

ENVIRONMENTAL ADMINISTRATION: ECOLOGICAL-ECONOMIC MACRO ZONING IN THE LEGAL AMAZON, BRAZIL ¹

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Abstract: The conservation of biodiversity has been a recurring theme of studies and debates carried out by the scientific community and governmental institutions. In this context, many efforts are directed towards the maintenance of Brazilian natural resources. Given the above, the main objective of this research is to discuss the structure of the Ecological-Economic Macro Zoning in the Legal Amazon in Brazil. With the adoption of multiple methods - exploratory, descriptive and analytic - this study is based on secondary sources interpretation and geoprocessing techniques. Based on territorial units, three typologies of territory were delimited: Network - focused on integration with neighboring spaces and stimulation of alternative means of production; Frontier - intended to contain the agricultural expansion; and Zoning - determined for conservation of natural resources. The proposed administration strategies consider contemporary themes such as climate change, maintenance of environmental services and encouragement of technology, among others. In this way, it is concluded that the established guidelines are innovative and can support the development of other ecological-economic zoning.

Keywords: ecological conservation; economic development; territorial units; administration strategies.

¹ Updated text of article originally published under the title “Ecological-Economic Macro Zoning: Reflections on the Legal Amazon in Brazil” in the European Journal of Scientific Research, 150(1):47-59, Aug. 2018

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Introduction

By the meeting of regions with similar economic, political and social problems and aiming at improving the planning of their social and economic development, the Brazilian government instituted the concept of "Legal Amazon" through the Federal Law No 1,806, of January 6, 1953 (Brasil, 1953) and repealed by the Federal Law No 5,173, of October 27, 1966 (Brasil, 1966).

Established by the Federal Law No. 6,938, of August 31, 1981 (Brasil, 1981), the National Environmental Policy, among its instruments of execution, environmental zoning, was later called "ecological-economic zoning" (ZEE - zoneamento ecológico-econômico) and regulated by the Federal Decree No. 99,193, of March 27, 1990 (Brasil, 1990). In the same year, the Ecological-Economic Zoning Coordinating Commission was created in national territory by the Federal Decree No. 99,540, of September 21, 1990 (Brasil, 1990).

According to the principles of the Brazilian Constitution (Brasil, 1988), the ZEE is conceptualized as an instrument for organizing the territory to be followed in the implementation of public and private plans, works and activities, establishing measures and standards for environmental protection designed to ensure the quality of the environment, water resources and soil and the conservation of biodiversity, ensuring sustainable development and improving living conditions of the population (Brasil, 2002, Article 2).

In summary, its general objective is to organize the decisions of public and private agents regarding plans, programs, projects, and activities that directly or indirectly use natural resources, ensuring full maintenance of capital and environmental ecosystems services (Brasil, 2002, Article 3). Therefore, it should contribute to the rationalization of use and management of the territory, reducing predatory actions and pointing to activities that are more appropriate to the particularities of each region, improving the capacity to perceive the interrelationships between the various components of reality and, consequently, increasing the effectiveness of public and private plans, programs and policies (MMA, 2016).

In addition to adequate territorial planning aimed at environmental conservation, socioeconomic development and social justice, institutional and financial conditions

should be guaranteed for its implementation, with an association of actions in the horizontal and vertical sense, as well as in a temporal and spatial manner. It is also important to highlight the imperative of interaction between national and regional plans, as well as between state and municipal levels, valuing the performance of federated entities in protecting the environment and promoting the development and integration of society and the sectoral vision (MMA, 2016).

Based on a broad national discussion process, the regulation of the implementation process of the ZEE was instituted by the Federal Decree No. 4,297, of July 10, 2002 (Brasil, 2002). In 2006, the version of the document was consolidated (MMA, 2006), which defines methodological guidelines and minimum operational procedures for the implementation of the ZEE at tactical and strategic levels and formalizes the necessary requirements for the execution of projects, with the emergence, as essential, of "a strategic vision of the national territory for political articulation and for objectifying goals of economic growth and combating social inequality, combined with the conservation of natural resources (MMA, 2016).

In short, the ZEE should be complementary to the adoption of policies, in the various scales of action on the territory, aiming at stimulating investments in areas more environmentally and territorially propitious (MMA, 2006). In this context, the main objective of this article is to reflect on this zoning process, with special emphasis on the transition spaces of the Legal Amazon to other biomes.

Methods and techniques

The study area encompasses all the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins and part of the states of Mato Grosso, Maranhão and Goiás, belonging to the same basin and to the region of occurrence of Amazonian vegetation (Figure 1). Despite occupying more than 5 million square kilometers (approximately 60% of the Brazilian territory) the region hosts only around 12% of the country's total population (IBGE, 2020). The region contains the entire Amazon, Brazil's largest biome, which accounts for 1/3 of the world's humid tropical forests, holds the highest biodiversity, the largest gene pool and 1/5 of the world's availability of drinking water (IBGE, 2018).

