

# Directives for Sustainability Management in the Amazon Forest Economy

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**Abstract**—This paper presents drivers to promote sustainable management in the forest economy in Rondônia, as an alternative to the traditional economic approach to forest resources. Therefore, the study questions how the forest management in the State of Rondônia can contribute as an alternative to the predatory use of the forest, mitigating the impact on the Amazonian socio-biodiversity. The general objective is to generate knowledge about the exploitation of timber and non-timber resources in Rondônia, and has as specific goals to promote the survey of the theme, as indicated in theory and according to practices carried out in the State of Rondônia / Brazil (1); to discuss the main characteristics of forest management with sustainability, promoting its multifaceted characterization in the face of commercial and intercropping (2); and finally, to address the alternative uses of Forest Management, indicating drivers and adaptive the spatial conditions of the Amazon region, specifically Rondônia (3). This research is characterized as qualitative with the method of content analysis; involved the raising of theoretical bases that describe the scenario of study and consultation of specialists, to promote the proficient contextualization, analysis, and inference of the results. It was verified that the drivers for sustainable forest management are alternatives to the predatory use of natural resources, providing the use of multiple conservative mechanisms, interrelating profitability and sustainable development, in favor of the emergence and consolidation of an integrated forest production chain with diversified industrial systems. This work is of interest to the

scientific community and rural managers and producers since it offers a contribution to the management of forest resources with sustainability.

**Keywords**— *Innovation, Sustainability, Timber Products, Non-timber Products.*

## I. INTRODUCTION

Logging in Rondônia is a consolidating market. However, the intensification of predatory anthropogenic actions triggered movements to contain their impacts. Examples of this include the elaboration of legal devices and Environmental Public Policies, whose focus was to confirm sustainable development to the demands of expanding the consumer market. The fact arouses society's interest in viable human alternatives and leads the argument that the management of natural resources from forests can be a solution, since it would meet the economic demands in the face of the irrationality faced in Rondônia, significantly reflecting these dynamics now pointed.

## II. OBJECTIVES

The question that guided the investigation was: how can forest management in the State of Rondônia serve as an alternative to the predatory use of forest resources? Therefore, it is the general objective to generate knowledge about the exploitation of wood and non-timber resources in the Amazon Region; and as specific goals carry out survey on logging legally certified in recent years (1), carry out multifaceted characterization in view of the management of tree species consistent in the marketing exercise (2), and

study the most feasible method and its adaptive conditions space, in the expectation of meeting planetary demands (3).

### III. THEORETICAL-CONCEPTUAL REVIEW

In this compartment, information on the theoretical-empirical support employed in the study is provided. Organized in sub-topics, the literature review deals with impacts and model of forest management, its main characteristics in the face of the concept of Sustainability and possible alternative uses of forest management.

#### 3.1 Impacts and Models of Management

Deforestation in Rondônia, Brazil, is a problem that has been triggered since the beginning of colonization with an aggravating situation until the year 2004, as explained by Piontekowski, Matricardi, Pedlowski & Fernandes (2014). The predatory approach to forest resources worsened by a percentage of approximately 41%, resulting from the comparison between 2016 and

January 2018, according to the Institute of Man and the Environment of the Amazon [IMAZON] (2018). Concerns about forest use stimulated public support for the expansion of the Forest Management Plan (FMP), described by Takeda (2015) as "[...] an electronic control mechanism for forest products and by-products used in the attempt to curb illegal logging and contain deforestation." The systematization of this approach is expressed in the National Council for the Environment [CONAMA] (1986) as "[...] any change in the physical, chemical and biological properties of the environment that affects the health, safety, and well-being of the pollution, usually resulting from anthropic activities to obtain materials or energies."

Forest management is proposed as a way of promoting timber production and organizing the exploratory activity, making it profitable, ecologically correct and minimizing impacts, according to the different concepts and forms of implementation indicated in Table 1.

Table.1: Characteristics of different models of forest management.

