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COMMERCIAL FIBERS OF THE AMAZON: OPPORTUNITIES AND OBSTACLES FOR EXPANSION

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ABSTRACT

This study conducts a literature review on fibers with commercial value from the Amazon, exploring their economic potential and the main challenges that limit their expansion in the market. Amazonian fibers, such as curauá (Ananas erectifolius L.B Smith), tururi (Manicaria saccifera Gaertn.), jacitara (Desmoncus polyacanthos Mart.) and tucumã (Astrocaryum aculeatum) have mechanical properties (such as rigidity, strength, low density and flexibility) that make them promising alternatives for sectors such as fashion, civil construction and biotechnology. However, barriers such as inadequate infrastructure, lack of standardization in extraction and processing processes, and absence of certifications make it difficult for these fibers to compete against synthetic materials. This study compares four Amazonian fibers, analyzing their mechanical properties, industrial applications, sustainability, and environmental impact. Using graphs and tables, the advantages and limitations of fibers were identified for comparison with synthetic fibers. The value chain was also mapped, highlighting logistical and regulatory barriers. The study emphasizes the importance of public policies and technological investments to promote the sustainable use of these fibers and strengthen local communities.

Keywords: Amazon Fibers, Sustainability, Circular Economy, Carbon Reduction, Amazon.

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INTRODUCTION

The Amazon, considered one of the largest ecosystems in the world, has an incomparable biodiversity that is reflected in natural resources of high economic value. Among these resources, plant fibers such as curauá, tururi, jacitara and tucumã stand out, where they are widely used in the manufacture of sustainable products for sectors such as civil construction, fashion and composites. These fibers, due to their mechanical properties of resistance and flexibility, become a viable alternative to synthetic materials, such as fiberglass (ARAÚJO; PEREIRA, 2018; HAGE, 2012).

In addition, the industry has shown a growing interest in ecological solutions that use renewable raw materials, aiming to meet not only the demand for sustainability, but also an increasingly aware and demanding public regarding the environmental impact of products (PINHEIRO et al., 2023). This industrial interest reflects a search for alternatives that reduce the carbon footprint, promote the circular economy and, simultaneously, offer competitive advantages by adding value to products.

The adoption of renewable raw materials also favors the diversification of the supply chain, promoting independence from finite resources and aligning with government policies to encourage sustainable practices. Thus, the integration of these raw materials into industrial processes represents a strategic advance that, in addition to benefiting the environment, can foster innovation and stimulate corporate social responsibility, aligning industrial production with the global goals of sustainable development (SANTOS; RIBEIRO, 2023).

The fibrous plants of the Amazon, which have structural parts of the plant such as curauá, buriti and jute, have been highlighted for their mechanical properties (such as rigidity, impact resistance, low density and flexibility), being considered viable and sustainable alternatives to replace synthetic materials in composites. These natural resources are characterized by high strength, low weight and low production cost, which attracts the interest of industries that seek to reduce the environmental footprint of their products (BUFALINO et al., 2014)

The automotive sector, in particular, has explored the potential of curauá, a light and resistant fiber that can replace fiberglass in components such as panels, upholstery and interior coatings. The use of curauá and other lignocellulosic fibers, in addition to reducing the weight of vehicles, promotes sustainability by reducing dependence on synthetic

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materials and petroleum derivatives, in line with the global demand for more ecological and economically viable industrial practices (LAMEIRA; CORDEIRO, 2023).

According to Companhia Têxtil de Castanhal (CTC, n.d.), this substitution, in addition to promoting the reduction of the carbon footprint, generates positive socioeconomic impacts by encouraging sustainable agricultural production, generating jobs in local communities. (GUIMARÃES; ODY, 2023), reports that replacing synthetic materials with natural fibers can not only increase the efficiency of products, but also significantly reduce energy costs in manufacturing.

However, despite the numerous economic and environmental advantages, the use of Amazonian fibers still faces challenges in terms of industrialization and commercialization (MAZARELO; PACHECO, 2011). These obstacles have restricted the expansion of these production chains and the expansion of their markets (FERREIRA; HOMMA, 2020)

In addition to the economic benefits, the sustainable use of these fibers contributes to the social development of riverside and producing communities (employment and income). The production of fibers such as curauá, for example, offers a viable economic alternative for regions that traditionally depend on extractive practices, promoting social inclusion and sustainability (FERREIRA; HOMMA, 2024; OLIVEIRA et al., 2022). With the integration of new technologies in the processing of these fibers, it is expected that local production chains will become more competitive and inserted in the context of the circular economy (RIBEIRO, 2009).

