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Shedding Light on the Brazilian Amazon Biotrade: A Study on Sustainable Development in Native Communities

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Abstract: The Amazon is a biodiversity hotspot. Around 90% of its territory is inhabited by native communities, who spontaneously organize themselves into groups of extractivists and small producers, relying on biodiversity as their primary means of sustenance. This paper aims to discuss how the biotrade of Amazonian biodiversity goods affects native communities with respect to environmental, social, and economic sustainability. Based on a sample of 178 native extractivists in four communities, we concluded that biotrade enabled native communities to market their products by adapting to existing conditions, considering the difficulties and the expectations of traditional residents, and contributed to the three dimensions of sustainable development.

Keywords: Amazon; native communities; traditional communities; biotrade; biodiversity; sustainable development; system approach; bioproducts

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1. Introduction

The Amazon biome preserves the ecological heritage of humanity [1]. Covering an area of 5.5 million km^2, it is the largest rainforest on Earth [2] and is home to 1 in 10 known species, with 2200 new plants and vertebrates cataloged from 1999 to 2015 [3]. Biodiversity refers to the variety of life on Earth, including the vast number of plant, animal, and microorganism species in addition to the variety of genetic material within ecosystems.

The Amazon is significantly composed of native forests and small urban areas. The municipalities within the Amazon are characterized by swollen cities, rural migration, a lack of infrastructure and services, and impoverished as well as unemployed populations with only a small portion of economically active members [4]. The moist tropical forest offers fruitful prospects from the integrative perspective of sustainable development: it is a biodiversity vault that preserves the planet's natural heritage. At the same time, it presents socioeconomic indicators incompatible with civilizational advance.

The biome is vital for native communities, providing sustenance for their livelihoods in the form of goods and services, such as food and medicine, and the conditions for their cultural, social, religious, and ancestral fulfillment [5]. These communities are culturally differentiated according to their forms of social organization, with a large part of their identity tied to the forest, rivers, plants, and animals [6]. They maintain ways of living that are different from general society. Their forms of collective work represent traditional practices that strengthen the community values linked to social life and natural resources [7].

The role of local communities in global value chains is mainly limited to raw material sourcing. As local communities rarely act beyond the first transformation step of producing bioproducts, their gross margin and, consequently, regional development are reduced. From a broader perspective, this situation is typical for many other non-wood forest products (NWFPs) in different parts of the world, such as honey in the Philippines [8] and palm oil in Indonesia [9]. For example, some biodiversity products, mainly used in the global cosmetics and pharmaceuticals value chains, are extracted from native communities in their primitive forms.

The bioeconomic value chain comprises mainly medicines, cosmetics, and low-volume chemicals [10]. It also includes natural foods, fuels, bulk chemicals, and many plant- and animal-based non-wood products [11]. These products are part of the nutrition, folk medicines, belief systems, and daily lives of forest communities. In spite of the increasing demand for these products from people outside the forest, the lack of business knowledge and investment inhibits these communities from participating in the global economy, specifically in the most profitable stages of the supply chain. The economic value is mostly captured downstream in the supply chain, by intermediaries, wholesalers, and retailers [8]; as the distance from the initial tiers (growers, gatherers, and producers) increases, the ability to track and maintain sustainability standards, such as anti-deforestation and fair trade policies, is reduced [12].

To answer the call for an integrated supply chain that can support a non-timber economy and sustain the livelihoods, natural surroundings, and cultures of native communities [8], companies have made efforts to design contracts according to sustainability criteria, including the collection, production, transformation, and commercialization of goods and services derived from native biodiversity, i.e., biotrade [13]. Since 2009, the Union for Ethical Biotrade (UEBT) has proposed actions to improve awareness about biotrade, such as developing ethical guidelines for countries that provide natural biodiversity materials. Fundamentally, biotrade should empower native communities and promote sustainable development. Definitively, if decoupled from ethical biotrade guidelines, it can reflect the widening of the biodiversity footprint of developing countries in a very conventional business-as-usual way [14]. The trade-offs and red flags arising from unethical biotrade include increased predatory extraction, permanent crop changes, economic dependence on external agents, sensitivity to market seasonality, and social as well as economic inequality. The biodiversity crisis is one of our generation's most significant challenges, and tropical forest conservation plays a fundamental part in halting mass extinctions and safeguarding animal and plant diversity [15]. Stakeholder pressure has led to global companies demonstrating a higher level of commitment to ethical biotrade. Strategic partnerships for sourcing forest goods, developing new products, and simultaneously safeguarding biome integrity have been tailored under the corporate social responsibility (CSR) principles and directed towards social legitimacy and external validation demands [16].

Considering biodiversity issues as wicked problems [17] and, therefore, approaching the question from the systems theory lens, this paper aims to investigate whether biotrade contributes to the social and economic progress of the native communities in the Amazon without overstepping the fragile environmental boundaries. This process is grounded in empowering leadership and cooperatives, valuing relationships, developing multistakeholder networks, and promoting people's development. The research question was as follows: does the trade of biodiversity products by the Amazon's native communities meet the conditions of the ethical biotrade standards?

Here, we report an issue neglected in previous studies by specifically examining development in the Amazon through interdisciplinarity and systems thinking. This paper contributes to the systemic comprehension of native Amazonian communities' economic activities and their relationship to sustainable development by investigating the nature of global companies' green supply chains. Methodologically, we analyzed primary data specifically collected for the proposed survey. This study also opens new windows for

the exploration of the empowerment vectors that can foster communities' civilizational advancement, preserve the forest, and promote sustainable development.

2. Theoretical Framework

The systems approach allows for the analysis of a social system, considering its wholeness and the relationships between elements. Applied to business and management theory, it contributes to understanding boundaries between systems and the concepts of autonomy, self-organization, and other interactions between internal system elements and external complexity [18,19]. To maintain viability, a system should balance its performance and cybernetics with the movements of external pressures [17]. Inspired by biological systems, social systems pursue environmental adaptations for survival, combining the autopoiesis of elements [18]. They process inputs, generating feedback and externalities to achieve intended objectives.