Management Model	Operational concept	Characteristics
Management of native forest	Extractive management of the natural forest.	Concession through public bidding processes of open forests of the State or the Federation.
Management of planted forest	Planting of forest essences for commercial purposes.	Planting and formation of forests in particular areas for commercial exploitation.

Source: Moura & Müller (2011).

According to State Law No. 1143, of December 12, 2002, established in Rondônia, which determines the regulations for the use of native extractive forests, granted through concessions based on sustainable management plans proposed for individuals or legal entities through contracts, or extraction can be carried out through public agencies.

The policy of agricultural management of Planted Forests was instituted in Rondônia by State Law No. 873, dated May 12, 2016, recognizes the contribution of this activity to mitigating climatic effects and promoting the social, environmental and economic development of Brazil, in the perspective of inclusion to producers. The report produced by the Brazilian Tree Institute (IBA) (2017) quantifies 7.84 a million hectares reforested in the country, with 91% of the wood used in the industries coming from forest plantations, as the international market has shown a higher preference for the acquisition of responsible wood. Currently, this industry is the most significant reference in sustainability, innovation, and competitiveness, constituting sources of hundreds of products and by-products present in daily life, as well as possible solutions to the problems of climate change, carbon sequestration, renewable energy source, and deforestation.

#### 3.2 Main Characteristics of Forest Management with Sustainability

The Brazilian Company for Agricultural Research (EMBRAPA) (2015) proposes two lines of follow-up that to be adopted in management practices, one focusing on preservation and another on conservation, the characteristics of which are presented in Table 2 and discussed below.

Table.2: Theoretical perspectives for management implementation

Forest preservation management	Management of forest conservation
<p><b>Benefits:</b></p> <ul style="list-style-type: none"> <li>- Preservation of species of local flora and fauna</li> <li>- Maintenance of the local ecosystem</li> <li>- Appreciation of environmental services</li> </ul> <p><b>Goal:</b>                      Avoid the urgent loss of some ecosystem threatened with extinction.</p>	<p><b>Benefits:</b></p> <ul style="list-style-type: none"> <li>- Use of the species present;</li> <li>- Increase in the alternatives of productive potential;</li> <li>- Commercial valuation of the property;</li> </ul> <p><b>Goal:</b>                      Promote strategies for direct use, generating profit and not degrading.</p>

Source: Danner, Zanette & Ribeiro (2012); Rezende (2012); Sartori, Latron & Fields (2014).

Referring to the first method presented, Danner et al (2012) confronts the hating prohibition of the use of this area, because according to its analysis, this is an indicator that causes loss of stimulus to the owners to maintain an isolated locality and the same time financially devalued the potential of the species present, so they tend to prevent the natural regeneration of plants to eliminate potential problems that take their domain out of this environment.

According to the National Confederation of Industries - [CNI] (2016), the success of the forestry sector depends on a multidisciplinary view that builds links downstream of the productive chain, avoiding the slight degree of articulation in the development of activities and the use of byproducts, sector and reducing economic representativeness.

In Rezende (2012) and Sartori et al. (2014), is understood that the concept of viability is more associated with a set of factors than the diffusion of a single aspect

and that the Triple Botton Line concept should be the central focus of the forest management plan. With the observance of the laws that establish the rules of forest management, promoting the creation of opportunities that integrate the community in the development of this activity, incorporating them in the production chain through an interaction mechanism, focusing on the economically viable consolidation of the conservation area forestry

### 3.3 Alternative Uses of Forest Management

EMBRAPA (2016) describes the importance of forests to the planet; responsibility for carbon storage, regulation of the water cycle, management of biological, ecological and socio-cultural balance. The use of forest resources can be developed considering the control of non-timber products (PNMs), or agroforestry management, whose fundamental requirements are indicated in Table 3.

Table.3: Alternative uses of forest management.