Local communities, such as the Santo Antônio de Caxinauá community, that depend on non-timber forest products, such as those that inhabit the Amazon and other tropical regions, include traditional groups, riverine and indigenous communities, who have extensive knowledge about the sustainable management of these resources. For these communities, the extraction and sale of natural fibers, such as curauá and jute, represent more than a source of income; are activities that keep the cultural and sustainable relationship with the environment alive (GIATTI et al., 2021)

In addition to the economic potential, the insertion of these fibers in the international market can encourage the preservation of forests, valuing ancestral knowledge about the sustainable use of natural resources. However, to reach this market, these communities face challenges, such as the need for infrastructure for production at scale, technical training, and the strengthening of marketing chains that respect the cultural and economic value of non-timber forest products (RAJLAKSHMI et al., 2024)

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Despite the great economic potential of Amazonian vegetable fibers, there are still technical and market barriers that make it difficult to expand their use on an industrial scale. Among the main challenges, the need to improve fiber processing techniques and strengthen local production chains so that they can compete with synthetic materials and global alternatives stand out. Therefore, the guiding question of this study is: What are the main barriers and opportunities for the expansion of the use of Amazonian vegetable fibers in the national and international markets?

The main objective of this article is to investigate the economic potential of Amazonian plant fibers, with emphasis on applications in civil construction and the automotive industry. Specifically, it seeks to: analyze the technical properties of the fibers evaluating their competitive advantages themselves; examine market opportunities for expanding the use of these fibers in sustainable industries; and identify the challenges that limit the large-scale use of these fibers in the national context.

METHODOLOGY

This article used a qualitative approach, as outlined by (GIL, 2022) by combining bibliographic research and comparative analysis to investigate the main characteristics, barriers, and opportunities for expansion of the Amazonian fibers curauá (Ananas erectifolius L.B Smith), tururi (Manicaria saccifera Gaertn.), jacitara (Desmoncus polyacanthos Mart.), and tucumã (Astrocaryum aculeatum) in the national market.

In this present study, a bibliographic survey was carried out that included scientific articles, and publications specialized in natural fibers and biocomposites. Websites and academic databases, such as ScienceDirect, Web of Science, SciElo, Springer and Google Scholar, were consulted with the objective of identifying studies focused on the physicochemical properties, applications and environmental impact of the fibers under analysis.

To ensure the timeliness and relevance of the information, articles published between 2015 and 2024 were selected, prioritizing studies focused on Amazonian fibers and their industrial applicability. In addition, works that addressed sustainability and circular economy practices were included, aiming to contextualize the use of these fibers in a scenario of growing demand for sustainable materials.

Based on the information obtained, a comparative analysis was carried out between the four Amazonian fibers, considering parameters such as mechanical properties,

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industrial applications and market potential, sustainability and environmental impact, in addition to the barriers and opportunities for insertion in the national and international markets. To organize and analyze the data, graphs and comparative tables were used, which facilitated a clear view of the advantages and limitations of each fiber in relation to the others and in comparison with conventional synthetic fibers.

A mapping of the value chain was prepared, identifying the main critical points that affect the production and commercialization of fibers, covering stages such as collection, transportation, processing and marketing, and highlighting the logistical and regulatory barriers encountered throughout the process. Table 1 highlights the main obstacles to obtaining and later using the fibers.

Table 1. Main problems in the production chain

	CRITICAL POINTS	LOGISTICAL CHALLENGES
FIBER COLLECTION	Variability in raw material quality	Remote access to collection areas
	Lack of adequate technology	Seasonality
	Low training of producers	Lack of support infrastructure
TRANSPORT	Poor infrastructure	Lack of route planning
	High costs	Fuel cost and tariffs
	Fiber damage during shipping	Dependence on the river and air transport
PROCESSING		REGULATORY CHALLENGES
	Lack of processing technology	Environmental and health standards
	Limited processing power	Quality certification
	Environmental impact	
MARKETING	Variation in the price of fibers	Taxes and tariffs
	Competition with synthetic fibres	Trade regulations
	Limited market	Intellectual Property and patents
POSTMARKETING (DISTRIBUTION AND END-USE)	Accessibility to the internal and external market	Regulations on sustainable products
	Competition with synthetic fibres	Safety standards

Source: Survey result (2024).

