

Natural fibers. Allies from the environment and combating rural poverty in Brazil and the world

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Abstract

This paper aims to analyze the importance of natural plant fiber production chains for the sustainable development of poor regions, and of the complex regional and local realities, which share similar problems in Brazil and in the world. Despite a considerable number of workers involved in cultivation, extraction and industrial processing of natural fibers, the public authorities have not given due attention and support to this sector to overcome problems that have persisted for decades. Although the world is drawing attention to climate change, seeking to favor forms of production that avoid environmental degradation and, mainly, to help fight poverty and hunger, many of the activities that naturally meet the requirements of environmental conservation and with strong social appeal are still not sufficiently organized and competitive in the face of large corporate agriculture. The priorities of the natural fibers sector in Brazil point to a strong dependence on the public power to initiate the necessary changes for its restructuring and revitalization. The diffusion of income generation possibilities in the countryside and the identification of new markets for natural fibers will depend on a collective and cooperative effort of the interested parties. New forms of global and local cooperation in seeking solutions to the difficulties faced by these sustainable economies and the use of technology may be key to the development and well-being of a considerable number of people, who are currently marginalized.

keywords: Brazil Local Development, Fight Against Poverty, Sustainable Development, Natural Fibers, Jute And Mallow, Sisal.

1. Introduction

The research of themes involving world development, whether in the economic, social and/or environmental dimension, allows society at large, and the public and private sectors involved, to commit themselves to improving the quality of life of all peoples, in all parts of the planet. As a reflection of these efforts, it is noted that each day the debates become more qualified, connected to and focused on the purpose of reducing social inequalities and protecting the environment.

It was in this spirit that a new development milestone was established in 2015, officialized by the document “Transforming Our World: The 2030 Agenda for Sustainable Development”, at the United Nations (UN) Summit in New York. This

paper urged countries and all social segments to engage in broad dialogue on contemporary issues crucial to achieving the ambitious goal of eradicating poverty in all its forms and dimensions, including extreme poverty (OnuBrasil, 2015), the biggest global challenge to sustainable development.

In the 1970s, the world realized that it was already using more resources than could be regenerated by nature, producing more waste and emitting more greenhouse gases (GHG) than could be absorbed by the ecosystem. In spite of this evidence, humanity has been increasing its pressure on the environment, a trend that has intensified with population growth and, mainly, as a result of carbon-intensive economic activities and exploitation of natural resources, leading many cities to the inexorable destination of environmental unsustainability.

In this context, the search for new materials and sustainability based on renewable natural resources has been taking center stage in many markets, research groups and public opinion, making room for natural vegetable fibers to regain an important place in the discussion on environmentally biased production and consumption. Plant fiber is a renewable, biodegradable raw material. Its production and processing uses little or no chemical product (depending on the type of fiber) and integrates perfectly with the agro-climatic conditions of the producing regions, without damaging the environment through the use of pesticides, burning or deforestation. In addition, the production and processing of these natural vegetable fibers are largely carried out by family farmers on small farms, and their industries employ millions of people throughout the world.

Looking at the environmental, economic and social potential of natural fiber chains in different parts of the world, the Food and Agriculture Organization of the United Nations (FAO / UN) established 2009 as the International Year of Natural Fibers (IYNF), a way to draw the attention of public and private sector authorities to the importance of these agricultural crops for several developing countries. For FAO, the production, processing and export of natural fibers and their manufactured products are vital to the economies of many countries and play an important role in food security and as means of livelihood for millions of small farmers and low-income workers.

Ten years after the UN manifesto in support of natural fibers, and with the new global definitions and goals for the sustainable development of the planet, it is necessary to reflect on “how” and “how much” these agro-industrial activities are aligned with the Sustainable Development Goals (SDGs), so as to place them in a strategic position in the fight against rural poverty in regions with peculiar environmental and agro-climatic characteristics, not only in Brazil, but also in the world. And it was for this purpose that the United Nations General Assembly (UNGA), at its 74th session recently held on November 21, 2019, in New York, approved a new Resolution for natural fibers - Natural plant fibers and

sustainable development - suggested by Bangladesh. This document cites the recommendations presented by the International Natural Fibers Organization (INFO), built during the meeting of the FAO Intergovernmental Group on Hard Fibers Group held in Beijing in October 2019. What is expected from this resolution, announced by the UN in favor of natural fibers, is that the promotion of these raw materials worldwide by research centers, companies, investors and consumers can be stimulated, generating new market opportunities, innovation and development for the producing regions.