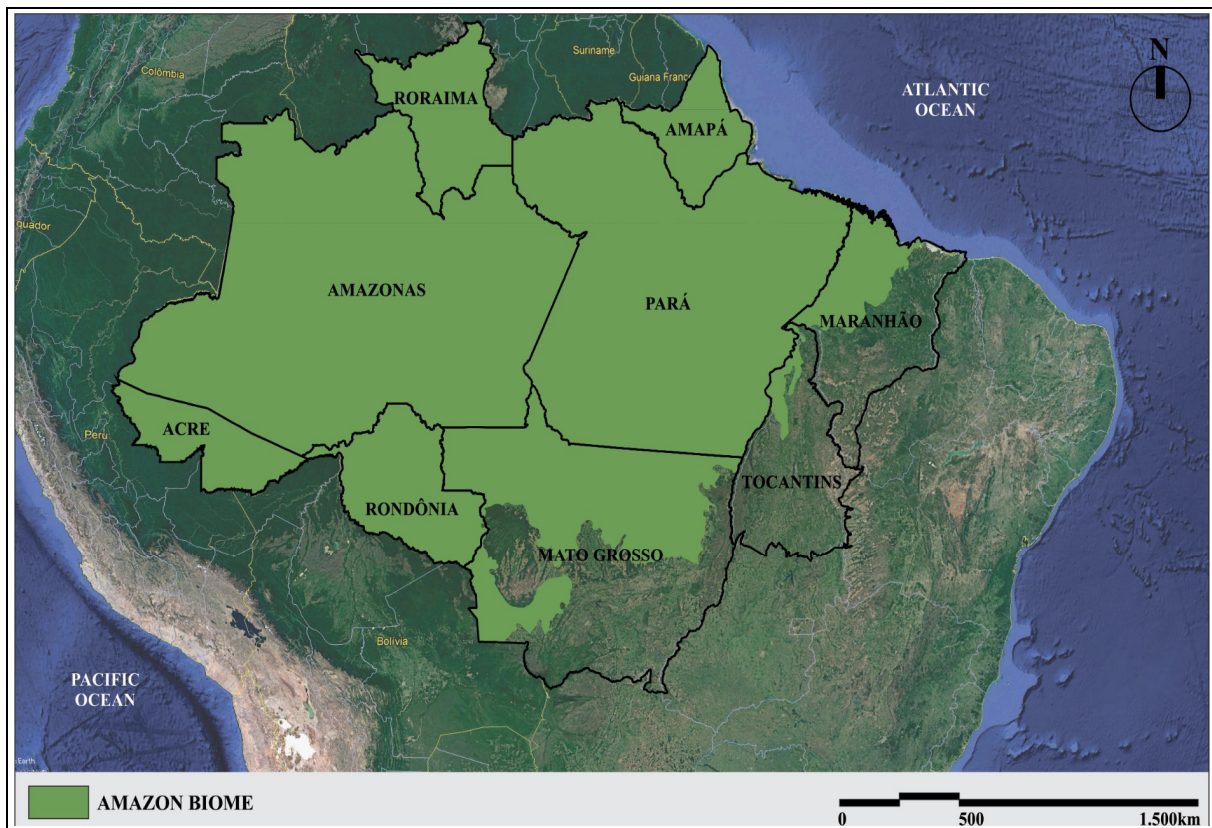


Figure 1: Map of the Brazilian States of Legal Amazon and biome vegetation cover. Source: Based on MMA (2009).

The Legal Amazon's nine states host only 55% of the Brazilian natives (close to 250,000 people) (FUNAI, 2021), protected by the indigenous Statute (Brasil, 1973). Basically, the methodological procedures were composed by multiple methods - exploratory, descriptive and analytic - and based on secondary sources interpretation and geoprocessing techniques, as presented below.

Results and discussion

The Ecological-Economic Zoning Program for the Legal Amazon was firstly proposed in 1991. Subsequently, the supervision of land management was transferred - through Provisional Measure No. 1,795, of January 01, 1999 (Brasil, 1999) - to the Ministry of National Integration, while the Ministry of the Environment was assigned responsible for the ZEE (MMA, 2016), confirmed by the Federal Law No. 10,683, of May 28, 2003 (Brasil, 2003). The structure of this instrument is divided into three types of territories (Figure 2). According to Figure 3, it is possible to detect the spatial expression of each one of them.