DISCUSSION AND INTERPRETATION OF RESULTS

Based on the data collected, the implications of the properties and uses of each fiber in the context of a market in transition to more sustainable solutions were discussed. The results were presented in order to contribute to the promotion of sustainability and circular economy, identifying the necessary conditions for Amazonian fibers to achieve greater competitiveness.

After interpreting the data, strategies were proposed for the expansion of the use of Amazonian fibers, including suggestions for public policies, tax incentives and development

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of processing technologies. Possible partnerships with sectors such as fashion, civil construction and biotechnology were also identified, aiming to expand the acceptance and use of these fibers in the market.

This study, however, had limitations due to the restricted availability of specific data on the sustainable management and industrial processing of Amazonian fibers on a large scale. In addition, variations in extraction and processing methods, which could influence the final properties of the fibers, were not addressed in depth, representing an additional limitation to the study.

CHARACTERIZATION OF AMAZONIAN FIBERS

Amazonian fibers, represented by curauá, tururi, jacitara and tucumã, have distinct physicochemical properties, which make them promising materials for various industrial sectors, especially in a context of growing demand for sustainable materials. Each of these fibers has a unique combination of strength, density and flexibility, determining characteristics for their practical application.

The curauá fiber, shown in Figure 1, is known for its high mechanical strength and low density, which makes it an attractive option for the manufacture of biocomposites. For Lameira and Cordeiro (2023), curauá stands out for its superior tensile strength than other vegetable fibers, a fact that expands its application possibilities in high-performance products. This property is essential for the production of high-strength and low-weight components, such as automotive parts and sports materials (BUFALINO et al., 2014).

Figure 1 – The Curauá (*Ananas erectifolius L.B Smith*) in fiber

Source: Virginia Giacon, 2015

The tururi, shown in Figure 2, is a fiber from the bunches of the Ubuçu palm tree (Manicaria saccifera Gaertn.). According to Dantas (2021), it is a species that is found

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mainly in the states of Amazonas, Pará and Amapá. The extraction of fibers is carried out with cuts manually by the riverside population. This process is slow, and the transport is carried out by vessels. Despite this, its use is promising because it has characteristics that differ from curauá, being a more flexible fiber with intermediate density, which favors its use in textile and coating products. In the view of Araújo and Pereira (2018), this fiber has the potential for the development of handicraft products and for the manufacture of accessories, which has attracted the attention of sectors focused on the circular economy and sustainable fashion. According to the CTC ([n.d.]), tururi has been used in local communities as a sustainable resource for the production of utilitarian and decorative objects, valuing traditional knowledge and reducing the need for synthetic materials.

Figure 2 – Ubuçu palm tree, extraction site of tururi fiber (*Manicaria saccifera Gaertn*)

Source: (GOMES, 2024)

The jacitara, shown in Figure 3, is a plant native to the Amazon region, found in wetlands and understory vegetation. According to Pereira (2022), the stems of the jacitara are quite thorny and flexible, extending from one tree to another in the upper part of the forest. The fruits, when ripening, have a color that varies between red and orange. The extraction of the fiber comes from the stem of the plant. Jacitara fiber is notable for its high flexibility and durability, characteristics that make it ideal for use in handicrafts and in the production of fashion articles and accessories, as shown in Figure 4. In addition, jacitara has a relatively low density, which allows it to be integrated into products that require

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lightness and malleability, such as bags and baskets. In the opinion of (GUIMARÃES; ODY, 2023), the fashion industry has become increasingly interested in natural fibers that can replace synthetic materials, and jacitara emerges as an alternative that combines aesthetics with sustainability.

Figure 3 – Jacitara (*Desmoncus polyacanthos Mart*.) in natural habitat

Source: (FERRAZ, 2019)

Figure 4 – Jacitara fan is made from the fibers

Source: (PEREIRA, 2022)

The tucumã fiber, shown in Figure 5, has a high strength and rigidity, in addition to a considerable density, which makes it suitable for use in semi-durable products and even in small constructions. Mazarelo and Pacheco (2011) point out that, although tucumã has limitations in terms of flexibility, its rigidity makes it an advantageous fiber for products that require structure and resistance, such as panels and light structures. In addition, the research carried out by Ferreira and Homma (2024) points out that tucumã fiber can

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replace, in some cases, plastic-derived materials in applications of less structural complexity, thus contributing to the reduction of the environmental impact associated with the use of conventional plastics.