2. *Why natural fibers? Historical importance*

Science reveals that natural fibers¹, both vegetable and animal fibers, have been used by man since prehistory, in various activities and with numerous practical utilities. Like the domestication of food plants which gave rise to agriculture, textile fibers have been a fundamental part of human life since the dawn of civilization. There are reports that fragments of cotton items dating from 4,500 BC were excavated in Mexico and Pakistan; that the history of silk began in the 27th century BC according to Chinese tradition; that the oldest woolen textile, found in Denmark, dates back to 1500 BC; that the oldest woolen carpet in Siberia dates back to 500 BC, and that flax was already grown during the Neolithic era, being one of the oldest fibers known to man².

According to Hedges (2010), vegetable fibers were useful in braids, clothing, adornments, rope, food and other commercial, cultural and architectural uses. Throughout history, raw materials were fundamental to the development of internal and economic social relations among peoples and cultures. In his ethnohistorical research, Costa (2014) explains that many ethnic groups of Brazilian Indians have mastered the technique of braiding and have developed tools such as baskets, nets, fishing traps, bags and containers, even using resins to waterproof certain products and make them more resistant and lighter for transporting.

Due to their flexibility and high resistance to salinity, one of the most common uses of vegetable fibers for several centuries was in the manufacture of reinforced navigational ropes. The “knot”, a unit used in navigation, was idealized by the scientist Alexander von Humbolt using knotted fiber ropes at

¹ In this article, the analysis is restricted to natural fibers of plant origin, also called lignocellulosic fibers, structural components of plants, formed by cellulose, hemicellulose and mainly lignin, a polysaccharide present in approximately 25% of plant matter. These characteristics of the plant sclerenchyma enable its use in activities where strong and flexible tissues are needed.

² Prof. Dr. Rasiyah Ladchumananandasivam: Fiber Technology Course - Introduction. Federal University of Rio Grande do Norte, Brazil.

regular distances to measure the speed of ships. There are also reports of the use of jute on Egyptian boats and in quipu³ (a form of “written” communication of some pre-Columbian peoples) that were certainly fundamental to these civilizations (Hendges, 2010).

Nowadays, plant fibers have numerous applications in several industrial segments: automotive, naval, aerospace (as primary and secondary materials), civil construction (geotextiles and reinforced materials), bio-composites⁴, animal feed, cosmetics, health, and in the sports industry, such as tennis racquets, golf sticks and ski boards (Ladchumananandasivam, 2011; Gonçalves et al., 2018). In addition to their classic applications, such as: packaging, sacks for agricultural products, ropes and textiles. Beyond this range of uses and applications, the production, processing and export of natural fibers and their manufactured products are vital to the economies of many developing countries. In many cases, they are the only income alternative for some traditional small farmers communities of and extractivists. A diagnosis presented by FAO in 2009 shows that practically all natural fibers (except cotton) are produced in subsistence farming systems, with low or no technological apparatus and with high demand for human labor, and reported some examples.

³ The Incas did not have a writing system. Instead, they used a coding system known as “quipu”, a set of ropes with lashings (knots) of different colors representing symbols or words.

⁴ Composites are heterogeneous materials that have at least two distinct phases: one called reinforcement, which is responsible for generating resistance to the material, and another called matrix, that corresponds to the medium that receives this reinforcement. In the case of bio-composites, one of the phases is made up of material of natural origin (e.g. vegetable fiber).

Table 1 - Diagnosis performed by FAO, 2009

Fiber	Scenario in 2009
Silk	<ul style="list-style-type: none"> - It is another important industry in Asia - Sericulture generates income for about 700,000 farm households in India, while silk processing provides jobs for 20,000 weaving families in Thailand and about 1 million textile workers in China
Jute	<ul style="list-style-type: none"> - In India and Bangladesh, it is estimated that 4 million small farmers earn a living directly, and support 20 million dependents, with jute cultivation
Coconut	<ul style="list-style-type: none"> - Each year, developing countries produce around 500,000 tons of coconut fiber, mainly for export to developed countries, for use in ropes, nets, brushes, mattresses and insulating panels. - Sri Lanka is the largest supplier of coconut fiber to the world market, and its coconut fiber products account for 6% of agricultural exports. - 500,000 people work in small coconut fiber factories in South India
Sisal	<ul style="list-style-type: none"> - The cultivation and processing of sisal in Tanzania directly employs 120,000 people and the sisal industry benefits about 2.1 million people. In this country, the government and private industry have been working to revive the demand for sisal fibre

Source: FAO, 2009. Prepared by the author

In the quest to secure and protect these traditional agricultural activities from non-food crops that involve little understanding of their value and importance, leaders of the natural fibers sector presented some arguments in 2006 at the United Nations General Assembly:

1. Natural fibers play an important role in the clothing of the world's population, besides presenting new and promising industrial uses;
2. Much of the world's natural fiber was produced as a source of income for small farmers in low-income and developing countries;
3. It is necessary to draw global attention to the role of income derived from the commercialization of natural fibers for food security and in the fight

- against poverty of various populations;
4. Although the production and consumption of natural fibers offers significant environmental benefits, concerted efforts should be made to ensure that these same benefits are not compromised by improper practices;
 5. It should be recognized that there are important potential partnerships among participants in the various natural fiber industries around the world;
 6. It is essential that work is done to increase public awareness of the economic and environmental attributes of natural fibers.