Alternative uses of management	Operationa lconcept	Characteristics
<b>Management of non-timber products</b>	Protection of varieties that make up the ecosystem; promote the ethnomedical use of herbal biocomponents.	Use of tree derivatives, such as nuts, flowers, fruits, fibers, latex, resins, oils and gums.
<b>Agrosilvopastoral Management</b>	Reconcile the preservation and production of food and animals; promote the recovery of degraded areas and the alternative use of the productive regions.	Improvement of the quality of life, increase of the productive capacity of the soil, diversification of the production, gain of profitability, animal welfare.

Source: Makishi, Viegas & Zacareli (2015); Oaks (2016); Lopes, Brito & Moura (2016); Goulart, Olival Arantes (2016) & Souza et al. (2017).

The market for PNMs as a promising export alternative, in addition to supplying local demands,

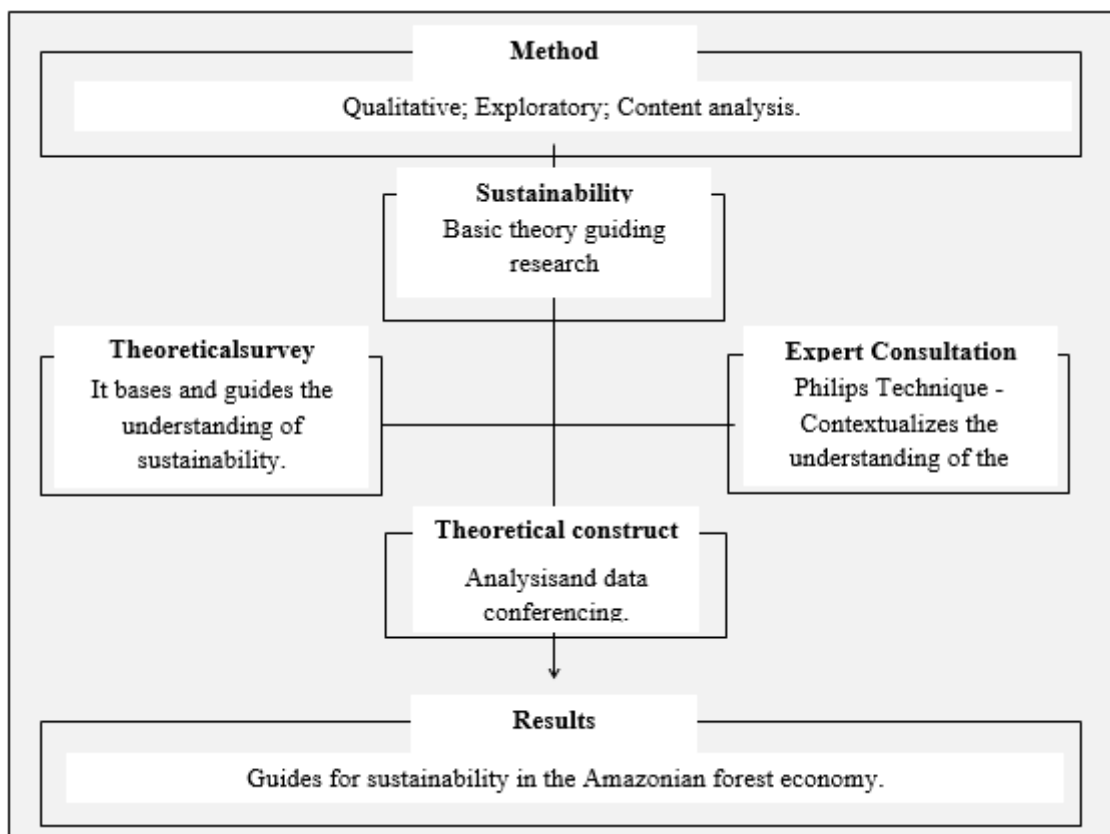
although the lack of incentive through public policies and market organizational structure is pointed out as

difficulties to be faced. The ethnomedical use of trees as another relevant aspect, estimating that approximately 30% of the medicines used are derived from vegetables both in the traditional secondary method, and 80% of the world population uses plants in health treatment.