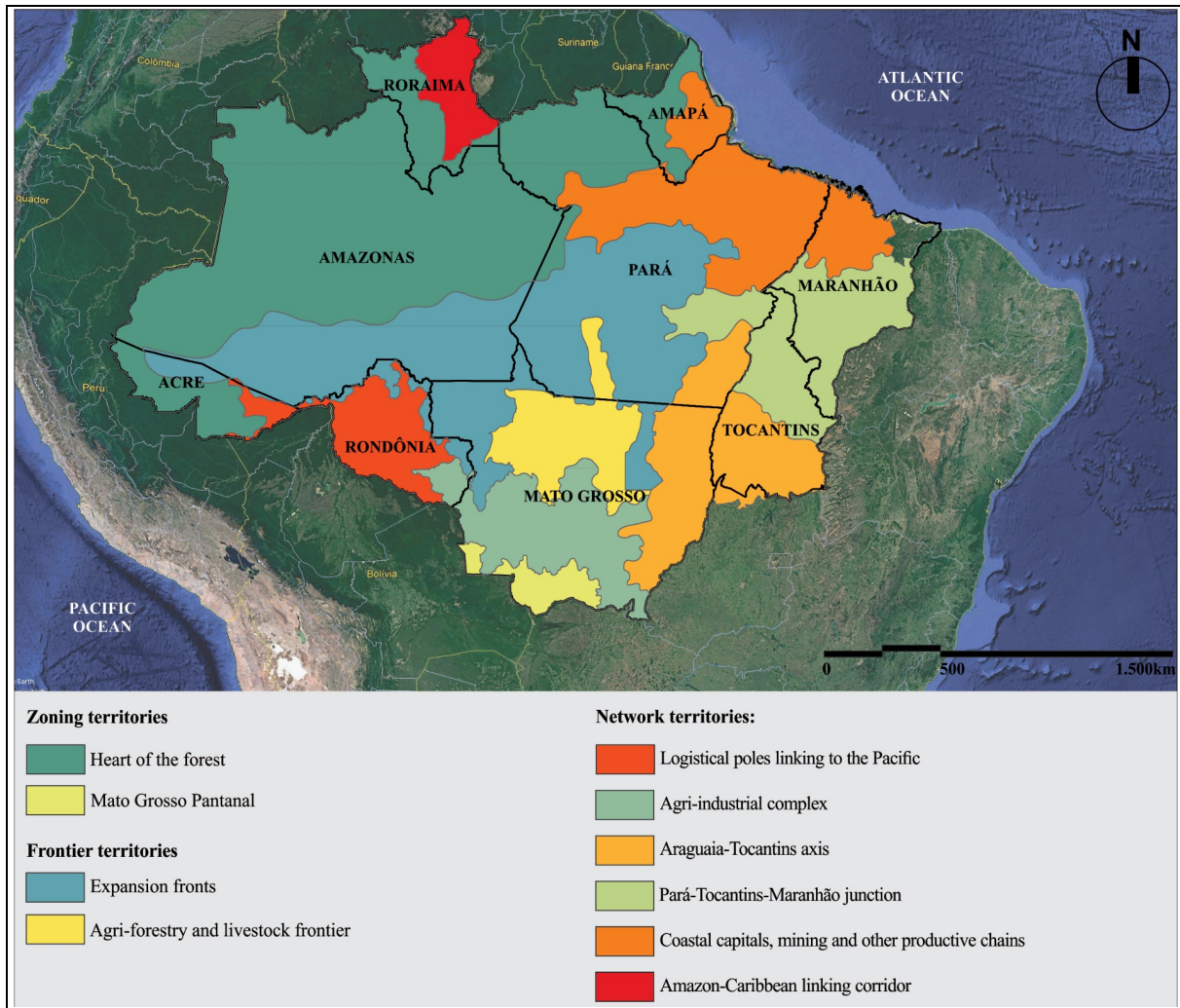


Figure 2: Map of the territories of the Ecological-Economic Macro Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

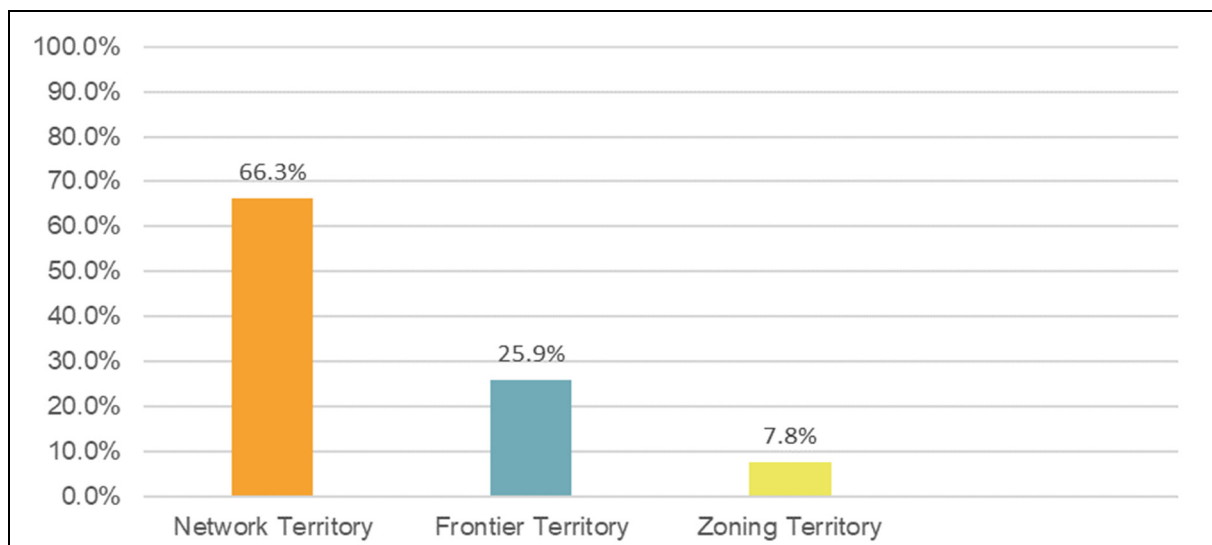


Figure 3: Graph of proportional distribution of the territories of the Ecological-Economic Macro Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

The formers are called **NETWORK TERRITORIES** (66.3% of the Legal Amazon area) (Figure 4), which main strategies are summarized in Table 1, are subdivided into:

- a) **Territorial Unit Coastal Capitals, mining and other productive chains**, which is located in the north-northeast portion, and strongly influenced by a mining company. For that reason, its configuration and social dynamics are related to productive chains of mineral activity (alumina, aluminum, bauxite, gold, iron, and kaolin); this area's networks and territorialities are marked by different economic activities (trade and services, wood, fishing and aquaculture, babaçu coconut breakers, and bulk carrier, for example);
- b) **Territorial Unit Amazon-Caribbean linking corridor** includes the eastern portion of Roraima State, which main road axes provide greater social, economic and cultural connectivity with Venezuela and the Caribbean. It has a high potential for agricultural development, but prevail small properties focused on family practices, extensive livestock and fruit growing. However, the main export product is the wood. Another relevant aspect is the presence of indigenous peoples;
- c) **Territorial Unit Pará-Tocantins-Maranhão junction** covers areas of cerrado intercepted by a range of conservation units⁷ and indigenous lands located in the border of the states of Mato Grosso and Tocantins. It comprises wetlands (Pantanal do Araguaia) and forested areas in the highest portions. Cattle and agriculture stand out in the economy. Despite the low socio-economic development, this area presents integration of internal networks of infrastructure, circulation, services and commerce;
- d) **Territorial Unit Araguaia-Tocantins axis** is located in a strategic spot between three states (Pará, Tocantins and Maranhão) due to the infrastructure networks of their four main traffic axes. The polycentric cluster is composed by cities with high and low hierarchical levels in the urban

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Natural protected areas regulated under the National System of Conservation Units (SNUC - Sistema nacional de Unidades de Conservação - Brasil, 2000).

network. Occupied by rural settlements, the north of Tocantins has conflicts related to land tenure and to the babaçu gathering⁸;

- e) **Territorial Unit logistical poles linking to the Pacific Ocean** is predominantly occupied by agroextractivist producers and small family farmers. The logging and the cattle raising caused heavy deforestation in Rondônia State.
- f) **Territorial Unit agri-industrial complex** covers great part of the territory the state of Mato Grosso and has diversified economic activities and structured human settlements, with a relatively efficient production support infrastructure and a well-developed service and trade sector.