On the occasion of the inclusion of this theme in the official calendar of the UN, and in the wake of the IYNF, the *International Symposium of the International Year of Natural Fibers* was held in Brazil (Salvador, Bahia) in 2009, which brought together authorities and experts on the subject from around the world. At this meeting, four main areas were established in the direction of broader work that would be coordinated by the International Natural Fiber Organization (INFO / FAO):

- Sensitize and stimulate the demand for natural fibers;
- Encourage appropriate government policy responses to the problems faced by natural fiber industries;
- Promote an effective and lasting international partnership between the various natural fiber industries;
- Promote the efficiency and sustainability of Natural Fiber Industries.

The IYNF was expected to have international repercussions. However, ten years after this major event, the scenario of the last decade is still worrying. In fact, there has been a considerable decline in natural fiber production, and threats to many of these economies and livelihoods persist due to the global financial crisis and the emergence of much cheaper synthetic alternatives, which is reducing the demand for these fibers each year.

According to the *Discover Natural Fibers Initiative* (DNFI)⁵, which works in cooperation with the FAO, the world natural fiber production in 2018 was estimated at 32 million tons. During the past decade, world production of natural fiber has ranged from 28 million to 35 million tons, with most of the year-on-year variation caused by climate-related declines in productivity. The amount of natural fiber produced in 2018 represents only 29% of total world production of

⁵ The Discover Natural Fibers Initiative (DNFI) was established in January 2010 as a result of the IYNF 2009, declared by the United Nations General Assembly. The DNFI is a voluntary association of individuals and organizations working to promote the interests of natural fibers. Available at: <www.dnfi.org>.

textile and clothing fibers (including animal and synthetic fibers) which reached 110 million tons in the same year, which means a productivity drop of almost 71% in 10 years. One aspect strongly related to the fall in fiber production is the low use of technologies, either in the field or in primary processing, and the underutilization of the plant, since fiber represents only 5% of the potential use of many fibrous plants such as malva, jute and sisal (Araújo and Pereira, 2018; Van Dam, 2018; Santos e Silva, 2017).

Even with their strong ecological appeal, traditional vegetable fiber products have been losing space to plastics and synthetic fibers due to their cost. However, it is noteworthy that only about 10 companies are responsible for more than 50% of world production of synthetic fibers, employing relatively little labor, while cotton is produced by tens of thousands of producers around the world, in several countries with lower environmental impact (Freire et al. 1997). Some industries such as automotive, two-wheel, naval and plastic began in the early 2000s to seek to use renewable raw materials, such as vegetable fibers in their products or processes, due to their advantages in replacing inorganic/ minerals fibers, such as fiberglass, commonly used in industry in formulations with different resins, plastics and rubbers (Galvani; Felix, 2017).

There is a huge field of business opportunities, including in the international market, for natural fibers, bearing in mind that we are living in times of significant changes in ethical values regarding the production and consumption of goods and services, which increasingly seek environmental and social sustainability. According to the Common Fund for Commodities (CFC, 2008), other reasons for increased demand for natural products may also be cited, such as: (i) recent concerns about shrinking oil stocks and their final depletion in the not too distant future; (ii) increased government legislation, such as land taxes; (iii) a greater emphasis on sustainability and biodegradability of industrialized products; and (iv) carbon credit.

According to Brandão (2012), this new bias in driving economic systems, often called “green economy”, is formed by: (i) the management of low carbon generating production processes; (ii) the rational use of natural resources and (iii) social inclusion. The author emphasizes that the timid practices of certain production systems, which tend to result in sustainable development, have been incorporated into the monitoring of climate change, the control of the role in the ozone layer and the accounting for greenhouse gas (GHG) emission levels. Starting from the premises defended by Brandão (2012) for a new social progress, one can try to associate this tendency with the qualitative changes that have been occurring in the way that the manufacturing industries are adjusting to consumers' environmental perceptions. By the end of the 20th century, most efforts to capitalize on the green movement focused on recycled products and environmentally friendly packaging materials, such as those made from biodegradable plastics or sustainably produced cellulose.