The general systems theory (GST) [18] was brought to the management field to deal with complex situations imposed by the changing environment; systems thinking offered a fundamental approach with which to overcome reductionism. Issues related to sustainable development can never be fully addressed with a linear focus. Sustainable development requires solutions to intricate problems regarding its recursive and cycling nature. Social, environmental, and economic dimensions bring interwoven relations that enable social researchers to address latent issues that are not clearly defined and that could feasibly be out of reach in single-dimension analyses [20].

Native communities are dynamic social systems with unique, intricate forest linkages with multiple purposes that go beyond the economic bottom line; thus, it is necessary to understand their relationships and respective engagements with the environment that maintain the viability of the system: this inquiry ought to be performed through a combined lens of people's traditional knowledge and with the critical perspective of the complex political and market claims over the role that their commodities play in an integrated, yet asymmetric, supply chain [21]. Natural resources compose the environment, or inputs, provided by the forest. By participating in a global value chain, communities adopt behaviors that can impair their cultural values, potentially developing emerging relationships of unbalanced trade-offs between system and environment, stretching the safe boundaries between identity and viability [22].

"*An isolated community is never typical of a region or a nation*" [23]. Each has its traditions, detailed history, and unique variations in life. A region's culture presents a denser organization than the sum of its communities. Thus, it would not be possible for a community to have the full breadth of a regional culture: it does not have all of the social classes, all of the occupations, or all of the political parties in a region. The study of an extractivist community in the Amazon, for example, does not reveal the whole of the complexity of Brazilian agricultural organization, the commercial and financial system, or the other biomes present in the national territory.

It is in communities that the inhabitants of a region make a living, raise their children, lead a family life, group themselves in associations, worship their gods, have their superstitions and their taboos, and are driven by the values and incentives of their particular cultures [23]. Native communities live from the sharing that still exists today in traditional villages and indigenous populations around the world [24]. Forms of collective work, spontaneously mediated by non-market productive relations, constitute traditional elements that strengthen community ties [25]. Thus, the commitment to rebuilding community life persists through the study of native communities and their self-sufficiency [26]. These groups have their cultural expressions, and their techniques are associated with the use of renewable resources and low-environmental-impact technologies.

To commercialize their products, native communities develop partnerships [27]. The access to and sharing of the benefits of these products should respect the Convention on Biological Diversity (CBD), which designates how "genetic heritage can be accessed and how the benefits that result from its commercial use are shared" [28]. This will ensure

that physical access to genetic resources is facilitated and that their benefits are shared equitably, which include associated traditional knowledge from indigenous and local communities. In this context, contracts developed according to environmental, social, and economic sustainability criteria are classified by the United Nations Conference on Trade and Development as biotrade [13].

Biotrade is an instrument to achieve the three basic principles of the Convention on Biological Diversity (CBD) [29]: the conservation of biodiversity, the sustainable use of its components, and the equitable distribution of the benefits. Governments have two essential functions in this respect: (a) implement a legal framework and procedures that facilitate access to genetic resources, and (b) ensure that the benefits derived from the outcome from their use are distributed fairly and equitably between users and providers. The CBD also intends to respect, preserve, and maintain the knowledge, innovations, and practices of communities and indigenous people with traditional lifestyles relevant to the conservation and sustainable use of biological diversity [29].

A product is considered biotrade when it meets seven objectives: biodiversity conservation; sustainable use of biodiversity; equitable sharing of benefits; socioeconomic sustainability; compliance with the law; respect for the rights of the actors involved; and clarity about land ownership [13]. The principles are hardly entirely found in a traditional trade contract, yet they are the guidelines for those who want to continuously improve towards a biotrade relationship [30].

Thus, it is common for products chosen for biotrade to have high potential for adding value, which allows the generation of jobs and income for native communities [31]. For Unctad [13], the product groups for biotrade are edible products, seasonings, food ingredients, cosmetics as well as pharmaceuticals substances, and aquaculture. The classification presented is widely used in community production as well as commercial initiatives and contributes to supply chain organization, identifying the information and training programs to perform each production activity [32].

The benefits of biodiversity sharing are recurrent in the literature on environmental and social studies. The potential biodiversity benefits for a non-timber products economy have received significant attention from academics. Even when sustainable development is overlooked or not central in the study, the triple bottom line dimensions are present in the sharing of its benefits [31,33–41].

3. Methodology

This research has a multimethod approach, including qualitative and quantitative procedures. This option allows for inference and the generalization of the conclusions of a scenario of the representation of the studied phenomenon [42]. The survey type was chosen for two reasons: first, because of its ability to explore topics on a large scale [43,44]; second, because most of the specific literature conducts an essentially theoretical approach, sometimes in conjunction with empirical approaches that prioritize qualitative research [45].

An initial survey was developed by Santos et al. [45] to capture the perceptions of native communities about the benefits of biotrade contracts and their impacts on the social, economic, and environmental dimensions. We submitted the instrument to the evaluation of five Ph.D. experts in the field of environmental management. This process has defined some punctual adjustments. It is divided into three dimensions: economic, social, and environmental statements, considering the literature on sustainable development and the principles of biotrade. The questionnaire used is available in the section "Appendix A" and its basic dimensions are displayed in Table 1.

Table 1. Dimensions of sustainable development and research variables.

Dimensions	Variables	Authorship
Economic	Income, job creation, profit, and outsourcing hiring	Pimentel et al. [31], Pearce and Moran [33], and McNeely [35]
Social	Conjoint solutions, traditional knowledge, valorization, diversity, poverty, and training	Correa [36], Pretty and Smith [37], and Barrett et al. [38]
Environmental	Natural resources conservation, increased volume, and predatory extraction	Macmillan et al. [39], Kate and Laird [40], and Ansell et al. [41]

The survey was applied in person, considering the lack of the Internet, the large number of illiterate people, and the long distances between Amazonian communities. The main advantages of personal contact, according to Cooper and Schindler [43] in addition to being confirmed during the application, were: (a) good cooperation of the respondents; (b) the possibility of anticipating the sequence of questions; (c) the facilitation of language and communication to reach illiterate/semi-illiterate respondents; and (d) sample management through closer profile analyses of the respondents.

