results also allowed a comparative analysis between the different publics studied (**Table 3**). The intermediate level of organization, represented by associations, showed significantly better results than the cooperative level of organization and informal sales (direct to middlemen), for financial, human, social, and physical capital. In natural capital, the results were similar for the three groups. In a general analysis, of the 17 studied indicators, the associates surpassed the cooperative ones in 7 (41%) and the informal ones in 10 indicators (59%).

4. Discussion

4.1 Brazil nut collectors: people who live with the forest

Brazil nut collectors interviewed in this research can be considered as Traditional Communities or Peoples, defined as:

> *... culturally differentiated groups that recognize themselves as such, that have their own forms of social organization, that occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices generated and transmitted by tradition. [24]*

The livelihoods of Brazil nut collectors are strongly linked to the environment in which they live. Subsistence agriculture, forest extraction and the use of rivers are among the main work activities developed. Each collector follows a specific strategy characterized by a complex combination of different production and income-generating activities. Most of the activities are developed in a very close relationship with

nature and require the use of traditional knowledge, which directly influences the outcomes and processes of the activity.

Brazil nut plays a historical role of paramount importance for the livelihoods of the Amazonian peoples. Hundreds of years ago, Amerindian peoples were directly responsible for the creation of dense Brazil nut groves [2, 25]. At that time, the Amazon forest was not under the threat of deforestation, as has been happening since the 1960s. In this sense, collecting Brazil nuts is a counterpoint to deforestation, directly contributing to forest conservation, as pointed out in the natural capital.

The indicator on forest conservation points out that the presence of Brazil nut trees encourages the protection of forests, preventing the forest to be cut down for other land uses or incentivizing its protection. In addition, 20% of the collectors interviewed stated that they were planting *B. excelsa* trees. These facts place the collectors in a central role in the conservation of the forest acting directly in the axis of the conservation of biodiversity and the mitigation of climatic changes.

The Brazilian Amazon has special importance in the discussion on environmental policies due to its cultural diversity, biodiversity, and its role in the global climate [26]. The danger of global warming urges to reduce greenhouse gas emissions and/or increase atmospheric carbon fluxes to biomass or soil. Due to its great extension, the carbon stock and its capacity to retain and release carbon, the Amazon forest is a fundamental component in this context. Greenhouse gas emissions caused by deforestation and forest degradation account for 20% of total emissions [27].

The *Bolsa Floresta* Program (**Table 1**), a program run by Fundação Amazônia Sustentável, can be considered a payment scheme carried out for the reduction of greenhouse gas emissions from deforestation and forest degradation including forest conservation, sustainable forest management, and maintenance of forest stock (REDD+). *Bolsa Floresta* beneficiaries are the only ones who receive this type of benefit among the groups studied, although reducing emissions via REDD+ constitutes an important strategy for mitigating climate change, particularly in developing countries with large forest cover [28].

In this sense, the activity of Brazil nut collectors is part of the international debate on REDD in terms of social issues, making the path to ensure that those who really need and act directly to reduce gas emissions are actually the beneficiaries [27, 29, 30]. Despite the uncertainties and methodological difficulties that would involve an assessment of the contribution of forests maintained by Brazil nut collectors, payment for this environmental service would be a challenge for governments, research institutions, donors, and conservationist organizations.

In addition to the conservationist role that Brazil nut collectors play, nut extraction ensures the necessary income for subsistence and investments in improving their quality of life. The income regularity, which harvests provide, is essential to reduce financial vulnerability in which they live, allowing investments in physical capital such as household goods, work materials, and community infrastructure. It was with the drop in international demand for Brazilian rubber, in the 1920s, that Brazil nuts began to gain economic significance [31]. And, from 1986, it became part of the official data of the Brazilian Institute of Geography and Statistics, having reached a volume of 34,644 thousand tons in 2016, generating an income of 110.1 million reais [14].

Brazil nut is a product that resists the climatic conditions of the Amazon, and can be transported and stored without the need for high investments in infrastructure and equipment, however, good collection and storage practices are recommended. Due to its natural durability, it has established itself as a product for the national and international market, even with very few incentives for public action, unlike other

agricultural activities that rely on incentives, from technical assistance and technological development to financing. Only recently, programs such as the Minimum Price Guarantee Policy for Sociobiodiversity Products (PGPM-Bio) and the Food Acquisition Program (PAA), provided possibilities for the commercialization of Brazil nuts to find complementary or alternative paths [32].

Cattle raising is increasingly becoming a common livelihood in several contexts across Amazonian agricultural frontiers and it sets the forest at risk, leading to forest conversion, as has been happening with rubber tappers in Acre or with settlers in southern Pará [33]. Cattle ranching is one of the factors that can lead to an increase in deforestation rates, which has been increasing in the Brazilian Amazon in 2019 and 2022. The decline in extractive activities can increase forest vulnerability. Factors such as technological progress, emergence of economic alternatives, population growth, reduction of stocks, wage levels in the economy, changes in relative prices, put extractivism in check [11]. The longevity of the nut collection and commercialization systems contrasts with the extractivism cycle pointed out by Homma [33], marked by initiation, rise, stagnation and decline.