FAO (2012) confirms that industries, particularly in high-income countries, are seeking more sustainable ways of operating, and looking at natural inputs in a more positive and proactive way. Natural inputs are being considered not only as technically valid components, but also as elements that can contribute to the pricing of products, due to their superior quality, environmental attributes that are compatible with production requirements and the possibility of responsible disposal, a subject widely discussed today, known as “life cycle assessment”. On the other hand, changes in the regulatory environment are playing an increasingly important role in encouraging industry to develop environmentally sound practices. In this regard, FAO drew attention to the regulation of the natural fibers market of direct relevance to these economies, pointing out legislative provisions ranging from the prohibition of non-biodegradable plastic bags to the establishment of material life cycle requirements for automotive industry. These regulatory provisions are indicative of the pronounced trend in many high-income countries towards legislation and production practices aimed at reducing social costs and environmental damage.

This pro-environment movement, which is also concerned with better living conditions for people and future generations, has been stimulating the growth of sustainable agriculture. Consequently, it has also induced the adoption of production and processing technologies that seek not to harm the environment (*environmentally friendly*)⁶, fostering economic development and strengthening the participation of small producers in the value chain.

3. Natural fibers in Brazil: their challenges and opportunities

In Brazil, the production of natural vegetable fibers is distributed in almost all national territory. Cotton is the leader in the ranking, accounting for about 2.6 million tons production in the 2018/2019 harvest, with significant growth of revenues, due to both the increase in prices (17.64%) and in production (30,96%) in the year, with Brazil being the world's second largest exporter (ABRAPA, 2019). However, cotton is one of the most environmentally expensive fibers to produce due to the intensive use of pesticides; approximately 16% of global insecticide use is due to cotton cultivation. In Brazil, cotton cultivation ranks 4th in pesticide consumption (after soy, corn and sugarcane, respectively), using an average of 28.6 liters of pesticide per hectare (PIGNATI et al., 2015).

⁶ Environment-friendly or environmentally friendly (also known as eco-friendly, nature-friendly, and green) are sustainability and marketing terms relating to goods and services, laws, guidelines, and policies that claim reduced, minimal, or no damage to ecosystems or the environment (WIKIPEDIA, 2018).

In addition to this negative impact on the environment, unlike other vegetable fibers, cotton cultivation in Brazil makes intensive use of cutting-edge technology, with highly mechanized field processes, which reduces the number of jobs. The production system of the plant fibers addressed in this article, despite their smaller scale, require a much larger number of workers, including family farmers and extractivists. This is probably due to the fact that the technologies used in these agricultural and industrial activities have hardly evolved. However, these crops are now well aligned with modern concepts of environmental preservation, such as “low carbon agriculture” and “organic agriculture”, as pesticides and chemicals are not used in their processes.

According to the 2010 *Brazilian Institute of Geography and Statistics* (IBGE) demographic census, Brazil's population was 190.8 million people, with 84.36% (160.9 million) living in urban areas and approximately 15.64% (29.8 million) in rural areas⁷. In a 2018, IBGE estimated that Brazil has already reached a population of 208.5 million people, and that of this total, the equivalent of 15.28% lives in rural areas, with the highest percentage being in the North (25%) and Northeast (27%). These regions are predominantly agricultural, which leads us to reflect on the importance of this activity, whether small or medium-sized (family farming) or large (agribusiness), for the country's economy and especially for the development of rural regions, since we are talking about 32 million people who depend on alternatives that generate employment and income in rural areas. Also, contributing to the reflection on the importance of agricultural production for Brazil, I point out some data: in 2017 the sector represented 21.6% of Gross Domestic Product (GDP)⁸, and in 2018 it increased by 4.6% (CEPEA, 2018). This growth was driven by a rise in the amount production of crops such as cotton, coffee, wheat and soybeans, which are important in terms of value. Despite all this strengths, there is no doubt about the urgency to balance the environmental and social cost of these highly pesticide-consuming activities (since it involves the health of farmers and consumers), and their water and energy consumption.

In this scenario, in search of sustainability for ecosystems and local populations, natural fibers can play an important role as an economic alternative for the poorest rural regions. In Brazil there are at least 10 types of vegetable fibers with real market potential: sisal, jute, mallow, piassava, bamboo, coconut, silk, curaua, golden grass, buriti, among others. Some are cultivated species, such as jute (*Corchorus capsularis*), mallow (*Urena lobata*), sisal (*Agavea sisalana*), coconut

⁷ The methodology for characterization of the urban and rural population adopted in Brazil differs significantly from the methodology adopted by OECD countries. For this reason, this high rate of urbanization of the Brazilian population is quite questionable (SILVA, 2018), available at: <<https://anovademocracia.com.br/noticias/10028-populacao-urbana-e-rural-no-brasil-analise-comparativa-dos-percentuais-segundo-criterios-do-ibge-e-da-ocde>> Access in: August 2019.