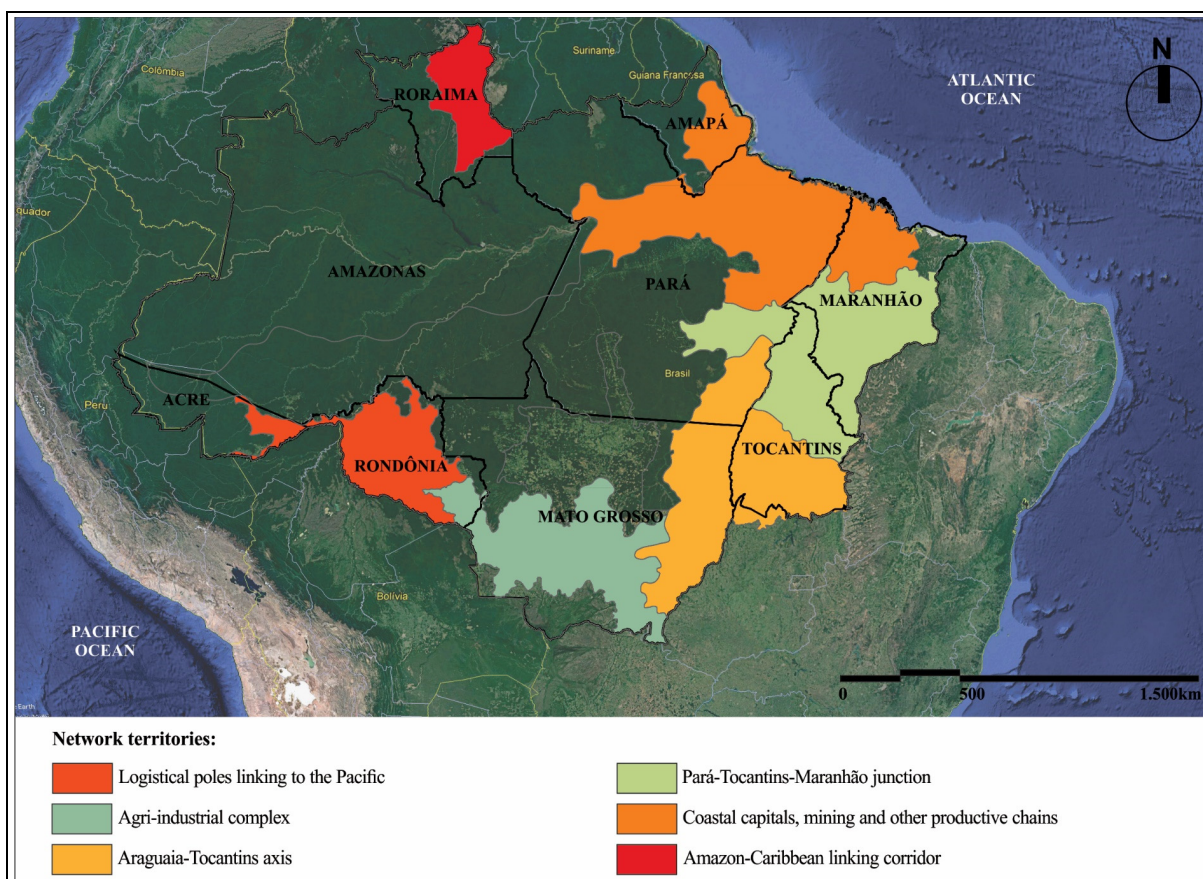


Figure 4: Map of the spatial distribution of Network Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

NETWORK TERRITORIES	MAIN STRATEGIES
Territorial Unit Coastal Capitals, mining and other productive chains	<p>ECOLOGICAL CONSERVATION: Promotion of the preservation of forest remnants, reforestation of the deforested forest in northeastern Pará; Prohibition of ores sale to industrial segments that use charcoal from native forest.</p> <p>SOCIOECONOMIC DEVELOPMENT: Proposition of a policy to the mining activity (creation of regulatory framework for the activity, implantation and expansion of steel mills, elaboration of studies on the production of coal from the babaçu coconut shells, formation of the green steel chain, adoption of more efficient and safer furnaces); Diversification of the local economy; Diversification of the energy matrix; Increase of the use of managed forest biomass; Promotion of responsible fisheries and aquaculture; Expansion of the infrastructure in Pará State and Maranhão State capitals.</p>
Territorial Unit Amazon-Caribbean linking corridor	<p>ECOLOGICAL CONSERVATION: Promotion of the reduction of the impacts of timber and agricultural production; Recovering of degraded areas, aiming at the integration of crop-livestock; Expansion of inspection actions with the purpose of curbing the presence of illegal mineral extraction.</p> <p>SOCIOECONOMIC DEVELOPMENT: Development of fruit growing; Implementation of a Zone of Processing and Exportation in Roraima State capital and the implantation of a dry port, aiming at the installation of industries and the improvement of conditions to flow the production; Development of infrastructure to support tourist points (hotel network and access routes).</p>
Territorial Unit Pará-Tocantins-Maranhão junction	<p>ECOLOGICAL CONSERVATION: Conservation and preservation of water resources; Conservation of alluvial complexes biodiversity; Reduction of pressures on areas of ecological interest.</p> <p>SOCIOECONOMIC DEVELOPMENT: Adjustment of the productive structure, aiming at the aggregation of value to the regional production and diversification of the agricultural and extractive sectors; Development of livestock in improved molds; Consolidation of an intermodal transportation corridor in the south of Tocantins (waterways, railroads and highways), aiming at promoting the north-south connection of the national territory; Promotion of sustainable tourism, especially in the main attractions.</p>
Territorial Unit Araguaia-Tocantins axis	<p>ECOLOGICAL CONSERVATION: Reconciliation of forestry expansion with the maintenance of fragile natural environments and ecological corridors.</p> <p>SOCIOECONOMIC DEVELOPMENT: Expansion of the available logistics, aiming at a greater region connectivity and development of the agromineral and industrial sectors; Stimulation to aquaculture of native fish; Management of the productive chain of forestry, including the</p>