Figure 5 – The fiber of the Tucumã (*Astrocaryum aculeatum*)

Source: (MACIEL; NASCIMENTO; PACHECO, 2008).

The comparison between these fibers according to tables 3 and 4 highlights how the diversity of physicochemical properties expands their application possibilities, allowing each fiber to adapt to different industrial demands. In a market increasingly focused on sustainability, these characteristics make Amazonian fibers a promising alternative to synthetic fibers, which often have a high ecological footprint and recycling difficulties (OLIVEIRA et al., 2022).

This diversity and adaptability reinforce the potential of Amazonian fibers as key elements for the development of a sustainable bioeconomy in the Amazon, as described by Ribeiro (2009) when analyzing ethnodevelopment in the region and the valorization of local natural resources in global markets.

COMPARATIVE ANALYSIS OF INDUSTRIAL APPLICATIONS AND MARKET POTENTIAL

This analysis compares the potential applications of each fiber in the different sectors, highlighting the advantages and challenges for its acceptance in the national and international markets. For a clear understanding, Table 2 below summarizes the properties and applications of each fiber, making it easy to compare with conventional synthetic fibers.

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Table 2: Industrial Applications of Amazonian Fibers.

Fibre	Industry Application	Specific Applications	Characteristics Distinctive
Curauá	Fashion, construction	Fabrics, biocomposite components for automotive parts	High mechanical strength and low density
	Biotechnology	Reinforcement for materials polymers and biodegradable plastics	Low carbon footprint, good performance on composites.
	Automobile	Nylon 6, material applied to panel buttons, sunshade hinges and on parts of the electrical part and electronics.	Resistance to degradation and low cost.
Tururi	Fashion handicrafts	Fabrics and coatings for Accessories and decoration	Flexibility and Unique texture.
	Sustainable design	Utilitarian and decorative products	Applicability in circular economy projects.
Jacitara	Fashion, interior design	Baskets, bags, decorative objects	High flexibility and durability.
Tucuman	Civil construction, fashion	Semi-durable panels, Lightweight structures, decoration products	High strength and rigidity.

Source: Survey result (2024).

Curauá fiber has high strength and low density, which makes it ideal for composites and biocomposite components, especially in the automotive industry and civil construction. These characteristics, combined with a reduced carbon footprint, place curauá as a viable substitute for synthetic materials that have a high environmental impact (BUFALINO et al., 2014). In the biotechnology sector, curauá is used in experiments to develop biodegradable plastics, reflecting a growing and promising market (CTC, [n.d.]).

On the other hand, tururi fiber finds applications especially in fashion and interior design due to its flexibility and unique texture, which are valued in the market for sustainable accessories and decorative products (ARAUJO et al., 2018). This fiber has been widely adopted in handmade products, taking advantage of the appeal of sustainability and the appreciation of products with cultural identity. Its flexibility makes it a versatile raw material, ideal for circular economy projects, which makes it attractive to consumers concerned about environmental issues (GIATTI et al., 2021)

Jacitara fiber is widely used in fashion and accessory products, such as bags and baskets, due to its durability and flexibility. This fiber is a popular choice in sustainable design and craft initiatives, adding aesthetic and sustainable value to products (GIATTI et al., 2021). Its application in interior design and fashion has been encouraged by initiatives

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aimed at the use of sustainable materials, which enables greater acceptance in the sustainable luxury market and in fashion industries with an environmental focus (Guimarães and Ody, 2023).

Tucumã fiber, on the other hand, has high rigidity, being suitable for use in civil construction and decoration. Its strength allows it to be used in the manufacture of panels and lightweight structures, as well as decorative accessories such as frames and supports. This rigidity and durability highlight tucumã as an alternative for semi-durable products, replacing synthetic materials and conventional plastics (Ferreira and Homma, 2024; Mazarelo and Pacheco, 2011). Table 3 shows the market potential of those listed in this study.

Table 3: Market Potential of Amazonian Fibers.

Fibre	National Market	International Market	Competitiveness in Relation to Synthetic Fibers
Curauá	High potential in the automotive and construction sector	Growing Interest in Biocomposites in Europe	Superior strength and sustainability
Tururi	Sustainable fashion and local crafts	Sustainable fashion and decoration in markets Asian and European	Valued for flexibility and cultural identity
Jacitara	Handmade and interior design products	Sustainable luxury market in the U.S. and Europe	High durability and aesthetic appeal
Tucuman	Construction and decoration	Potential for export in the decoration industry and construction	Rigidity and durability comparable to plastic

Source: Survey result (2024).