⁸ In addition to the primary activities carried out in the establishment, the GDP of agribusiness comprises the transformation and distribution activities.

(*Cocos nucifera*) and curaua (*Ananas erectifolius*), and others come from extractive management, such as piassava (*Attalea funifera*), buriti (*Mauritia flexuosa*) and golden grass (*Syngonanthus nitens*). In addition, the proportion of family farmers who work and depend directly on the cultivation and extraction of these fibers is considerable, representing a socioeconomic weight for the producing regions, as well as strong cultural elements associated with the cycle of production, extraction and processing of fibers.

For many of these traditional farming populations, there are no other economically viable local activities in the short- or medium-term, due to the characteristics of rural infrastructure and even the ecosystem of these regions themselves. Jute and mallow, for example, have completely adapted to the Amazonian floodplain ecosystem, which follows the river water cycle. Sisal has adapted well to the climatic characteristics of the northeastern backcountry, which goes through long periods of drought. These farmers have the traditional knowledge of fiber maceration and defibration; they also preserve the popular knowledge of plant management for seed harvesting using technologies that were developed in their own communities and production system.

It is estimated that the cultivation of natural fibers alone directly involves about 190,000 people (formal and informal) distributed in more than 600 municipalities from north to south of the country, especially in the North and Northeast (Table 2). Most of these municipalities have a low Human Development Index (HDI) and are in the extreme poverty range.

Table 2 - Production regions and number of workers involved in the cultivation of natural fibers in Brazil⁹

Natural Fiber	Region	Number of fiber producers	Number of Municipalities involved
Mallow and Jute	North (Amazon)	4.500	15
Sisal	Northeast	35.000	152
Piassava	North and Northeast	5.000	25
Coconut	Northeast	100.000	9
Bamboo	Northeast	40.000	250
Silk	South	7.550	230
TOTAL		192.500	681

Source: Brazilian Ministry of Agriculture's Natural Fibers Sector Chamber (prepared by the author)

We are talking about an economy that produces approximately 500,000 tons of vegetable fibers and generates about 350 million reais, involves 40 industries, almost 50 family producer organizations (Table 3) and about 300,000 workers (from planting to industrial transformation). It is important to emphasize that many of these workers in the natural fiber sector live exclusively from this activity, and over time have developed their own production technologies in adverse situations. However, the production of almost all these fibers has been falling every year, and this may reflect the lack of a government agenda prioritizing small production sectors.

⁹ Data gathered in recent consultation with members of the Natural Fibers Sector Chamber, as much important information to analyze the fiber sector is not found in official statistics.

Table 3 - Data from the natural fibers sector in Brazil

Natural Fibers	Production 2018 (Ton)	Gross value of production (million R\$)	Number of industries	Number of Associations / Cooperatives of producers
Mallow and Jute	7.264	19,00	3	2
Sisal	57.962	224,00	14	12
Piassava	8.481	12,00	4	4
Coconut (coir)	4.500	9,00	14	4
Bamboo	400.000	36,00	4	14
Silk	517	55,00	2	11
Total	478.724	355,00	41	47

Source: Brazilian Ministry of Agriculture's Natural Fibers Sector Chamber (prepared by the author)

Based on the premises of *sustainable development*, aiming at maintaining harmony between economic, social and environmental factors to ensure the integrity of the planet, nature and society throughout the generations, it is believed that the natural fibers sector can play an important role in local and regional development in Brazil. Natural fibers present a differentiated potential for opportunities in relation to other food crops, that cannot grow in certain regions such as the semi-arid (due to long periods of drought) and in the Amazonian floodplains (flooded lands every six months with rising rivers). Despite their countless qualities and market potentials, and possible new applications, the natural fibers industry has faced real obstacles that have been known for decades without receiving due attention from governments, such as: i) lack of investments in research and development of technologies to improve fiber planting, harvesting and fiber processing systems; ii) lack of technical assistance to small farmers; iii) rural credit lines inappropriate to the crop cycle; iv) precarious rural infrastructure for storage and disposal of production; v) lack of reliable industry statistics; and vi) little social organization of producers, which makes them vulnerable in the face of difficulties (Alves et al., 2004; Ferreira, 2016; Araújo and Pereira, 2017; Naves, 2017).

Added to these aspects that weaken the fiber sector, the lack of basic public services such as education, health, sanitation, safety and transportation in the producing regions continue to persist. It can be affirmed, therefore, that there are two central issues in the discussion about the difficulties faced by the natural fibers sector in Brazil: the weak public action in promoting these productive chains and in meeting the basic needs of these citizens.