Agroforestry management, through the planting of multi-species tree species, replacing the itinerant way of using the properties that are still commonly used in intensive cultivation, resulting in wastes of areas that can be recovered through soil correction methods.

#### IV. METHODOLOGY

This research involved the establishment of theoretical bases that characterize the scenario of study and consultation of specialists to promote the contextualization proficient for cognitive analysis and inference of the results, according to the methodological design identified in Figure 1, whose descriptive is introduced in the sequence.



Source: Prepared by the authors.

Fig.1: Methodological design of the study.

The approach was qualitative, following Creswell & Clark (2013) that defines it as research that is concerned with making inferences to broaden and give depth to the subject matter. To prepare this task, the Content Analysis Method was used. Moraes (1999) conceptualizes a method of content analysis as a tool that allows the interpretation and description of the documentary content present in texts using both induction and intuition as an investigative strategy to reach the systematic form of quantitative and qualitative understanding, raising the outside of the typical reading level and increasing the knowledge of the message.

This method of approach, according to the said author, constitutes more concrete stages of the investigation, with the more limited purpose regarding the general explanation of the phenomena less abstract. They

presuppose a real attitude towards the event and are limited to a particular domain, in the perception of Lakatos & Marconi (2003), the reason why the approach prescribed by these authors is used in this document, with a general survey from papers selected in literary collections.

The collection of the theoretical elements made possible the understanding of the correct way to use the Forests in Rondônia in a sustainable way. This type of intervention on biodiversity offers drivers for the use of permanent preservation areas and commercial planting, so as not to cause damage to the environment or its attributes, much less compromise the quality of life of the next generations; Moreover, the misuse of these natural resources, or their inadequate management, results in all complexity of damages as recorded in the theoretical

survey inserted in the study. The general survey also serves to provide a basis for the understanding of acceptable sustainability in the exploration of forests in a mutualistic way. According to the author Meira (2008), Philips technique was used to arrive at a result through the fractionation of groups with different information. Employing a semi-structured interview questionnaire, with public agencies related to the forest sector, regarding the impacts on the forest system; consulting professors of the Forestry Engineering course of the Federal University of Rondônia (UNIR), to understand the scientific perspective for the forest scenario; and together with forestry consulting companies, to analyze market trends. All these perspectives offer the optimum state for the proposal of intervention in favor of the application of the principles of sustainability in the face of the local reality.

## V. DIRECTIVES FOR THE FOREST ECONOMY WITH SUSTAINABILITY

Table.4: Timber production and marketing in the scale of 1000 reais. (Brazilian currency)

Year	Product	Volume	Value of commercialization (R\$)
2012	Wood	2.386,04m <sup>3</sup>	158.237,00
	Firewood	41.485 m <sup>3</sup>	103.000,00
	Charcoal	44 t	97.000,00
2013	wood	4.003,30 m <sup>3</sup>	331.231,00
	Firewood	24.579	721.882,00
	Charcoal	-	2.000,00
2014	wood	3.757,35 m <sup>3</sup>	303.457,00
	Firewood	497.007 m <sup>3</sup>	16.491,00
	Charcoal	-	2.000,00
2015	wood	3.757,35 m <sup>3</sup>	303.457,00
	Firewood	497.007	16.491,00
	Charcoal	-	2.000,00
2016	wood	1.439,01 m <sup>3</sup>	172.879,00
	Firewood	46.541 m <sup>3</sup>	3.017,00
	Charcoal	-	2.000,00

Source: Adapted from IBGE (2018).

It is observed that the model of forest exploitation has focused on the exploitation of wood products, and in the production of charcoal, the information does not record the volumes produced with precision, as there are several irregularities in the coal industries ranging from informal work to illegal sale. Management with planted forests, regulated by the Secretary of State of Rondônia for Environmental Development (SEDAM) (2011), has contributed to this management model becoming consolidated in the process of recovery of areas degraded by anthropic action.