NETWORK TERRITORIES	MAIN STRATEGIES
	encouragement of the use of native species and the industrialization of timber production; Promotion of tourism, in the main attractions.
Territorial Unit logistical poles linking to the Pacific Ocean	ECOLOGICAL CONSERVATION: Creation of protected areas; Conversion of extensive livestock farming into sustainable systems; Valorization of the forest to maintain environmental services. SOCIOECONOMIC DEVELOPMENT: Strengthening of tourism and family farming; Promotion of improvements in the circulation infrastructure, by strengthening intermodal to expand the possibilities of local production.
Territorial Unit agri-industrial complex	ECOLOGICAL CONSERVATION: Stimulation of the sustainable tourism exploitation; Elaboration of severe legislation and inspection and a broad social pact to curb illegal deforestation and to recover water sources, restore riparian forests, stop the invasions in to indigenous land and protected areas; Development of strategies of occupation and exploitation of resources; SOCIOECONOMIC DEVELOPMENT: Regulation and innovation of the processes, products and distribution of wealth promoted by the agricultural and livestock activity; Diversification agricultural production, with the implantation of industries in strategic locations; Stimulation for structuring a pole of production of inputs near the producing regions and establishment of a policy for the implementation of basic industries; Improvement and intensification of animal husbandry, with the advanced industrialization of meat and leather; Promotion of sustainable aquaculture productive chains.

Table 1: Main strategies of the territorial units **Network Territories** of the Ecological-Economic Macro Zoning of the Legal Amazon. Source: Prepared based on Brazil (2010) and MMA (2009).

As the Network Territories occupy two thirds of the entire study area, it is diagnosed the importance of the integration of the Amazon region in Brazil. The proportional distribution of these specific territories is presented in Figure 5, in which one notices the importance given to the coastal capitals, mining and other productive chains (26.8%), demonstrating the relevance of the diversity of activities in the formation of regional networks.

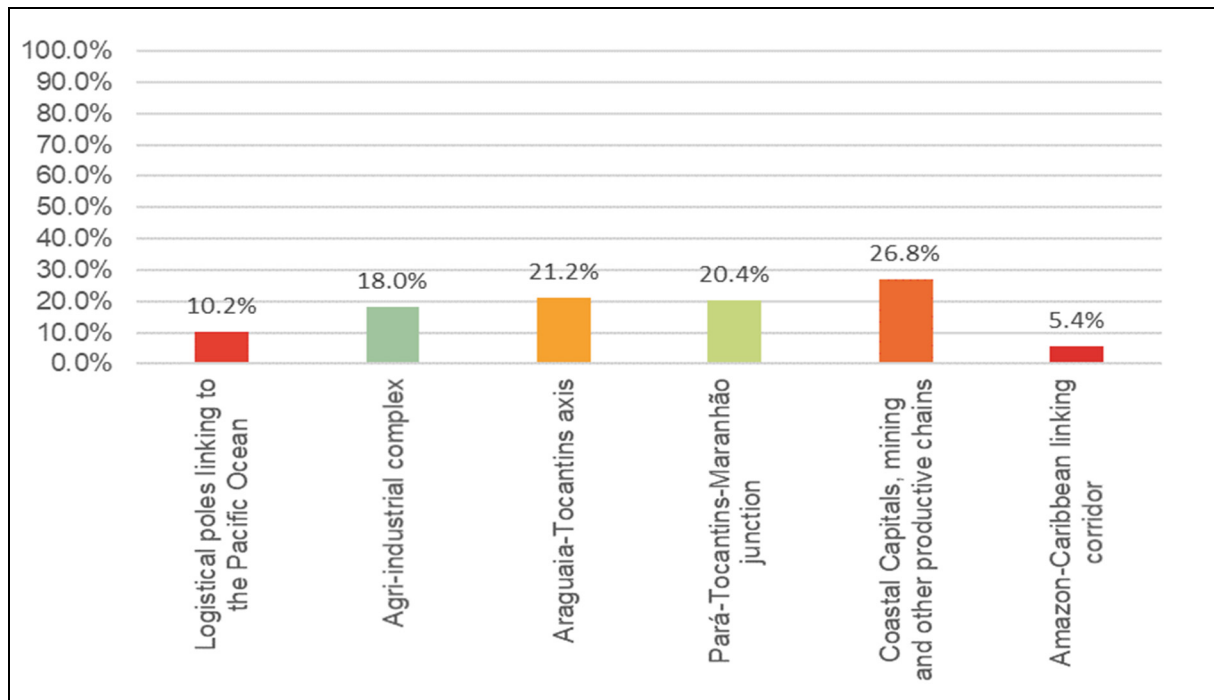


Figure 5: Graph of the proportional distribution of Network Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

In complementation to the traditional Central Places Theory (Christaller, 1966), still at the end of last century, Grabher and Stark (1999:533) warned that ‘entrepreneurship is not the isolated individual personality but the social networks that link firms and the actors within them’, valuing principles of diversity and adaptability.