The sample used for this research involves residents of Amazonian native communities with biotrade contracts.

The communities are located over approximately 150 km^2 in the state of Pará, in the Brazilian Amazon (Figure 1). Data collection was conducted in November 2017 through in loco questionnaires applied by the researchers during visits to four native communities and their surroundings. The Biodiversity Authorization and Information System (SISBIO) allowed the visits and reserves access (authorization number: 55141-1). Following a preliminary visit to the region, four communities were identified on which to conduct the research (Figure 1), namely:

- Boa Vista Organic Producers Association—APOBV;
- Campo Limpo Community Rural Producers Association—APROCAMP;
- Abaetetuba Fruit Growers Cooperative—COFRUTA;
- Tome-Açu Mixed Agricultural Cooperative—CAMTA.

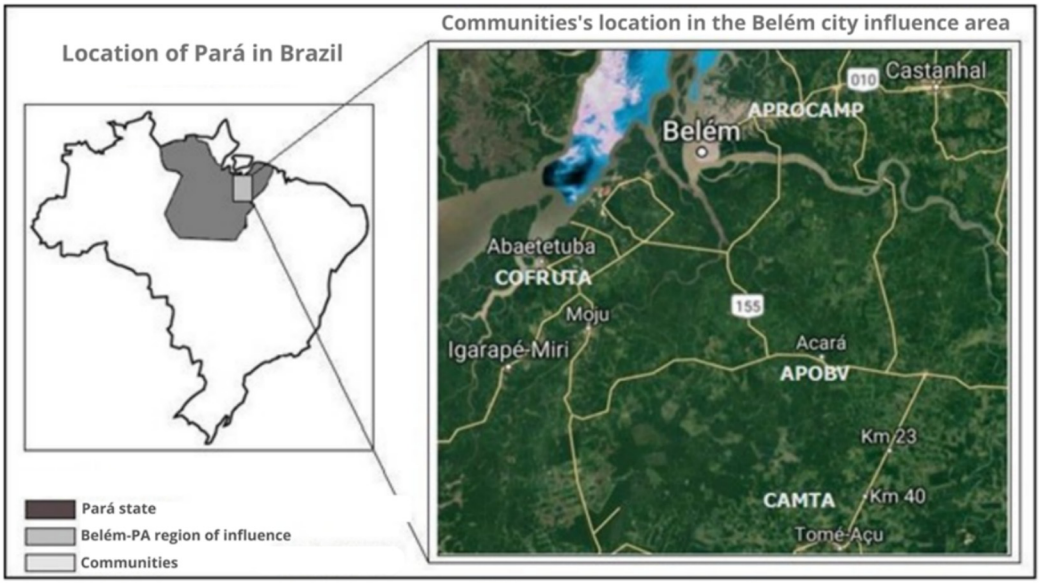

Figure 1. Pará state map, highlighting the location of the four communities.

Firstly, we contacted the communities by telephone to present the research and establish a schedule for the forms. Problems that arose due to logistics extended the negotiations

for thirty days. We adjusted the calendar of regional events during this period: the planting and harvesting periods of certain products.

Each community explores a biodiversity product through traditional knowledge and genetic heritage: APOBV ("Pripioca"); APROCAMP ("Capitiú" and "Estoraque"); COFRUTA ("Açaí"); and CAMTA ("Andiroba"), as detailed in Table 2. The fieldwork allowed the researchers to establish interactions with a sample of 54% of the population (Figure 2), corresponding to 178 questionnaires, as in the work by Hill and Hill [46]. Therefore, this table shows the main products from each of the communities, according to the perceptions of the interviewees.

Table 2. List of the main products for each community.

Product	Community (%)			
	APOBV	**APROCAMP**	**CAMTA**	**COFRUTA**
Pineapple	X			X
"Açaí"	X		X	X
Acerola	X		X	X
Andiroba	X		X	X
Banana	X	X	X	X
Breu-branco	X			
Buriti	X			X
Cocoa	X		X	X
Cashew	X			X
Capitiú	X	X		
Star fruit	X			X
Chestnut	X		X	X
Cupuaçu	X		X	X
Estoraque	X	X		
Guava	X		X	X
Soursop	X			X
Mango	X		X	X
Passion fruit	X		X	X
Muruci	X			
Murumuru	X			X
Pataqueira	X	X	X	
Black pepper	X		X	X
Dragon fruit			X	
Pitanga	X			
Priprioca	X	X		
Tapereba	X	X	X	X
Vegetables	X		X	X
Ucuba	X		X	
Lemon		X	X	
Orange				X

Source: Research data.

We proceeded with a descriptive analysis of the entire database, factor analysis, and average comparison by variance (ANOVA) in the provided data, selecting pair-to-pair differences. The factors explain 41.74% of the total variance in responses and have an overall Cronbach's alpha of 0.716. The independent variables comprised three perceptions: social, economic, and environmental. Therefore, it was possible to verify how many respondents perceived the existence of each of these dimensions in the daily activities of their communities. Using the predominant frequency observed for each question, the necessary measures (mean, standard deviation, minimum, median, and maximum) were calculated to construct a boxplot graph (Table 3). Thus, the graphs allowed for a visual analysis of the position, dispersion, symmetry, and outliers of the dataset.