Aiming at conserving the forest, it is important to value the production of nuts within natural forests and the work carried out by collectors. Nut production brings improvements to local livelihoods and contributes to forest conservation. This research corroborates the results found by Guariguata et al. [7] where socio-ecological systems do not require major changes to maintain yield, actions may be indicated to preserve, diversify and intensify the production of Brazil nut groves, making them increasingly integrated into human modified landscapes.

4.2 The role of associativism and cooperativism

The organization of production and commercialization processes, when carried out through associations, proved to be more beneficial for collectors, when compared to the Cooperative system and commercialization through middlemen. COVEMA, the cooperative to which collectors in the Manicoré region are linked, has a more complex organizational structure, with a larger number of collectors and representing a larger geographic area, being responsible for the administration and management of a nut processing plant that sells Brazil nut at vacuum packages. To establish a viable business structure, an initial phase of 10–20 years would be required, followed by a consolidation phase of similar duration [34]. In this sense, the Cooperative, created in 2006, would still have a time of at least 20 years for its consolidation.

In addition to the intrinsic complexity of managing a cooperative, the historical development context of social groups in the region does not favor the work developed by complex collaboration networks. The Amerindian peoples suffered a relatively recent process of social and cultural disruption. The colonization of the Americas followed the expansion patterns of other empires in history, characterized by wars, enslavement, deportation and genocide [35]. In the Brazilian Amazon, this process occurred more sharply from the 18th century onwards, in the search for forest products [36], when the extermination of indigenous peoples in the Brazilian Amazon took place.

The Rubber cycle had a social, economic and cultural impact on the Amazon. Approximately 500,000 Brazilians were transported from the northeast region to the north of the country to work in the rubber plantations. The rubber tappers, descendants of northeastern migrants, were incorporated into an organized system to control the scarce workforce, where the rubber tappers were forced to sell and buy in

the rubber tapper's shed and were tied to the boss who supplied them with the goods [10]. Changes to break with this system began to intensify from the 1970s and 1980s, with movements led by rubber tappers such as the *Aliança dos Povos da Floresta*. In Manicoré, where COVEMA was established, the work of the National Council of Rubber Tappers (CNS) was fundamental to boost community organization in the municipality [37].

The collection and commercialization of Brazil nuts follows the traces of this same system. Most of the collectors interviewed (92%) had their parents involved in extracting resins/gums (75.2%) and/or Brazil nuts (76.2%). However, the results found in financial capital show that collectors who are organized in associations or cooperatives managed to expand their sales options (**Tables 2** and **3**), reducing dependence on middlemen, accessing differentiated markets and obtaining better prices. Of the organized collectors, 56% declared that they still sell to middlemen. In this case, as they have commercialization options, they sell to whoever offers the best prices. Collectors who sell directly to middlemen have few or no sales options, adopting the value stipulated by the middlemen, which has historically been an unfavorable system for collectors [37, 38].

Among the levels of organization studied, associativism is the one that most resembles the social organization of Amerindians, based on the reciprocity of family networks, increasing proximity and the level of trust between individuals [34]. Higher organizational levels are usually more fragile [35]. However, associations have no legal attribution to market and earn profit. The creation of cooperatives or another type of legal representation that enables commercialization must permeate the discussion process of formalized groups.

The organization of producers brought improvements in several studied indicators, showing its importance in overcoming historical difficulties. One aspect still to be considered is the low presence of young people, showing a tendency for future generations to be removed from collection, therefore, strategies that will promote the participation of a younger public can come to collaborate with continuity in the transmission of knowledge and the strengthening of the activity. For this, it is necessary to offer better opportunities for education and work, as well as other socioeconomic conditions that are more favorable to the maintenance of young people in their communities of origin.

5. Conclusions

Brazil nut collectors have extensive traditional, ecological and technical knowledge about the activity they perform, in addition to making use of a wide range of forestry products. The importance of the forest in their livelihood means that, in addition to being people who depend on the forest, collectors play the role of guardians of the forest. The forest provides livelihoods for people, who contribute to its conservation. However, the difficulty of accessing formal education, technological development and internet, can lead to the removal of these actors from living with the forest, increasing the risks of its destruction. Recognition of this gap in service provision is essential to propose ways of including this group in public policies for the development of the Amazon.

The associations, representing an intermediate level of organization for marketing, between direct sales to the middleman and the cooperative, brought the most benefits to the collectors' livelihoods. The improvements found in indicators such as

the choice of buyers, price negotiation, expansion of external relations and infrastructure, show the importance of social organization for the production and commercialization of Brazil nuts, overcoming historical difficulties.

This research showed that Brazil nut collection is an activity that improves the livelihood of local populations and contributes to forest conservation, with associations and cooperatives playing an important role in this process. Increasing business management capacity, promoting plantations, strengthening local and regional markets and seeking income alternatives for times of insufficient harvest, may be some of the actions that should be promoted.

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