On the other hand, the low spatial participation of the Amazon-Caribbean linking corridor (5.4%) can be justified by the direct connection of the Legal Amazon with spaces of other neighboring countries, extending its scope for this extra national approximation. In this sense, Lombaerde and lapadre (2008) affirm that this interaction is related to a partial progress, because is not necessarily global, moreover, in the case of sensitive natural environments.

The second types are called **FRONTIER TERRITORIES** (25.9% of the Legal Amazon area) (Figure 6), which main strategies are summarized in Table 2, and are subdivided into:

- a) **Territorial Unit agri-forestry and livestock frontier** encompasses the northern portion of the Mato Grosso State. The occupation of this space is recent (between the decades and 1970 and 1990), where large estates focused on the exploitation of wood and livestock;

- b) **Territorial Unit expansion fronts** has low demographic density, precarious infrastructure, and high biological diversity. Its forest remnants induced the implementation of several conservation units.

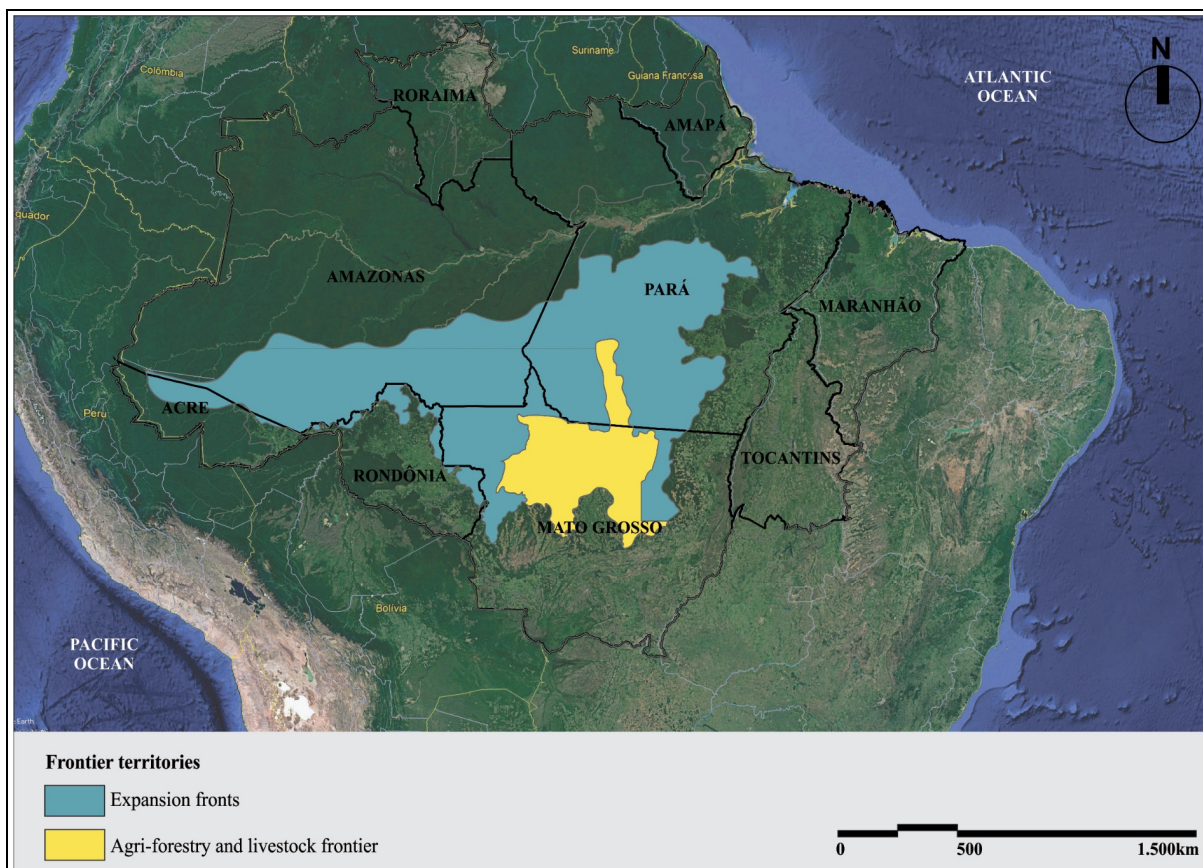


Figure 6: Map of the spatial distribution of Frontier Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

FRONTIER TERRITORIES-	MAIN STRATEGIES
Territorial Unit agri-forestry and livestock frontier	<p>ECOLOGICAL CONSERVATION: Recovery of environmental liabilities; Maintenance and recovery of springs and riparian forests in the river basins.</p> <p>SOCIOECONOMIC DEVELOPMENT: Exploitation of hydroelectric potential; Structuring of agroindustrial villages; Implementation of modern timber industry.</p>
Territorial Unit expansion fronts	<p>ECOLOGICAL CONSERVATION: Elaboration of agricultural zoning aiming at containing the agricultural activity in the region; Strengthening of agroforestry systems with the objective of recovering degraded and deforested areas.</p> <p>SOCIOECONOMIC DEVELOPMENT: Promotion of tourism; Utilization of hydroelectric potential; Feasibility of bioprospecting policy; Promotion of sustainable forestry practices.</p>

Table 2: Main strategies of the **Frontier Territories** of the ecological-economic macro zoning of the Legal Amazon. Source: Prepared based on Brazil (2010) and MMA (2009).