The national market for these fibers is promising, especially in the automotive sector and in civil construction, where curauá emerges as a competitive fiber replacing synthetic fibers due to its resistance and low environmental impact. Internationally, European countries have shown interest in sustainable biocomposites, reinforcing the export potential of curauá (BUFALINO et al., 2014).

For the tururi, the national market focuses on fashion and handicrafts, valuing products with cultural identity and sustainability. In international markets, such as Asia and Europe, tururi has aroused interest in sustainable fashion niches and decorative products with differentiated aesthetics, which values its flexibility and cultural appeal (Araújo and Pereira, 2018).

Jacitara has high acceptance in the sustainable luxury market, especially in the US and Europe, where durability and aesthetic appeal are valued. Interior design products and

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accessories made with this fiber have been increasingly incorporated into sustainable fashion catalogs (Guimarães and Ody, 2023).

And tucumã provides the improvement of rigidity and durability, making this fiber promising for use in civil construction and decoration in the domestic market, while in the international market, it has competitive potential in replacing plastics in semi-durable applications, meeting the growing demands for ecological materials ((Ferreira and Homma, 2024; Mazarelo and Pacheco, 2011).

The comparative analysis between Amazonian fibers reveals that each one has specific advantages that make them competitive in diversified sectors. Compared to synthetic fibers, natural fibers from the Amazon have significant environmental advantages, such as a reduced carbon footprint and the possibility of integration into circular economy cycles, characteristics that position them favorably in a global market that is increasingly oriented towards sustainability (SILVEIRA et al., 2024). Table 4 presents the physical and mechanical properties of the fibers and later, Table 5 shows the percentages of the chemical composition of the different lignocellulosic fibers.

Table 4: Physical and mechanical properties of fibers.

FIBRE	DIAMETER (µM)	TENSILE STRENGTH (MPA)	MODULUS OF ELASTICITY (GPA)	SOURCE
Curauá	151.27 ± 36.36	515.54 ± 202.45	22.14 ± 7.10	(NETA et al., 2015)
Tururi	182 ± 18	213 ± 93	10.5 ± 2%	(MONTEIRO, 2016)
Jacitara	16,7 ± 0,9	74,4 ± 16,9	18,74 ± 3,85	(FONSECA et al., 2013)
Tucuman	72,33 ± 10,28	124,12 ± 48	8,3 ± 1	(PENNAS, 2019)

Source: Survey result (2024).

Table 5. Percentage of the chemical composition of different lignocellulosic fibers.

FIBRE	CELLULOSE (%)	HEMICELULOSE (%)	LIGNIN (%)	SOURCE
Curauá	71,03	17,3	9,53	(NETA et al., 2015)
Tours	74,1	12	31,1	(Buli, 2017)
Jacitara	66,8	18,44	14,68	(FONSECA et al., 2013)
Tucuman	49,35	13,12	37,43	(KIELING et al., 2023)

Source: Survey result (2024).

SUSTAINABILITY AND ENVIRONMENTAL IMPACT OF FIBRES

Amazonian fibers, such as curauá, tururi, jacitara, and tucumã, have substantial environmental advantages over synthetic fibers, due to their renewable origin and lower carbon footprint. Figure 6 exemplifies a sustainable production cycle from natural fibers.

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Figure 6. Diagram showing the sustainable process of composite plastics reinforced with natural fibers.

Fonte: (KAMARUDIN et al., 2022)

During the life cycle of these fibers, environmental impacts are minimized by sustainable extraction and low-energy processing, essential characteristics in a circular economy scenario (OLIVEIRA et al., 2022).

The curauá, for example, has been highlighted for its low environmental impact in the production of biocomposites, with less waste generation and the possibility of returning to the production cycle after disposal (BUFALINO et al., 2014). In contrast, synthetic fibers, such as polyester, are associated with highly polluting processes, which involve petroleum derivatives and contribute to the generation of microplastics and greenhouse gas emissions, making it difficult for them to decompose and recycle (Guimarães and Ody, 2023)

Thus, Amazonian fibers not only align with circular economy principles, but also offer a sustainable alternative that reduces environmental damage and promotes reuse.