Situations such as these put at the center of the debate the development of public policies and a sustainable agenda that may truly fulfill the simplest tasks, with the most practical scope and at the speed that the environment and the poorest people need. However, despite the frequent use of the term “sustainability” in slogans and political discourses, in practice the basic and essential steps to protect the environment and the most vulnerable populations have not been taken. Public policies may or may not transform a reality in a positive way, depending on the priorities of the government agenda for different topics.

Natural fiber chains in Brazil have a long history of discontinuing public initiatives and have suffered twice due to the worsening of the climate issue, which has significantly affected the ecosystems of the producing regions, causing food shortages and consequently hindering production. This year, for example, the Amazon had 50.5% of the hot spots, followed by the Cerrado with 39.1% and the Atlantic Forest with 11% (data from the *National Institute of Space Research, INPE*) in 2019¹⁰. Most states in the Legal Amazon had fires above the historical average, and some had to declare emergency situations - Amazonas and Acre - because of the vast regions affected by smoke. Climate changes have also directly affected the behavior of Amazonian rivers, which lately have filled or dried much above average in the floodplain regions, as well as in the northeastern semi-arid region, with prolonged droughts occurring for long periods, beyond historical records.

These and other limitations, such as the large distance between rural producing regions and their administrative centers, as well as the lack of political representation in municipal and state assemblies, left these small farmers with little say in achieving and conducting sectoral public services policies.

¹⁰ Half of the fires in 2019 were concentrated in the Amazon region. Available at: <<https://g1.globo.com/natureza/noticia/2019/08/20/amazonia-concentra-metade-das-queimadas-em-2019.ghtml>> Access in: Dec. 2019.

4. How can natural fibers contribute to fighting rural poverty and protecting the environment?

In a summary analysis of the poverty figures - 865 million people worldwide live on less than a dollar a day, or USD 0.99 more precisely. Esther Duflo, the most recent Nobel laureate economist, points out that with this scenario it is possible to think "*this is a problem I cannot solve*". In this sense, Esther Duflo, along with her poverty research partners Abhijit Banerjee and Michael Kremer, argues that the way out may be to look at the problem from a more micro and localized perspective, in order to understand how the poor really live, in which contexts and which problems they face.

The need for a regional and local approach, also advocated by Elinor Ostrom (2012), is of paramount importance to understand the dynamics of poverty and its determinants, leading a broad and diverse concept of poverty. For Ostrom, it is impossible to map out a single plan for the entire planet that can protect it and avoid a global humanitarian crisis. This will only be possible with multi-level polycentric initiatives, involving local, regional and national actors, leading to the development of their own strategies to deal with different issues in each context and ecosystem. Zupi (2018) contributes with the analysis that development comprises complex systems in evolution, with objectives and interlaced processes. The author argues that "*standardizing development aid practices can entail risks of routinizing, institutionalizing and depoliticizing participation, which should be an active enabling process to enable people to engage in the self-determined development of their lives and environments, rather than a co-optation practice and a process of making local people participate in the 'project' to achieve predetermined national or global development goals*".

In this conception, it becomes urgent to propose reflections on the economic alternatives that can meet different needs of complex realities regarding the ecosystem, social, cultural, economic and political aspects, in order to reduce the inequalities of populations most vulnerable to poverty.

Despite having achieved considerable poverty reduction rates from 2002 to 2014, in 2018 Brazil still presented a significant number of 23.3 million people (11.2% of the population) living below the poverty line, including 13.5 million below the extreme poverty line¹¹ (6.5% of the population) - 4.5 million more than in 2014 -, when the country experienced the lowest levels of unemployment (IBGE, 2018). The persistence of the regional component is also observed, with the worst rates of human development, education and basic sanitation concentrated in the North and Northeast regions of the country. Only in the Brazilian Amazon, around 20 million people (49% of the population) live in

¹¹ Monthly per capita income below R\$145.00 or U\$S 1.9 per day, a criterion adopted by the World Bank to identify the condition of extreme poverty.

poverty.

Studies conducted by the *Getúlio Vargas Foundation* in 2018¹² point out that although Brazil has left the “Hunger Map”, the largest number of individuals living in extreme poverty is still concentrated in its rural areas. The 2010 census conducted by the *Brazilian Institute of Geography and Statistics* (IBGE) indicates that the proportion of the population living in permanent private habitation below the poverty line was 3.7% in urban areas, rising to 20.8% in rural areas. By focusing in particular on the population in extreme poverty in rural areas, it can be seen again that the concentration is critical especially in the Northeast, reaching 30.7%. Using another parameter, such as people who received up to R \$ 127.50 ($\frac{1}{4}$ of the minimum wage at the time), the percentage rises to 52.1%, or 6.9 million people living under the condition of extreme poverty.