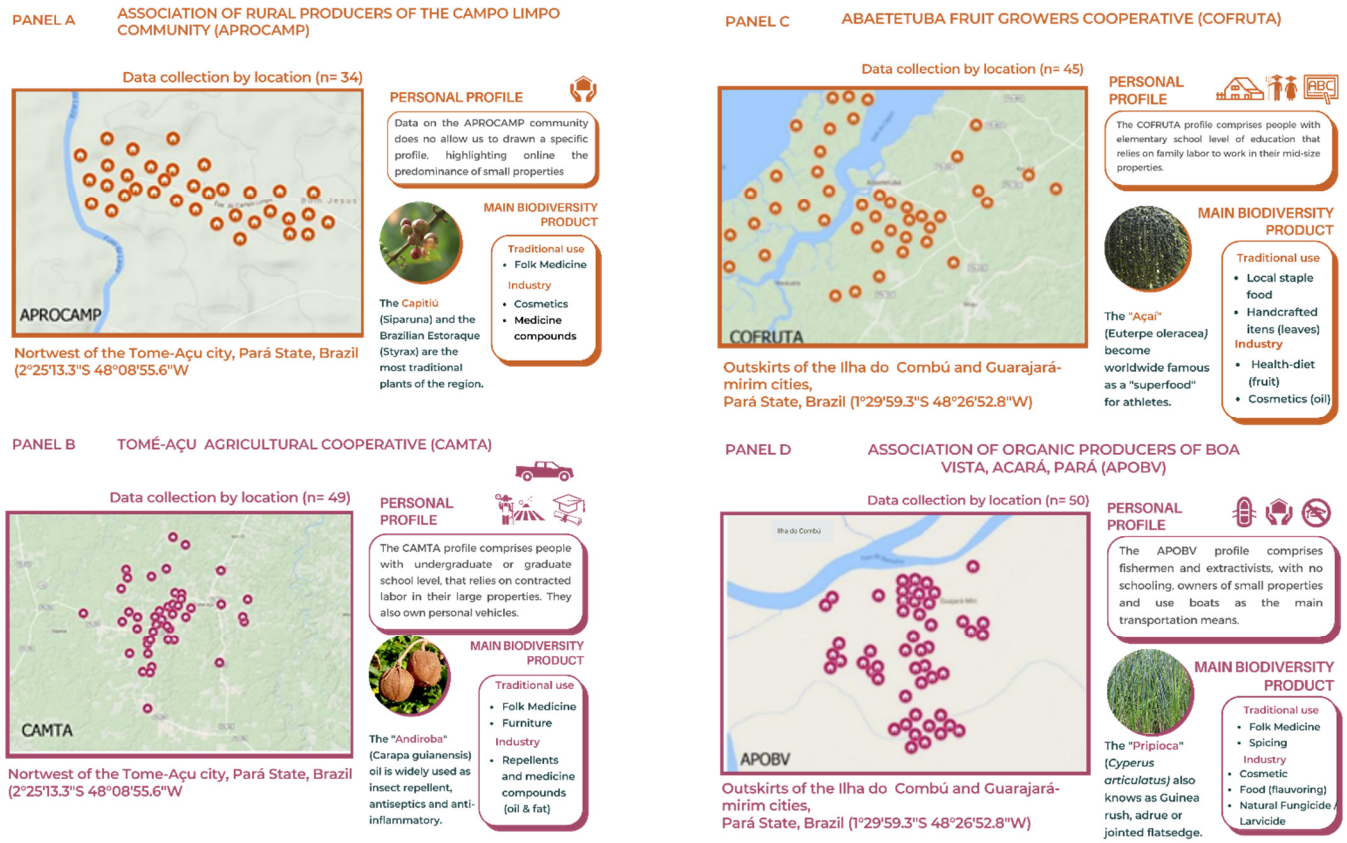

Figure 2. The geographic position of the data collected by location, community profile, and most traditional biodiversity product. Adapted from: Castellani et al. [47]; Machado et al. [48]; Miot et al. [49]; and Natura [50].

Table 3. Descriptive stats.

Community	Factor	n	Average Amount of People Who Perceived the Existence of Each Dimension	Standard Deviation	Minimum	Median	Maximum
APOBV	Social	50	25.88	4.54	15.00	27.00	35.00
	Economic	50	25.52	4.60	9.00	26.50	30.00
	Environmental	50	15.96	2.93	8.00	17.00	20.00
APROCAMP	Social	34	28.56	4.11	18.00	29.00	35.00
	Economic	34	26.82	2.67	19.00	27.50	30.00
	Environmental	34	15.65	3.16	6.00	16.00	20.00
CAMTA	Social	49	29.65	3.95	17.00	30.00	35.00
	Economic	49	22.61	3.89	8.00	22.00	29.00
	Environmental	49	13.53	4.05	6.00	15.00	20.00
COFRUTA	Social	45	23.91	5.01	12.00	24.00	34.00
	Economic	45	23.33	4.10	12.00	23.00	30.00
	Environmental	45	14.58	3.31	4.00	15.00	20.00

Source: Research data.

Subsequently, comparisons between groups were made by an analysis of variance (ANOVA). Tukey's post hoc test was also used for multiple comparisons. The averages were compared two-by-two across all of the available pairs of averages (Tables 4–6). The comparisons generated a representation, where communities were ranked according to the level of perception of the existence of each one of the three dimensions in the daily activities of the communities.

Table 4. Social perception.

Comparison	Estimated Difference	Simultaneous Confidence Interval (95%)		Tukey's Test *
APROCAMP vs. CAMTA	−1.09	−3.66	1.47	
APROCAMP vs. APOBV	2.68	0.12	5.23	***
APROCAM vs. COFRUTA	4.65	2.04	7.26	***
CAMTA vs. APOBV	3.77	1.46	6.08	***
CAMTA vs. COFRUTA	5.74	3.37	8.12	***
APOBV vs. COFRUTA	1.97	−0.39	4.33	

* The symbol "***" represents a difference between groups at a 5% significance level. The absence of the symbol indicates no difference between the groups.

Table 5. Economic perception.

Comparison	Estimated Difference	Simultaneous Confidence Interval (95%)		Tukey's Test *
APROCAMP vs. CAMTA	4.21	1.91	6.51	***
APROCAMP vs. APOBV	1.30	−0.98	3.59	
APROCAMP vs. COFRUTA	3.49	1.15	5.83	***
CAMTA vs. APOBV	−2.91	−4.98	−0.84	***
CAMTA vs. COFRUTA	−0.72	−2.85	1.40	
APOBV vs. COFRUTA	2.19	0.07	4.30	***

* The symbol "***" represents a difference between groups at a 5% significance level. The absence of the symbol indicates no difference between the groups.

Table 6. Environmental perception.