The Frontier Territories occupy little more than a quarter of the entire study area. This proportion is very significant because these spaces concern areas of forest edge effects and ecotone characteristics, and both of which are very fragile in ecosystemic terms (Laurance et al., 2007; Farina, 2008[1998]). The proportional distribution of these specific territories is presented in Figure 7, with 81.8% of its spaces related to the Territorial Unit Containment of expansion fronts with protected areas and alternative uses, with appropriate valuation of ecosystem services (Lele et al., 2013).

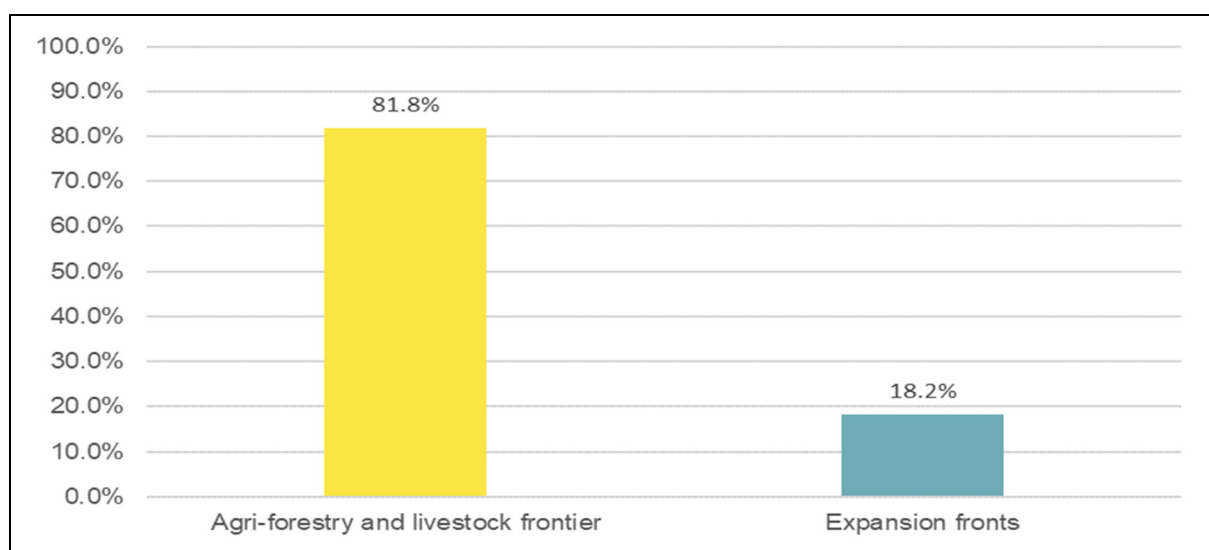


Figure 7: Graph of the proportional distribution of Frontier Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

The third units are called **ZONING TERRITORIES** (7.8% of the Legal Amazon area) (Figure 8), whose main strategies are summarized in Table 3, and are subdivided into:

- a) **Territorial Unit heart of the forest** has portions of dense ombrophilous forest and both low population density and degree of anthropism;
- b) **Territorial Unit Mato Grosso Pantanal** has large flooded areas and high restrictions for human use.

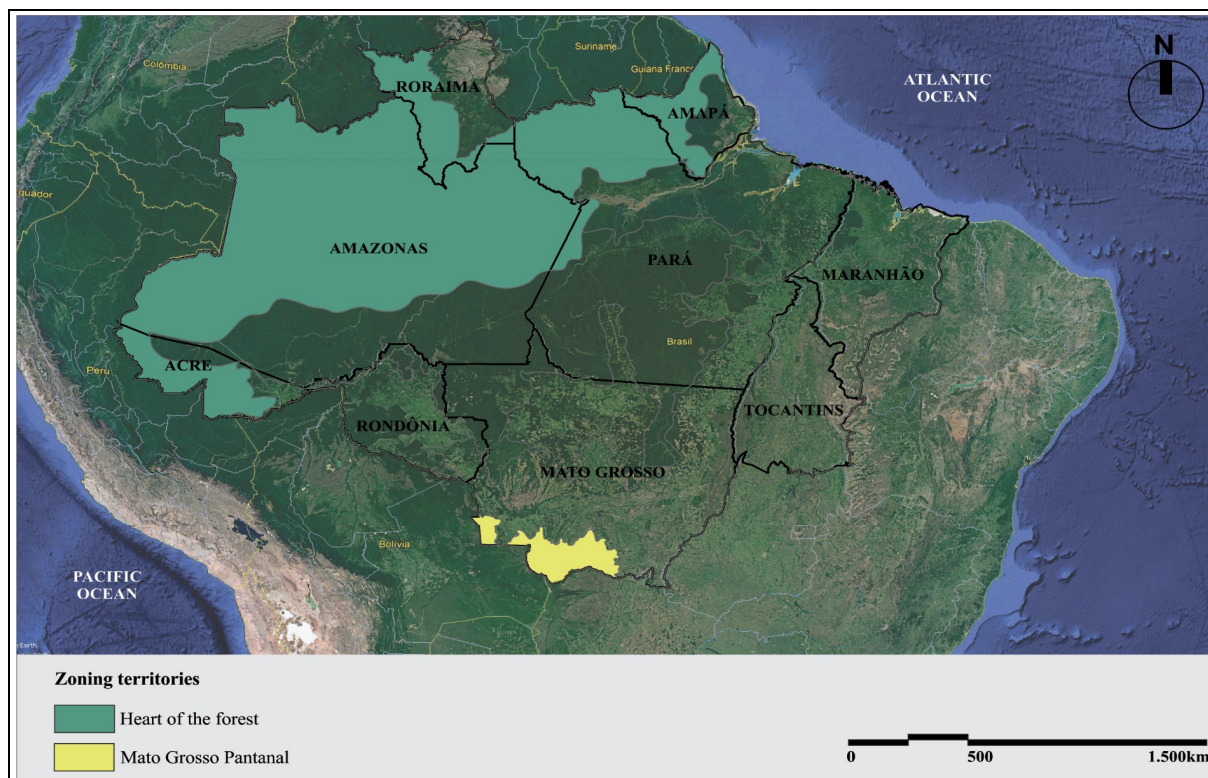


Figure 8: Map of the spatial distribution of Zoning Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