The data of SEDAM (2018) offer an estimate of R\$ 44 million generated by the small producers that invested in this branch in the period from January to

In the following sub-topics will be treated the results related to legally certified wood, the multifaceted characterization given Planting with tree species and, finally, the innovation proposal and its adaptive the spatial conditions of the region.

### 5.1 Survey on Timber Production

The state of Rondônia has developed concession policies for the management of conservation of native forests in conservation units, intending that exploitation privileges the sustainable interrelationship of the man with the environment without neglecting profitability. Regarding the production of wood in these areas, data from the Brazilian Institute of Statistical Geography - [IBGE] (2018), presented in Table 4, describe the production in the period from 2012 to 2016, as well as the value added to this vineyard :

September of 2016; the technical authorization analysis shows extraction of just over 27 thousand m<sup>3</sup> in logwood of the Teak species. Also, it is observed in Rondônia an area of 17,000 hectares of Teak and the Eucalyptus already reaches 6,060 hectares.

According to the specialists, the timber production in the modalities practiced in Rondônia has the destiny to the national and international market, with emphasis on Europe and countries like China and the United States, and the Brazilian states of Rio de Janeiro, São Paulo, and Mato Grosso. The commercialization has privileged the most abundant species within the Resex's timber PMFs, including *Angelim*, *Ipê*, *Garapeira*, *Faveira*, *Pinho Cubano*, *Maracatiara*, *Cambará*, and *Roxinho*.



Already in the planted forests, the essences of commercial interest cultivated are the *Pinus*, *Eucalyptus*, *Teak*, *Pine Cuiabano*, *Rubber*, and *Acacia*.

**5.2. Multifaceted Characterization in Plantation View with Arboreal Species**

The analysis of the practical scenario based on the theoretical support and the experts' perception allows for sizing according to the potentiality of the Rondonian forestry economy, such as those identified in Table 5.

Table.5: Potential for sustainable forest management in Rondônia.

Dimensions	Characteristic
<b>Economic</b>	Management of Planted Forests - Drivers of the Industrial Economy: Wood and derivatives processing; integration with other industrial systems;
<b>Environmental</b>	Management of Preservation - Drivers of Environmental legality: Restoration of the ecosystem degraded by illegal, low-tech or high-impact practices;
<b>Social</b>	Management of non-timber products - Managers to socio-botanical identity: Preservation and encouragement of local practices of use of PNMs according to their medicinal tradition of native forest management.

Source: Prepared by the authors.

The tree species Teca and Eucalyptus, used in the local timber industry, are rich in fiber and have the potential to be used in the pulp and paper industry in the State of Rondônia, which is still a non-existent market. Other native varieties such as bamboo, taquerias, babassu and also organic waste can be used in agriculture for the production of sugar cane and sisal.

The National Institute of Space Research - [INPE] (2017) shows a total deforested area in the state of Rondônia of 83.5 km<sup>2</sup>, involved in this impact is the destruction of APPs, legal reserves and other adverse localities, degraded for the most part to the implantation of

livestock. In the cattle ranching scenario, the IBGE (2016) shows the presence of a herd with approximately 13,682,200 cattle, occupying an extension of nearly 10 million hectares with the extensive grazing system, representing the waste of millions of km<sup>2</sup>.

**5.3 Drivers for Innovation and Adaptive**

The analysis of the study scenario in the face of its potentiality and the current use leads to the identification of the drivers presented in Table 6, allowing the discussion of the necessary adaptive the competitiveness of the forest economy.

Table.6: Drivers for innovation in forest management in Rondônia.