Comparison	Estimated Difference	Simultaneous Confidence Interval (95%)		Tukey's Test *
APROCAMP vs. CAMTA	2.12	0.15	4.09	***
APROCAMP vs. APOBV	−0.31	−2.28	1.65	
APROCAMP vs. COFRUTA	1.07	−0.94	3.08	
CAMTA vs. APOBV	−2.43	−4.20	−0.65	***
CAMTA vs. COFRUTA	−1.05	−2.87	0.78	
APOBV vs. COFRUTA	1.38	−0.43	3.20	

* The symbol "***" represents a difference between groups at a 5% significance level. The absence of the symbol indicates no difference between the groups.

Finally, a correspondence analysis revealed associations between the variables under study and their categories. According to their representativeness, the points were naturally distributed based on the values of the profiles (Table 7). Thus, points of similar profiles were closer than points from profiles with discrepant characteristics.

Table 7. Analysis between qualifying questions and places of application.

Variable		Coordinate	
		Dimension One	Dimension Two
Type of labor	Contracted labor	−1.1507	0.1523
	Family labor	0.2717	−0.036
Level of education	No schooling	1.3094	1.784
	Elementary school	0.4167	−0.2126
	High school	−0.3352	−0.2028
	Undergraduate/graduate	−1.2569	0.6488
Professional activity	Farmer	−0.3303	−0.3101
	Extractivist	0.9446	0.6548
	Other professional activity	1.1566	1.1338
	Fisherman	1.2788	1.4997

Table 7. *Cont.*

Variable		Coordinate	
		Dimension One	**Dimension Two**
Total property area	Large property	−1.232	0.4618
	Minifundium	0.7288	0.1607
	Average property	0.2956	−0.0925
	Small property	0.2054	−1.2119
Main means of transport	Boat	0.8827	0.6932
	Motorcycle	0.1073	−0.7382
	Other means of transport	0.4567	−0.7087
	Own vehicle	−1.4462	0.6014
Community	APOBV	1.0175	0.8136
	APROCAMP	0.1199	−1.346
	CAMTA	−1.4142	0.5399
	COFRUTA	0.3188	−0.4749

Source: Research data.

4. Results and Discussions

4.1. Communities' Profile Data

A description of the sample exhibits that the majority of the respondents were male (57%), married (57%), more than 35 and less than 61 years old (60%), had a high school degree (37%) and elementary school degree (30%), were farmers (77%), their families were composed of three or four people (57%), had lived in the community for over 31 years (57%), and had small properties (42%). They mostly traveled by motorcycle (30%) and boat (28%). Their budget income was up to USD 220 monthly. Their productive activities were related to planting, breeding, hunting, fishing, extractive activities, and crafts. Most of the communities also had access to piped water and electricity (82%).

4.2. Analysis of Social, Economic, and Environmental Perceptions

All of the dimensions presented positive benefits, clarifying that sustainable development comes from native communities' producers' perceptions. However, the results exhibited higher benefits in the economic dimension than in the social and environmental dimensions. There is a disparity between the data among the four communities, as presented in Figure 3.

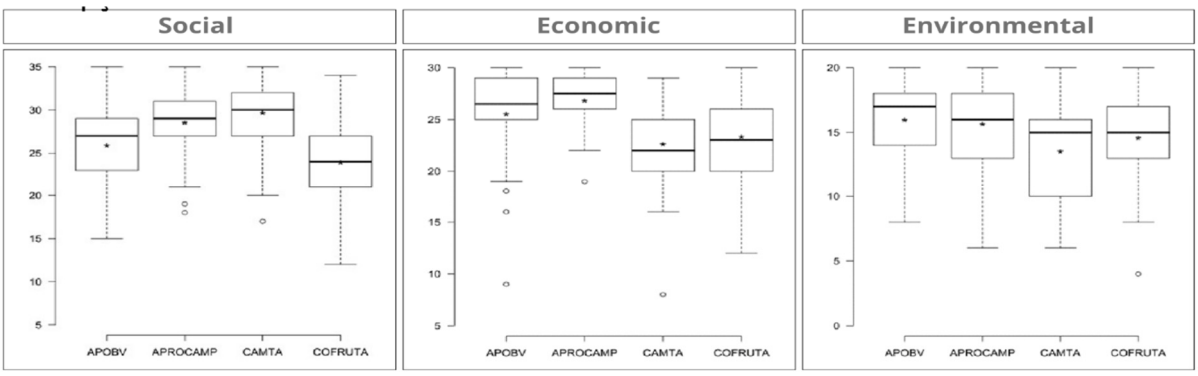

Figure 3. Social, economic, and environmental perceptions. Source: Research data.

The CAMTA presented a median above the other communities for social perception. Simultaneously, the APOBV and the APROCAMP had lower medians, and the COFRUTA was the community with the lowest median and the highest variability. The APROCAMP and the APOBV were influenced by the benefits experienced with biotrade, such as increased incomes, the construction of new housing, access to electricity and drinking water,

garbage collection, the building of headquarters, community buses, and production improvements.

Analyzing the economic dimension, the APROCAMP presented the highest median among the communities and the smallest dispersion. The APOBV community had similar values but with more excellent dispersion. Finally, the COFRUTA was the community where the perceptions of the economic impacts had the most significant variability.

As for environmental perceptions, the CAMTA and the COFRUTA had the lowest median and the highest dispersion. The APOBV had the largest median and the APROCAMP had the second highest.

4.3. Domain Scores Regarding the Communities

Each domain's score, crossed with the application sites, demonstrated the positioning of each community in the analyzed dimensions. Figure 4 summarizes this comparison and presents the communities in order, from the lowest perceptions to the highest. These data were obtained from 5-point Likert scales, as detailed in Appendix A.

