Public Policies and Politics: The Brazilian Dilemma to Reduce Deforestation

Políticas Públicas e a Política: o Dilema Brasileiro para Reduzir o Desmatamento

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ABSTRACT

Worldwide environmental debates have advanced as a response to the need to curb global warming. In 2015 the Paris Agreement was established, in which countries set environmental goals for 2025 and 2030. Brazil is a signatory to the Agreement and identifies deforestation in the Amazon Rainforest as its main environmental problem. This study proposes an interpretation of the actions of Brazilian governments to reduce deforestation in the Legal Amazon from 2000 to 2020. For that, we conducted a literature review on deforestation and used relevant secondary data. The results show that Brazil did not have a plan to control deforestation until 2004. After that the government starts to control deforestation efficiently until 2011. From that year onwards, efficient policies are abandoned, and several environmental setbacks are imposed. The final part of this study proposes new approaches for the continuity and improvement of efforts to combat deforestation in the Legal Amazon.

Keywords: Amazon. Deforestation. Global Warming. Paris Agreement.

RESUMO

Os debates ambientais em todo o mundo avançaram como resposta à necessidade de conter o aquecimento global. Em 2015 foi estabelecido o Acordo de Paris, no qual os países estabeleceram metas ambientais para 2025 e 2030. O Brasil é signatário do Acordo e identifica o desmatamento na Floresta Amazônica como seu principal problema ambiental. Este estudo propõe uma interpretação das ações dos governos brasileiros para reduzir o desmatamento na Amazônia Legal de 2000 a 2020. Para isso, realizamos uma revisão da literatura sobre o desmatamento e utilizamos dados secundários relevantes. Os resultados mostram que o Brasil não tinha um plano para controlar o desmatamento até 2004. Depois disso, o governo passa a controlar o desmatamento de forma eficiente até 2011. A partir desse ano, políticas eficientes são abandonadas e vários retrocessos ambientais são impostos. A parte final deste estudo propõe novas abordagens para a continuidade e aprimoramento dos esforços de combate ao desmatamento na Amazônia Legal.

Palavras-chave: Amazônia. Desmatamento. Aquecimento Global. Acordo de Paris.

1 INTRODUCTION

Environmental discussions have expanded internationally since the Stockholm Conference held in 1972 in Sweden. Nations seek to stabilize the global climate system and contain the increase in global temperature, which is caused by greenhouse gas (GHG) emissions (Rei et al., 2017). This becomes clearer when one considers the three pillars of the International Climate Regime: the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement.

The emergence of the UNFCCC, in 1992, meant a breakthrough in climate and environmental negotiations at the international level. These negotiations have been held annually in meetings called Conferences of the Parties (COP). In these international forums, countries jointly assess alternatives to mitigate climate change and the best actions to be implemented to ensure adaptation to these changes. In this context, the conference held in Kyoto, Japan, in 1997, stood out, resulting in a Protocol through which industrialized countries committed to reducing their levels of GHG emissions (Viola, 2002).

The conference held in Paris in 2015 is also worth mentioning. This conference resulted in a broader commitment between countries, the Paris Agreement. The parties involved in this agreement committed to maintain the average global temperature within 2ºC above preindustrial levels. Thus, the 21st COP, held in Paris, aimed to strengthen the global response to the threat of climate change and reinforce the capacity of countries to deal with its resulting impacts (Rei et al., 2017).

To reach the new agreement, all countries that committed to reducing their GHG emissions had about two years to present their Intended Nationally Determined Contributions (iNDCs) (Souza & Corazza, 2017). Then, these turned from intended contributions to Nationally Determined Contributions (NDCs). Furthermore, NDCs became part of the legal framework of several countries. This is the case of Brazil, where this formalization took place through Decree No. 9073, of July 5, 2017 (Brasil, 2017).

As a result, Brazil has committed to reduce its GHG emissions to a level 37% below 2005 levels by 2025. The country also established a subsequent indicative contribution to reduce greenhouse gas emissions to a level 43% below 2025 levels by 2030. Regarding deforestation targets, the country has committed to end illegal deforestation in the Amazon and to restore 12 million deforested hectares in that territory by 2030 (Brasil, 2016).