Dimensions	Characteristics	Guides
<b>Economic</b>	Management of Planted Forests - Drivers of the Industrial Economy: Improvement of wood and by-products; integration with other industrial systems;	- Policies to encourage the establishment of the forest production chain to promote and increase integrated local production - Diversification of production with species of commercial interest already adapted to the environment.
<b>Environmental</b>	Management of Preservation - Directives on Environmental legality: Restoration of the ecosystem degraded by illegal practices, little technical or impactful;	- Diversification of the plantation with higher performance species, nature of the Amazonian environment, and that provide economic advantages with the management of non-forest products. - Integration and recovery of productive areas with agroforestry management;

<b>Social</b>	Management of non-timber products - Managers to the socio-botanical identity: Preservation and encouragement of local practices of use of PNMs according to the traditional tradition of native forest management.	- Policies to encourage the establishment of the productive chain of cosmetics, favoring the legalization and formalization of the extraction of forest essences - Patenting of products and licensing of production in the face of the preservation of local interests in the face of international demand.
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Source: Produced by the authors.

The competitive impact can occur in the axis of diversification between the species currently cultivated and those with high potential of commercialization present in the extractive reserves, such as *Angelim Pedra*, *Roxinho*, *Angelim Amargo* and *Favera Ferro*, complementing the offer of products of commercial interest. The incentive policy can direct the form of management to the corporate, individual or community format.

In the installation of native species for the recovery of Permanent Preservation Areas (APPs), according to the need for restoration of degraded areas or by legal requirement, the *Açaí*, *Copaíba* and *Seringueiras species*, when tested on the basis of their performance in terms of profitability, to gains from timber production (IBGE, 2016).

The competitive demand provokes the use with other species, such as *Buriti*, *babaçu*, *cipó tiririca* and palm trees in general, as there is an excellent demand for artisan and industrial production, both in the domestic and in the external market.

As for agroforestry integration in livestock production, the problem faced is in the axis of high impact and low quality of management, as indicated in EMBRAPA (2016). The primary driver here is the integration of the system of control of planted forests in mountainous areas and line with the agroforestry integration pasture, applying reforestation with the fruit species at strategic pasture points, increasing animal comfort due to the high temperatures present in the area providing greater productivity.

Agriculture practiced in the conventional model on farms that need to be recomposed to conform to the New Forest Code requires the replanting of vegetation through the agroforestry consortium and application of the Planted Forest Management Plan, using varieties as more profitable, such as such as Coffee, *Cupuaçu*, Brazil nut, *Acai*, Lemon, Orange, Cocoa, Banana, *Jambo* and Avocado.

The phytotherapeutic market for several years has generated technological expansion in several locations in Brazil and accelerated the cosmetics industry, favoring the development and commercialization of cosmetics from Amazonian flora. Political measures in the organization

and management of the forestry production chain are necessary to create, integrate and articulate the different stages in favor of competitiveness with the sustainability of the forest economy.

## VI. CONCLUSION

This work presented drivers to promote sustainability management in favor of the competitiveness of the forest economy in Rondônia and as an alternative the economic approach of high impact on the Amazonian socio-biodiversity. To do so, he surveyed the theme as indicated in theory and according to the practices carried out in the State of Rondônia / Brazil; discussed the main characteristics of forest management with sustainability, promoting its multifaceted characterization in view of planting with tree species and forest consortium and agrosilvopastoral; and finally, it addressed the alternative uses of Forest Management, indicating the most feasible method and its adaptive the spatial conditions of the Amazon region, specifically Rondônia, in the expectation of meeting planetary demands. Given the proposed problematization, drivers for sustainable forest management as alternatives to the predatory use of natural resources were found, since the installation of this activity requires normative standards that include the obligation to preserve illegal sites, as well as the use of conservation mechanisms. Multiple conservative aid inter-linking profitability to sustainable development. Such arrangements can be implemented in favor of the emergence and consolidation of an integrated forest production chain with diversified industrial systems, favoring the competitiveness of the forest economy in Rondônia.

This work is of interest to the entire scientific community and the Amazonian society, managers and rural producers since it contributes to the solution of problems related to the management of forest resources with sustainability.

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