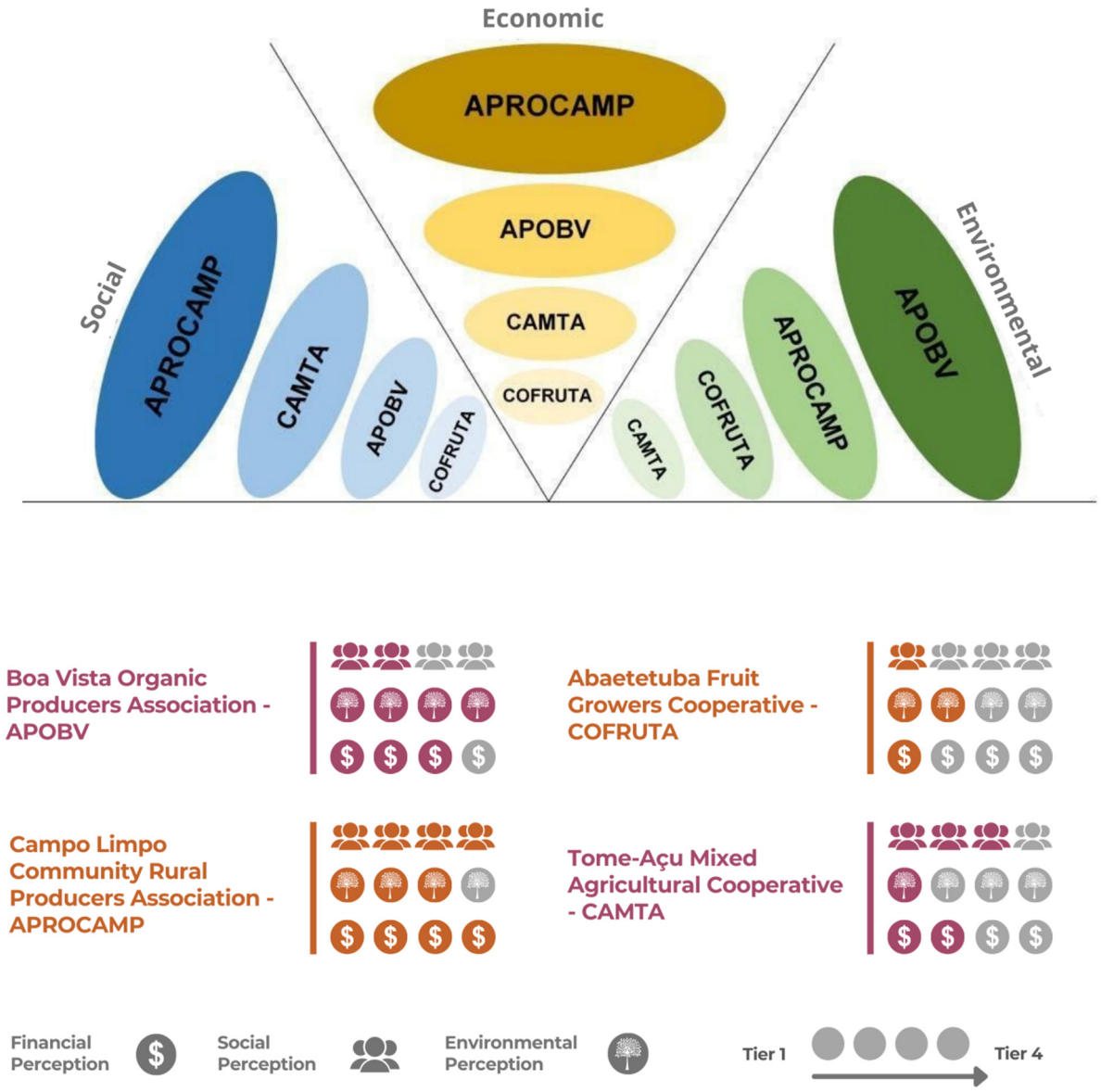

Figure 4. Summary of domain scores. Source: Research data.

Possible comparisons of social perceptions according to Tukey's test at 5% were the APROCAMP versus the APOBV and the COFRUTA as well as the CAMTA versus the APOBV and the COFRUTA. Two situations can be clarified by noting that the APROCAMP and the CAMTA achieved the best results. First, the APROCAMP invested the amount received from the Capitiú and Estoraque biotrade contract into community improvements, such as purchasing a bus that transports students and residents.

Additionally, the APROCAMP had a project of building a washing and packaging plant for fruits and vegetables produced in the community to add value to organic production. In addition to fruits, the CAMTA producers also grow black pepper and cocoa, products with developed and high-cost markets. With a higher income, producers have access to masonry houses, automobiles, electricity, running water, and schools, representing an excellent wellbeing upgrade, considering local socioeconomical standards. Furthermore, the cooperative offers technical support for the diversification of production and cultivars, and, in some properties, hardwood cultivation is stimulated by the planting of seedlings.

The financial perceptions of the APROCAMP were higher when compared to those of the CAMTA and the COFRUTA. For the APOBV, the financial perceptions were higher than those of the COFRUTA and CAMTA. The residents of the APROCAMP, as was also the case for the social perceptions, indicated that the biotrade contracts increased family income and provided improvements to quality of life. For the APOBV, there were also high financial perceptions. However, resources were invested in new homes and the construction of a community headquarters.

These communities realize that the most significant value is added to their products after they sell them. Placing market products with added value is the main difficulty encountered [51]. The difference between the two associations is that the APROCAMP aims to process raw materials or produce finished products to have more and higher added value in the commercial chain. In comparison, the APOBV invested the resources in building masonry houses and building a new headquarters. Unfortunately, diversifying production and adding value is a distant reality for the associations; most of them have few conditions and knowledge for processing, much less selling finished products.

Despite their limitations, the APROCAMP and the APOBV had higher environmental perceptions than the other cooperatives. Organic production and the pursuit of diversification in smaller communities contrast with the dispute between the CAMTA's large and small producers to meet black pepper and cocoa export contracts. While the largest producers prioritize only one crop, the smaller ones choose to diversify production and constant income.

4.4. Relationship between Characterization and Communities

Correspondence analysis revealed associations between the variables under study and their respective categories. The profiles found are represented in Figure 5. It is observed that the communities' geographical positions, plus the economic conditions, confer an inherent individuality to the region, which, among other influences, determines the means of transport of the residents. In the APOBV, for 52% of residents, the boat is the most used means of transport; however, as there is access to the city of Acará-PA by land, bicycles (30%) are also an option. At the APROCAMP, the most frequently used vehicle is the motorcycle (74%), followed by the bus (24%), which belongs to the community. In the CAMTA, 86% of respondents use a car, and in the COFRUTA 54% use boats.