However, the most problematic categories for the Brazilian emission reduction targets are those concerning changes in land use and forests and agricultural activity. Data

from 2020 show that these activities correspond, respectively, to 46% and 27% of total gross emissions in Brazil (SEEG, 2021). Deforestation is a major problem for Brazil because it is the main activity of the most emitting sector, at the same time that it has a strong relationship with agricultural expansion.

This emission profile is thus one of the main environmental problems in Brazil, directly correlating with the high rates of deforestation in the country. The conversion of native vegetation areas to other uses is a complex phenomenon that poses several challenges to the Brazilian government. Among these challenges is compliance with the emission reduction targets agreed upon by the country in international forums. The Paris Agreement, for example, projects significant reductions in total emissions for Brazil, with the closest target being a reduction to a level 37% below 2005 levels by 2025 (Brasil, 2017).

Thus, damage to the forest does not only represent an environmental loss, but also an economic loss. This is because the Brazilian economy has about 24.8% of its Gross Domestic Product (GDP) coming from agribusiness (CEPEA, 2023), which can be directly affected by more restrictive environmental policies. In addition, the environmental debate has contributed to consumer markets becoming more demanding about the sustainability of production processes. Therefore, an increase in deforestation may result in boycotts of agricultural products of Brazilian origin, leading to economic losses for the country.

In this sense, this study analyzes deforestation in the Brazilian Legal Amazon between 2000 and 2020. More specifically, it assesses government actions that have contributed to reducing deforestation in this region. Furthermore, it analyzes the actions of Brazilian governments to reduce deforestation in the Legal Amazon from 2000 to 2020.

Brazil stands out in this context because it is a forestry country, with around 500 million hectares of natural and planted forest. This number corresponds to about 59% of its territory. The Amazon Forest, the largest tropical forest in the world, corresponds to about 68.5% of the Brazilian forest area (MAPA, 2019). The biodiversity of this forest provides some products for human consumption such as fish, wood, and inputs for pharmaceutical components. Moreover, the forest has a regulatory character, sequestering carbon and recycling water (Fearndside, 1999; 2008). The ecosystem services provided by the Amazon Biome are many, such as the approximately twenty billion tons of water transpired per day. This ecosystem service brings to the continent a significant part of its air humidity, in a phenomenon known as "biotic moisture pump" (Makarieva & Gorshkov, 2007). This phenomenon accounts for the humidity levels occurring in more than three thousand km inland (Salati et al., 1979). In addition, it regulates the rainfall regime through flying rivers

(Nobre, 2014), which explains part of the immense agricultural potential of Brazilian lands.

In doing so, we organized this study into four sections. Section 1 introduces the issue addressing an international approach, contextualizing environmental actions of the International Community. Section 2 discusses the environmental issue from the perspective of economic theory, referring to various empirical studies on deforestation. Section 3 begins the discussions on deforestation from 2000 to 2020 in Brazil. Finally, section 4 brings reflections and perspectives for further research.

2 THEORETICAL FRAMEWORK

2.1 An economy approach to the environment

The study by Pigou (1920) is a forerunner of the environmental approach to economics. In this study, Pigou identified what he called market failures. These market failures consist of possible benefits or harm caused to third parties by a decision maker when carrying out an undertaking. That is, when deciding to exploit a certain resource or carry out a work, for example, an economic agent can have a positive or negative effect on the society in which it operates. These effects were called "externalities", and can generate a social cost when the externality is negative or a social benefit when it is positive. Market failures were thus considered - as failures - because the market was incapable of rewarding or punishing the responsible for these externalities.

The study by Pigou gave rise to what became known as the "Pigouvian Tax" or "Pigou Tax". This tax is applied by the State to the agent responsible for a negative externality. The thesis behind this tax is that if the State imposes a cost on the economic activity that generates negative externalities, the agent generating this externality must recalculate its optimal production considering the new tax. This would reduce the level of activity that generates externalities, leading to a new equilibrium point. In this new equilibrium point - Pareto optimal point -, society and the causer of the externality are at a lower level of externalities, resulting in greater social welfare (Cannan, 1921).