The incorporation of multiple dimensions into the concept of poverty makes it possible to translate a social phenomenon, which in itself is quite heterogeneous, since people differ from each other in various ways, both in terms of external and circumstantial characteristics. For example, more than 100 million Brazilians today do not have access to sewage collection and treatment, and 70% of these people live in the North and Northeast, the vast majority in the Amazon region. Likewise, only 57% of the population in the Northern region is supplied with treated water (Trata Brasil Institute, 2019). Thus, Arrecthe (2018) draws attention to the preliminary need to distinguish between monetary and non-monetary inequality in poverty studies, since the former refers to the income of individuals, while the latter refers to the dimensions that go beyond income such as access to public services, living conditions and capacities.

The definition of such dimensions is controversial among authors who recognize the difficulties involved in measurement (as highlighted by Martha Arrecthe), and the effects of these dimensions are the result of combining, in time, of policies with other exogenous factors such as demographic changes, social behaviors and market forces. Paula et al. (2013) emphasize that knowledge of rural poverty is useful for researchers and policy makers, especially in stimulating actions aimed at reducing regional inequalities, leading development to the areas most affected by this phenomenon. These researchers recommend policies that aim to stimulate local potentialities, in which the geographical component is considered as a marker of where these anti-poverty policies should initially be employed.

Much is discussed about regional “development models” in Brazil. With the radical change of political groups in power, as a consequence of the democratic intention to purge an endemic corruption that has plagued the country over the

¹² Poverty and inequality have increased in the last 4 years in Brazil. Available at: <<https://portal.fgv.br/noticias/pobreza-e-desigualdade-aumentaram-ultimos-4-anos-brasil-revela-estudo>> Access in: Jun. 2019.

past 20 years, these debates have become much tougher, especially when it comes to the Amazon biome. As stated by Fregapani (2000) the links between environment, development and conflict are complex and often misunderstood. There are numerous interests involved, and conflicts tend to increase as resources become scarce and competition for them increases. Perhaps for this reason the Amazon Rainforest is the protagonist of so many headlines. The fact is that the eastern part of the Amazon has already been significantly deforested, but the western part still has over 95% of its preserved forest.

Moreover, in the Amazon region we find the largest reserves of renewable natural resources in the world, which if exploited based on science and biotechnology – in a sustainable way – will be able to develop and protect the populations living there. The potential in the field of vegetable fibers, medicinal plants, regional fish, acai, chestnuts, cocoa, tropical fruits, essential oils and adventure tourism is enormous, not to mention the unexplored mineral reserves. In fact, the axiom is that the forest has its survival assured only if its maintenance and management have economic value, that is, if it is worth more standing than the ground. Moreover, there is no way to protect the environment without providing decent living conditions for the people who live in the forests, which is the first aspect to be noted and which highlights the importance of natural fiber agriculture for these ecosystems.

It is important that countries with extensive plant coverage, like Brazil, research and seek markets for species with high plant fiber production, which can even be produced and semi-industrialized by family agriculture. Jute and mallow plant fibers, for example, have been able to fulfill a relevant social role by fixing riverine populations in their natural and cultural environment for almost nine decades. Cultivated mainly in the northern region of the country, and currently in decline, they still generate income that feeds about 4,000 smallholder families. These vegetable fibers generate the yarns used to make sacks that pack much of Brazil's coffee export production, about 40% to 50%, and are the basis of various handcrafted articles; moreover, these fibers are used by the fashion and clothing industry for multiple purposes.

Sisal fiber, on the other hand, assumes the same role as mallow, but in the northeastern semi-arid region, as it is produced mainly in the state of Bahia. This supply chain alone supports more than 35,000 families, includes 152 municipalities in 3 Brazilian states, has 14 industries and 12 producers' associations (as shown in Table 3). The other fibers mentioned, such as piassava, silk, coconut, bamboo and even those with smaller production scale, such as carnauba, buriti, curaua, golden grass etc. follow the same local economic, social and environmental dynamics. The challenges to rebuild some of these supply chains are mainly related to technology and governance, not only by the agents themselves, but also on the market mechanisms, as shown in a survey of priorities in the natural fibers sector presented in the following table (Table 4).