The level of education was influenced by some variables, such as proximity to the urban center and educational infrastructure (i.e., rural schools) in the community, in addition to level of income. In the CAMTA, the variable "Higher Education and Postgraduate" influenced the income of families who can afford their children's studies in other cities. The variable "No schooling" makes up the APOBV profile. Despite the presence of a primary school, the community is far from the capital, Belém, and the municipality of Acará. Additionally, there are many elderly residents without education. Finally, the COFRUTA has in its profile the variable "Elementary School".

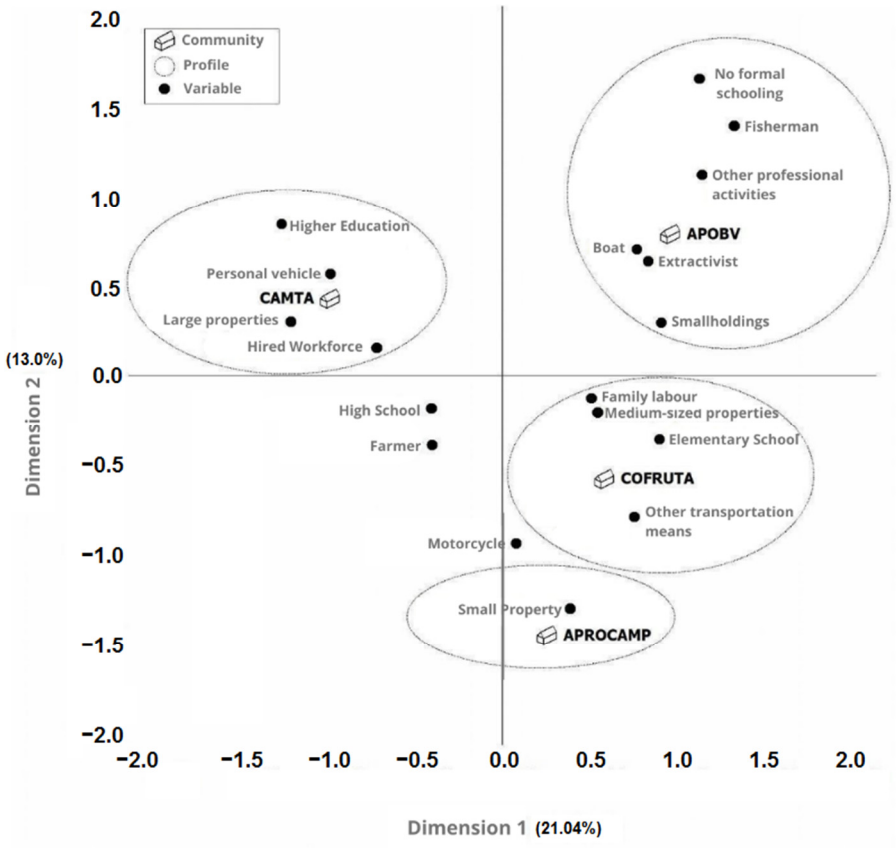

Figure 5. Correspondence analysis among the communities. Source: Research data.

As for the size of property, the cooperatives present "Big property" (the CAMTA) and "Medium property" (the COFRUTA). The variables "Minifundium" and "Small property" are more common for the associations. It is also worth mentioning that smaller properties suffer more from the expansion of oil palm cultivation in the region.

Finally, the profiles showed "Contracted labor" (the CAMTA) and "Family labor" (the COFRUTA). Although the cooperatives hired more third parties to harvest products, all of the communities hired more or less external people during the harvest period.

4.5. Qualitative Results

It is agreed that the communities suffer from a lack of integration between companies and scientists to overcome difficulties imposed by regional underdevelopment. Several situations hinder development, such as the distance between local markets, poor road infrastructure, lack of warehouses, distorted taxes, and almost no commercial chains. Similar barriers, mainly related to market constraints and costs, are also perceived by small producers trying to implement integrated crop–livestock sustainable systems in the Amazon as an alternative to conventional beef-producing ranches [52]. Alongside cattle, palm oil production is responsible for land transformations, such as deforestation [53], and pressure on indigenous and traditional communities [54] in the belt of tropical countries such as Indonesia, Peru, and Brazil [55]. The challenge faced by the cooperatives from the northern Brazilian Amazon, approached in this study, is not an exception in this case.

Companies put pressure on small rural units made up of family farmers who use the land as a structuring center for communities. These farmers are "invited" to participate in supply chains so that companies might use land without buying it, using the labor force, traditional expertise, and the various social relations of production. This consists of a recurrent challenge in agroecological relations between small landholders and international supply chains; similar challenges are observed in the Ghana palm oil linkages with a U.K. fairtrade initiative [56]. The ethical biotrade standards are central in the 2030 Agenda

prerogatives, percolating specific Sustainable Development Goals (SDGs), such as 17.10, which posits the promotion of "a universal, rules-based, open, non-discriminatory and equitable multilateral trading system (. . .)", and on a broader scope the entire range of the targets and indicators from the SDGs, such as SDG 8, on decent work standards, 11, on safeguarding cultural heritage, 12, for the promotion of sustainable supply chains, and 15, on safeguarding land ecosystems [57].

This scenario reflects the forest folk traditions by state policies for rural areas. The way of life that is closely related to natural resources, but limited to the intensification of work and the valorization of mutual aid, is far from adhering to market rules and brings producers closer to the territory's surrendering to agroindustrial complexes. In addition to wasting land, the model wastes farmers themselves, and the production of communities that supplies the local population is compromised by the absence of products such as Açaí, Manioc/cassava flour, Maniva, Tucupi, Miriti or Buriti, fish and shrimp, mango, Cupuaçu, Pupunha, Brazilian nuts, and Bacuri. This process aligns with the perceptions of Matias et al. [8] on the bounded relationship between cultural heritage, natural resources, and ecological services.