Samuelson (1954) also contributed to the debate by defining concepts about the property rights of goods in the economy. These concepts are described in terms of exclusivity and rivalry in their consumption. A public good is a good that contains the characteristics of non-exclusivity and nonrivalry, which means that a public good is a good whose society cannot be prevented from accessing. Non-exclusivity indicates that the use of that good cannot be prevented by an individual or exclusive consumption right. In turn, nonrivalry

indicates that the use of that good cannot be prevented by a dispute with another individual, which would evidence a scarcity of that good. A public good is a good that the whole society should be able to consume, as it has no restriction on exclusivity and does not suffer from scarcity in the market. Some good examples are public parks, national security, state education, etc.

A private good, on the other hand, has the characteristics of exclusivity and rivalry. This means that an agent can limit third-party access to that good. Exclusivity denotes exclusive use of a good through the right of ownership, which is guaranteed by the State. Rivalry means that this good can be disputed between individuals in a society (in a market, for example). In other words, a private good is any good that may have its consumption limited by an individual through ownership rights and market competition. All durable and nondurable goods that can be purchased in a market and any means of production whose ownership is guaranteed by the State are examples of private goods (Samuelson, 1954). It is also important to highlight the study developed by Coase (1960) on Pigou's externalities. Already influenced by property and state action issues, Coase proposed an alternative to the Pigouvian Tax. For him, the State should not charge a tax that discourages the production of a good that causes a negative externality, but rather provide agents with the tools to understand the production of externalities. This proposal, which emphasizes the importance of a clear distribution of property rights, became known as the "Coase theorem" (Coase, 1960).

These alternatives proposed by Pigou and Coase are important for the study of relationships with the environment. The study by Pigou is one of the first to consider the negative effects that can be generated by economic activity. The author finds in the application of a tax a way to bring balance to society. In turn, the interpretation of Coase (1960) is that one agent should not be prevented from causing harm to another, as this impediment would in itself harm one of the agents. For him, the solution between the agents can be reached by defining who is authorized to cause harm to others, and the solution occurs by preventing the greater of the two possible harms in that situation.

It is possible to find Pigouvian characteristics in situations such as the application of fines to agents who commit illegal deforestation. This fine is a penalty in the form of an economic sanction that serves to control the deforestation activity of the agents. On the other hand, one can empirically observe Coase's approach in undefined land tenure situations in the Amazon Forest. The places with the most conflicts over land ownership concentrate the greatest deforestation activities. Weakly defined property rights in the Legal Amazon generate land disputes between different agents living in that region. Empirical studies that prove these

relationships in the Brazilian territory and that define the characteristics of illegal deforestation in the country will be discussed below.

2.2 The empirical approach to deforestation in Brazil

Changes in land use and forests essentially involve deforestation, that is, the conversion of a "forest" area to a "nonforest" area. In Brazil, the project Monitoring the Deforestation of the Brazilian Amazonian Forest by Satellite (PRODES) of the National Institute for Space Research (INPE) defines the concept of gross deforestation as the cutting of primary forest. This type of forest is also called virgin, primitive, native, or ancient forest (Fearnside, 2017). In this case, secondary forests are not included, that is, those that were recultivated after suffering a major disturbance by fire, cutting, or even wind.

Another important distinction is that of net deforestation. The Food and Agriculture Organization (FAO) of the United Nations provides data based on the net deforestation metric through the Global Forest Resource Assessment (FRA), which reports data on global deforestation. Net deforestation consists of the difference in the forest area of a given place between two moments in time. It considers both the loss in the form of deforestation and the recovery of the area through regeneration or reforestation (Brown & Zarin, 2013).

The main studies on the Amazon Forest report that deforestation in the area occurs from the investment decision perspective. The model that best describes the Brazilian Legal Amazon is that of an open, small, and free-access economy. This approach assumes that prices are exogenous, population is endogenously determined, production is sold in markets, and property rights are not defined, encouraging deforestation to acquire ownership of the area. From this perspective, one can divide the variables into three types: market conditions, political influence, and initial conditions (Ferreira & Coelho, 2015; Silva, 2009).