BARRIERS AND OPPORTUNITIES FOR EXPANSION IN THE DOMESTIC MARKET

The expansion of Amazonian fibers in the domestic market faces several logistical and regulatory barriers, as well as infrastructure challenges that limit its competitive potential. For (AGUILERA, 2022), despite studies pointing to the quality, low cost, abundance, and sustainability potential of these Amazonian fibers, the industry's interest in investing in these productions and diversifying its raw material base remains low. At the same time, the lack of public incentive for this production model added to the devaluation of traditional Brazilian knowledge means that producers are not motivated to continue with production.

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The transport and distribution of fibers from remote areas hinder access conditions and the lack of storage and processing structure hinder logistics efficiency (Araújo and Pereira, 2018). In addition, the absence of specific regulations and government incentives for the sector prevents Amazonian fibers from gaining scale and competitiveness compared to widely used synthetic alternatives.

However, the opportunities for growth are significant, especially with the growing demand for sustainable products that respect circular economy practices. The use of natural fibers drives industrial advancement, both in the manufacture of clothing and textiles and as reinforcement in composites, aiming to improve the properties of plastic or cementitious materials. Sectors such as automotive and construction take advantage of the excellent cost-benefit ratio of these materials, combined with the remarkable characteristics that reinforcements give to the matrix (SILVEIRA et al., 2024). These factors create a favorable scenario for the development of partnerships and incentive policies that enable the expansion of these fibers, meeting both environmental needs and the demands of the global market.

PROPOSITIONS FOR EXPANDING THE USE OF AMAZONIAN FIBERS

To expand the use of Amazonian fibers, it is essential to implement public policies and tax incentives that favor the production and marketing of these sustainable raw materials. Incentive strategies, such as tax reductions for plant-based products and subsidies for the development of production infrastructure, could boost the competitiveness of fibers in the national and international markets (ARAÚJO; PEREIRA, 2018). In addition, the creation of specific lines of financing for the research and development of processing technologies would be essential to improve the quality and durability of the fibers, facilitating their application in demanding sectors such as civil construction and biotechnology. Strategic partnerships with sustainable fashion, biotechnology and civil construction industries are equally important to promote the adoption of Amazonian fibers on a large scale. Affirms (GUIMARÃES; ODY, 2023), that these collaborations can increase the visibility of natural fibers in the market, meet the sustainability demands of consumers, and reinforce the environmental and economic advantages of these alternatives compared to synthetic materials.

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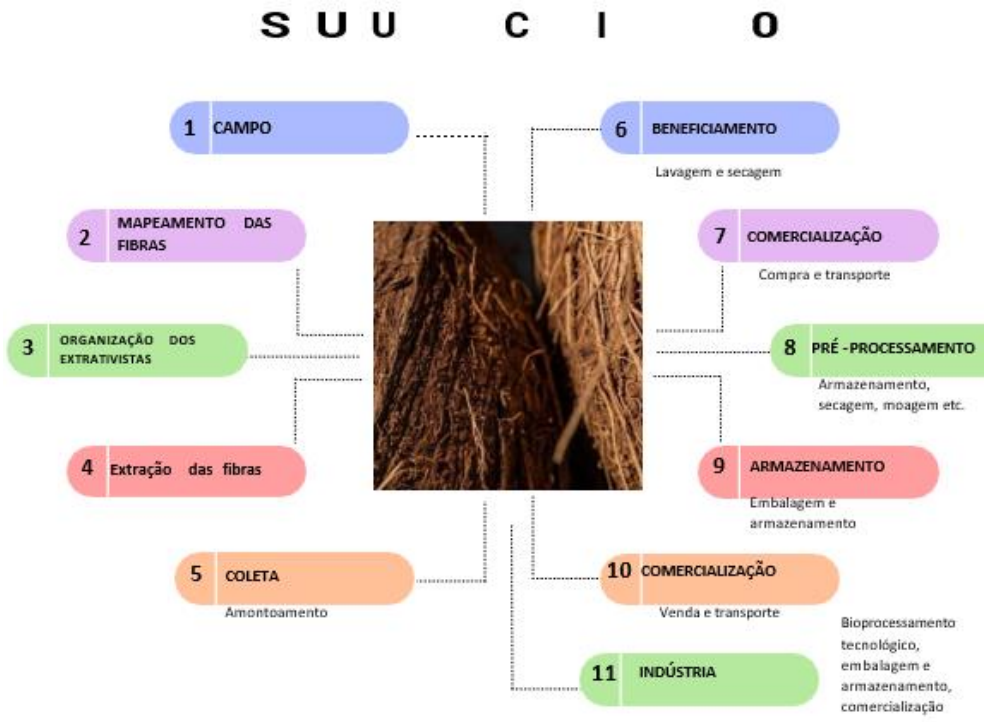
MAPPING THE AMAZON FIBER VALUE CHAIN