5. Conclusions

In this research, both interdisciplinarity and systems thinking contributed to a better comprehension of native Amazonian communities' economic activities within green supply chains. The COFRUTA maintains the lowest level of social perceptions, as producers are dissatisfied because the cooperative does not buy all "Açaí" production, forcing negotiations with distributors. This result corroborates Silva, Barbosa, and Albuquerque [58], who state that the sustainability of the COFRUTA is strategic for the region as it plays a leading role in the workers' organization process. The bigger picture aligns with the negative impacts of asymmetry in economic and negotiation power in global supply chains.

The studied literature provides some indications that biotrade should empower native communities and promote sustainable development [14]. The field results also allowed the revealing of in-depth aspects concerning how it can be managed in practice. For example, assessing the perceptions of residents of traditional communities on biotrade is an essential tool for adapting and improving existing conditions for marketing their products, considering the difficulties and expectations of traditional residents. Although limited to the context of traditional communities surveyed in the Amazon, these findings have important implications that allow us to state the contributions of biotrade to sustainability promotion.

According to Lyons-White and Knight [12], as the distance from the initial tiers of the chain increases, the capability of tracking and maintaining sustainability standards, such as no-deforestation and fair trade policies, is reduced. Therefore, companies have made efforts to design contracts according to sustainability criteria [13]. The field results showed several challenges and specific conditions regarding this practice. The surveyed communities (associations and cooperatives) partnered with focal companies that offered different resources and competencies. This fact has shaped supply contracts, which are confidential, but the buying and selling relationships of biodiversity products have not disregarded the conditions of biotrade. On the other hand, producers' perceptions of the partnership are strongly influenced by the increase in income and benefits, which can be misleading when considering short-term or upfront benefits.

Another situation, of managing trade-offs [15], can be observed in the analysis of dimensions, which showed that satisfaction with social aspects increases in the same proportion as household income. Renumeration for work and the price paid for products are better evaluated by the associations, as is the concern for the environment. Cooperatives stand out for encouraging ownership diversification while working to balance supply and demand for products. There were investments in production and projects for marginal innovations as well as the development of new products in both cases.

The personal profiles found for the communities show polarization of the variables. One dimension shows a highly educated profile, with vehicles, large property owners, and hired labor contractors. On the other hand, there is a low level of education in a sample composed of riparians, fishermen, and extractivists, owners of small glebes of land, and small boats as the primary means of transportation. The profiles are not complete, but simulate the differences between communities, especially from a financial perspective.

This research's limitations should be considered in the analysis of its results, since the results show statistical associations between the analyzed variables of a contextual sample. Applications of a specific questionnaire for traditional communities can provide information about communities located in other biomes and the marketing of other products. In future research, the role of focal companies for the development of biotrade and the relationship between strategic decisions made by communities and representatives' discourse should be examined. Finally, we acknowledge that the triple bottom line framework is narrow/limited in understanding a maximum possibility of variables regarding sustainability. In spite of this, this framework was useful in finding important characteristics to deepen the understanding of Amazonian biotrade in an exploratory way. Future research could also adopt broader frameworks, such as the PESTEL framework, in order to integrate more variables in the analysis of biotrade issues.

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Appendix A

Table A1. Questionnaire.

Questionnaire
1. Genre:
(a) female
(b) Male
2. Age:
(a) ≤15 years
(b) Between 16 and 30 years old
(c) Between 31 and 45 years
(d) Between 46 and 50 years
(e) ≥61 years

Table A1. *Cont.*

Questionnaire
3. Marital status: (a) Cohabited (b) Married (c) Divorced (d) Single (e) Widower
4. Grade of schooling: (a) None (b) Teaching fundamental I (c) Elementary school II (d) High school (e) Incomplete graduation (f) Graduate
5. Professional Activity: (a) Farmer (b) Retired (c) Autonomous (d) Extractive (e) Civil servant (f) Fisherman (g) Other activities
6. Size of the family: (a) $\leq$two people (b) Between 3 and 4 people (c) Between 5 and 6 peoples (d) Between 7 and 8 people (e) Between 9 and 10 people
7. Time that reside at community: (a) Between 2 and 10 years (b) Between 11 and 20 years old (c) Between 21 and 30 years (d) $\geq$31 years old
8. Total area of the property: (a) Smallholding (b) Small property (c) Average property (d) Great property
9. Main transportation modal: (a) Boat (b) Bicycle (c) Motorcycle (d) Own vehicle (e) Bus
10. Monthly income from the sale of raw materials cousin: (a) $\leq$BRL 880.00 (b) Between BRL 881.00 and BRL 1760.00 (c) Between BRL 1761.00 and BRL 2640.00 (d) Between BRL 2641.00 and BRL 3520.00 (e) Between BRL 3521.00 and BRL 4400.00 (f) Between BRL 4401.00 and BRL 6160.00 (g) Between BRL 6161.00 and BRL 7920.00 (h) Between BRL 7921.00 and BRL 11,440.00 (i) Between BRL 11,4421.00 and BRL 20,240.00 (j) Between BRL 20,241.00 and BRL 30,800.00 (k) Between BRL 30,801.00 and BRL 40,480.00 (l) $\geq$BRL 40,481.00

Table A1. *Cont.*

Question	Disagree Totally	Disagree Partially	Indifferent	Agree Partially	Agree Totally
11. The income from the sale of raw materials cousin facilitated the renovation of the house or acquisition of vehicle.					
12. Quality of life improved after family became a supplier of raw materials cousin.					
13. The sale of raw material brings new opportunities and jobs for families.					
14. The supply contracts attracted people who were outside the community.					
15. Can you calculate the cost and profit of raw material sold.					
16. The amount received from the sale of the products is enough to sustain your family.					
17. Need to hire outsiders of the community at some stage of production.					
18. Producers work together to solve the problems of the association/cooperative.					
19. It is possible to preserve knowledge of traditional selling feedstock.					
20. Producers are valued by companies.					
21. It's important for the family diversify your source of income with other products or activities.					
22. Production certification helped conserve your natural resources.					
23. The amount of feedstock is enough for to meet companies.					
24. The value of labor has increased with the supply in feedstock.					
25. At areas degraded they are being recovered inside of the property.					
26. All employees receive environmental awareness training.					
27. There are effective actions to prevent or control hunting, fishing, and predatory extractivism.					

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