ZONE TERRITORIES	MAIN STRATEGIES
Territorial Unit heart of the forest	<p>ECOLOGICAL CONSERVATION: Remuneration of environmental services, strengthening of the ecological corridor of Central Amazonia.</p> <p>SOCIOECONOMIC DEVELOPMENT: Structuring the city network (development of Amazonas State capital as a world city of the Amazon brand; maintenance of tax incentives in the Manaus Free Trade Zone); Management of wood exploitation; Certification of forest products; Investments in research to make local production viable and the commercialization of pharmaceutical and cosmetic products with Amazonian products as raw material; Development of tourism; Exploitation of mining products.</p>
Territorial Unit Mato Grosso Pantanal	<p>ECOLOGICAL CONSERVATION: Expansion of inspection actions related to fishing activity, extractivism and sanitary conditions; Promotion of environmental education programs.</p> <p>SOCIOECONOMIC DEVELOPMENT: Promotion of tourism; Strengthening of the artisanal fishing production chain; Raising of extensive cattle; Improvement of local infrastructure.</p>

Table 3: Main strategies of the territorial units **Zoning Territories** of the Ecological-Economic Macro Zoning of the Legal Amazon. Source: Prepared based on Brazil (2010) and MMA (2009).

The Zoning Territories occupy a small part of the study area. The proportional distribution of these specific territories is presented in Figure 9, with almost all these spaces (95.7%) related to the Territorial Unit **heart of the forest**, that is, to the protection of conserved areas. This is an undisputed benefit for the sustainability of future generations (Pawar and Rothkar, 2015).

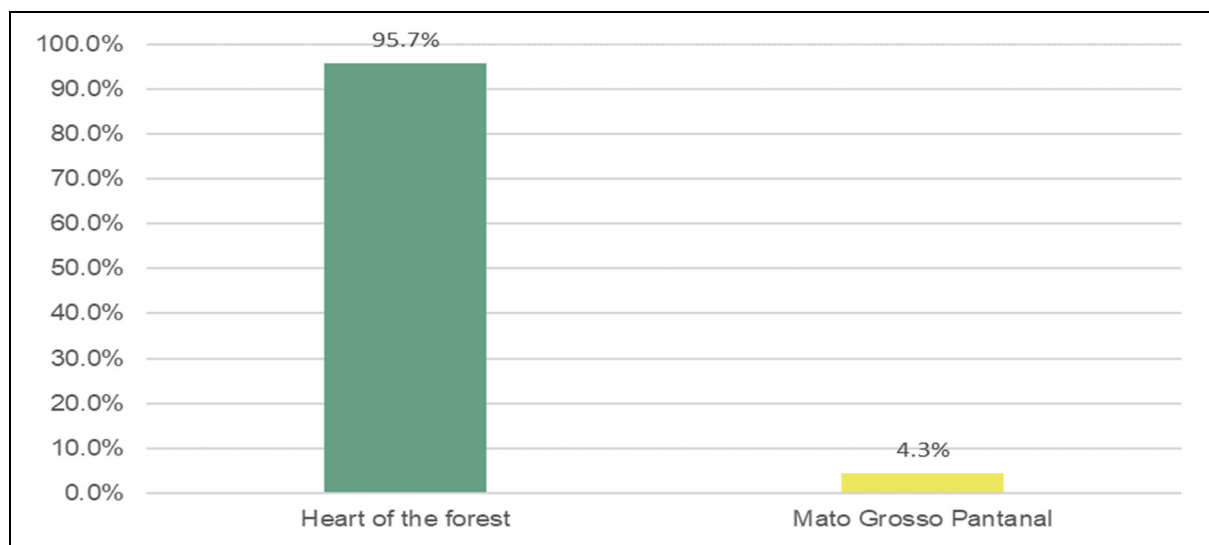


Figure 9: Graph of the spatial distribution of Zoning Territories of the Macro Ecological-Economic Zoning for the Legal Amazon. Source: Prepared based on MMA (2009).

Conclusion

There are many efforts - both in academia and in the institutional sphere - to conserve biodiversity. In this context, one of the greatest challenges is the territorial management of the Brazilian Legal Amazon considering the local socioeconomic, ecological and cultural diversity.

Among the methodological aspects adopted, it is important to highlight the territorial units as elements of planning and management, which consider aspects related to environmental conservation, main methods of local production, land issues, existent infrastructure, socioeconomic conditions and protection of traditional communities.

Regarding the analyzed spatial subdivision, it is verified that despite its territorial extension, only 7.8% of the Legal Amazon are in the Zoning Territories, areas with greater biological diversity and, therefore, with bigger land use and occupation restrictions. On the other hand, Network Territories aim at the integration of the Legal Amazon with the national context and the neighboring countries (66.3%). Frontier

Territories (25.9%) mainly focus on containing the expansion of agriculture border. Still, it is important to emphasize themes such as the incentive to innovation and technology, the maintenance of environmental services, the adaptation to climate change and the integration with national territory and countries that constitute the International Amazon (Venezuela, Colombia, Peru, Bolivia, Ecuador, Suriname, Guyana and French Guiana). Taking this into account, the Ecological-Economic Macro Zoning of the Legal Amazon is considered an innovative experience, which can provide subsidies for the conservation of natural resources from other regions and for the scientific development.

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