The mapping of the Amazonian fiber value chain, in Figure 7 below, reveals a series of steps that include collection, transportation, processing, and marketing, each with specific challenges. In the initial collection stage, extraction is carried out mainly by local communities in remote regions, in a sustainable and manual manner.

Figure 7: Fiber value chain structure



Source: Survey Result (2024)

However, the lack of adequate infrastructure for transportation and storage compromises quality and raises costs, directly affecting the competitiveness of fibers (ARAÚJO; PEREIRA, 2018). This critical point is exacerbated by the absence of efficient outflow routes, especially during the rainy season, which affects transport and hinders connectivity to processing centers.

In the processing stage, where the fibers are cleaned, dried and prepared for industrial use, the lack of appropriate technologies in the collection areas limits the quality and added value of the products. As a result, fibers need to be transported to distant centers, further increasing logistics costs and reducing the efficiency of the production chain. According to Bufalino et al. (2014), the development of regional technologies for processing could boost the added value of fibers, improving their suitability for biocomposites and other industrial products.

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In commercialization, there is a regulatory and standardization gap that prevents the insertion of Amazonian fibers in competitive international markets. The absence of origin and sustainability certifications makes it difficult to meet the requirements of markets that value materials with environmental guarantees. Public policies that encourage the certification and standardization of fibers could promote their global acceptance, meeting the growing demand for sustainable products (GUIMARÃES; ODY, 2023).

In addition, investments in transportation infrastructure and regional processing centers near collection areas could reduce costs and optimize the production chain, promoting the sustainable and economic development of Amazonian communities (CTC, [n.d.])

LIMITATIONS OF THE STUDY AND PROSPECTS FOR FUTURE RESEARCH

This study faced some important limitations, especially in obtaining specific data on the sustainable management and methods of extraction and processing of Amazonian fibers on a large scale. The lack of standardization in extraction and beneficiation methods makes it difficult to establish uniform parameters to compare fiber performance.

According to Araújo and PEREIRA (2018), another significant limitation was the scarcity of long-term studies examining the environmental impact of larger-scale production, limiting the ability to assess the true potential of Amazonian fibers in a circular economy scenario.

Prospects for future research include the development of more in-depth studies on standardized extraction and processing techniques, which could optimize the quality of fibers and increase their competitiveness in the market. Experimental studies that analyze the complete life cycle of these fibers, from extraction to disposal, are necessary for a more accurate assessment of their sustainability and potential return to the production cycle (GUIMARÃES; ODY, 2023).

In addition, it would be relevant to invest in research aimed at improving the sustainable management of the plants that provide these fibers, promoting production that is both environmentally responsible and economically viable for local communities (BUFALINO et al., 2014). These advances would contribute to the understanding and feasibility of the use of Amazonian fibers on a large scale, strengthening their role in a market increasingly focused on sustainability.

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CONCLUSION

The review of commercial fibers from the Amazon reveals the vast economic potential that these sustainable raw materials can offer in various sectors, such as fashion, construction, and biotechnology. However, despite the advantageous physicochemical properties and the growing demand for renewable alternatives, Amazonian fibers face significant challenges that limit their expansion and competitiveness in the market.

Logistical barriers, lack of adequate infrastructure, absence of standardization in extraction and processing methods, and the lack of specific certifications make it difficult to fully exploit its potential. These obstacles highlight the importance of public policies and investments in technology and infrastructure, which favor the commercialization of fibers in a comprehensive and sustainable way. In addition, the creation of strategic partnerships with sectors that value sustainability can promote greater visibility and acceptance of fibers in the global market, increasing opportunities for local communities and the bioeconomy of the Amazon region.

Future studies and the development of innovative solutions will be fundamental to overcome the current limitations, expanding the industrial applicability of these fibers and consolidating their role in a market increasingly committed to responsible environmental practices and the circular economy. Thus, Amazonian fibers have the potential to play an important role in sustainable development, valuing the region's natural and cultural resources, while generating economic opportunities for the place.

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