Table 4 - Priorities of the Brazilian natural fiber sector (mallow / jute, coconut, sisal, piassava, silk and bamboo)

1 ^o	To seek incentives and encouragement for feasibility studies and research that develop technologies aimed at the production system, processing and new uses of different natural vegetable fibers with economic potential
2 ^o	Carry out a census of the vegetable fiber sector, with georeferencing of producers, for monitoring and planning of harvests, which will support several other policies
3 ^o	Establish a National Program to Support the Cultivation of Vegetable Fibers through the Ministry of Agriculture, Livestock and Supply (MAPA), with goals and deadlines set for a decade
4 ^o	Rural credit: adapt financing demands; create specific promotion and credit lines for the different natural fibers (cultivated and extractive); extend the scope of the financing policy to the most distant fiber producers
5 ^o	To seek support from the public authorities in strengthening the social organization of producers (associative and corporativism) and in training in different skills important to their activity
6 ^o	Articulate new partnerships with companies in the automotive, plastic transformation, cellulose, construction, fashion, among others with interests in natural vegetable fibers
7 ^o	Restructure the minimum price policy and implement agricultural insurance for specific crops of the floodplain region
8 ^o	Articulate the support of the legislature (municipal, state and federal) in the agendas of interest of the natural fibers sector
9 ^o	Create a register or seal of "organic" for natural fiber products in Brazil that meet the main sustainability requirements by adopting criteria for standardization, classification and certification
10 ^o	Create mechanisms to manage and articulate Brazil's natural fiber production chains through corporate governance with the creation of an Institute for the Governance and Development of Brazil's Natural Fibers, and; strengthen its Sector Chamber of the Ministry of Agriculture

Source: Author's elaboration

However, the cost of production of natural fibers and their products needs to be reduced so that they can be competitive and perform better than other products.. If natural commodities do not achieve a greater advantage than their competitors, especially in terms of quality, environmental and social appeal alone will not yet be able to promote the development of these supply chains. In this competitive race, it is understood that for a reorganization of the natural fibers sector, it is important the actors of the production chain be involved in the strengthening of the institutional environment and participation in decision-making processes in the scope of public policies, factors that determine the forms of governance of the chain.

5. Final considerations

Economic development cannot be pursued without considering the social and environmental dimension, just as there is no way to make homogeneous policies for a country the size of Brazil, with different biomes, soil types, climate, vegetation and water resources beyond cultural differences. We know, therefore, that sustainable development can only be built with enterprises that, besides economic growth, prioritize the conservation of the environment and the valorization of human capital. Having said that, it is unacceptable to neglect an ecologically based economy that, in Brazil alone: (i) produces around 400,000 tons of natural fibers (excluding cotton); (ii) generates about 300,000 jobs (including industry and commerce); (iii) reaches about 680 municipalities in different parts of the country, especially in the poorest regions, including the much coveted Amazon; (iv) generates around 350 million reais, and; (v) includes more than 40 industries, will be neglected. The decline in production and cultivated area, together with insufficient investment in research and technological development, is compromising the future of these fibers. On the other hand, the natural fibers sector is nevertheless resilient for having resisted the various economic and political crises that marked its trajectory and, despite everything, still strives to occupy a space worthy of its importance in the local development of its regions.

The priorities raised with the productive sector through the *Natural Fiber Sectorial Chamber* demonstrate that most of the actions depend on the support or even on the total initiative of the public power. Only actions 6, 9 and 10 (Table 4) are feasible without any support or dependence on the government. Moreover, the first of the ten priorities highlights the need for investment in research and technologies that can develop the sector from the farming level to new applications of fibers to new markets. In this sense, it is important to

emphasize that the different vegetable fibers produced in Brazil have great potential to be explored by biotechnology, and even nanotechnology, with expectations of considerable economic and ecological results.

However, it is worth mentioning that the social factor expressed in priorities 5 and 10, “*need for greater organization and empowerment of producers*” and “*improving sector governance mechanisms*” corroborate that it is not a simple task to restructure and develop the fiber sector. For this long-awaited progress, it is necessary to make changes in the countryside, taking a look at the rural producers, especially their living and working conditions. This requires the involvement of public authorities in the adoption of public policies that prioritize basic needs in rural areas such as education, health, transportation, sanitation; and the private sector in the pursuit of improving its production systems, developing new products and, mainly, qualifying the participation of agents in the production chain in the decision-making processes that interest them, that is, in the governance of the sector.

It is therefore necessary to focus on new forms of cooperation to guide the collective search for solutions to the common problems experienced by the natural fibers sector and its thousands of rural workers who struggle daily to survive the limited geographical conditions and especially the scarcity of basic services in rural areas in Brazil and other producing countries. The resolution of the 74th session of the UN General Assembly on natural fibers stresses that this effort should involve international and regional organizations, the public sector, the business community, academia and especially the entities representing workers and farmers. Therefore, based on my experience as a researcher for over ten years, I reaffirm that only strong and coordinated cooperation between all stakeholders can promote an effective and long-lasting international networking partnership capable of effectively supporting research and sustainable development of the natural plant fiber economies.

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