Regarding the variables of the first type, market conditions, the price of agricultural products stands out. These, as previously mentioned, are exogenous, being represented by commodity prices in the international market. The higher the prices of these commodities, the more the incentives for farmers and ranchers to expand their land, explaining the increase in deforestation. The main commodities discussed in these studies on the Amazon are soybean and cattle, with cattle being the main factor and soybean a secondary factor. This is due to the logic of land appropriation, which will be explained below. While cattle raising stimulates deforestation in the Legal Amazon, soybean crops advance over areas previously occupied by

pasture for cattle raising. This relationship is perhaps the most studied, thus being widely reported in studies such as those by Arima et al. (2007), Faminow (1998), Ferreira and Coelho (2015), Margulis, (2004), Mattos and Uhl (1994), Mertens et al. (2002), and Silva (2009).

Within the second type of variables is political influence, which can manifest itself through institutional changes and credit policies. In terms of institutional variables, it is worth mentioning the level of inspection, which can be higher or lower; environmental protection policies, which may or may not exist; and legislation on land tenure, which can be well or poorly defined. Furthermore, literature reports often mention land disputes, as land tenure is not well defined in the Legal Amazon. Araújo et al. (2009) highlights that the poor definition of land tenure facilitates private use of public lands. If the land is explored for one year, the right to use it is granted, and after five years it is possible to obtain a title deed. This tenure logic, permitted by law, added to a large extension of nonallocated public lands and the social inequalities in the country, encourages the reproduction of conflicts between landless people, farmers who seek to increase their planting area, land speculators, and indigenous peoples with or without demarcated territory. In this regard, Sant'anna and Young (2010) identified the positive relationship between land conflicts and deforestation in the Amazon region, using the homicide rate as a variable.

While landless people find support in the law to take unproductive land, speculators who own it find in deforestation a way to make use of that land. In general, the exploitation of new areas begins with livestock activity, which has a short-term return. Then the owners sell the land to farmers who plant soybeans and other grains. Land disputes in Brazil thus have as their main factor the lack of clear regulations on land delimitation and ownership, especially in the case of Union lands and Indigenous Territories. Speculation, land grabbing, legislation, and conflicts over land are thus closely linked (Araújo et al., 2009; Fearnside, 2017; Sparovek et al., 2019).

Other factors related to land conflicts are the expansion of the agricultural frontier and population density. The agricultural frontier is the advance of agricultural activities on the environment. In Brazil this frontier has already been in the Atlantic Forest and in the Cerrado. Currently, it is in the Amazon Forest, in what researchers call the arc of deforestation. The need for agricultural expansion correlates with the increase in land prices as the region is occupied. This increase causes the need for agents to look for new lands so that these can be sold. This expansion can only be carried out with access to a new area, which must occur through the construction of a road. Therefore, construction of roads is a key factor for

encouraging deforestation (Kirby et al., 2006; Laurance et al., 2001; Pfaff, 1999; Pfaff et al., 2007; Soares-Filho et al., 2006).

The construction of a road represents access to previously unaccessed areas, which in turn activates immigration. This increases population density and reduces the transportation costs of agricultural products grown in that location. The construction also adds value to the land, activating greater interest from speculators who can deforest. In addition, it fosters the need for other infrastructure works, which also trigger deforestation (Fearnside, 2017). The literature highlights other causes that are also important for explaining deforestation in Brazil. These include mining activity, money laundering, tax incentives, obtaining firewood, and population growth (Fearnside, 2017).

From section 2 onwards, the paper discusses deforestation with an emphasis on the Amazon territory. Section 3 highlights the variables discussed in this section according to relevant events for the period. The period from 2000 to 2020 is of great importance, especially for the group of variables related to market conditions and political influence. Thus, the study will highlight the influence of soybean prices on the international market, plans to control and monitor deforestation activity, property rights, and access to credit.

3 RESULTS AND DISCUSSIONS

3.1 Market prices as drivers of deforestation (2000-2004)

While Brazil was the country that most deforested in the decades of 1990 and 2000 (FAO, 2010), the following years accounted for a significant reduction in this activity. Deforestation in the Legal Amazon has three distinct moments in relation to market variables and political influence for the period from 2000 to 2020. Figure 1 shows the numbers in deforested area for this entire period.

Figure 1 - Deforestation in the Amazon Forest from 2000 to 2020, in km^2.
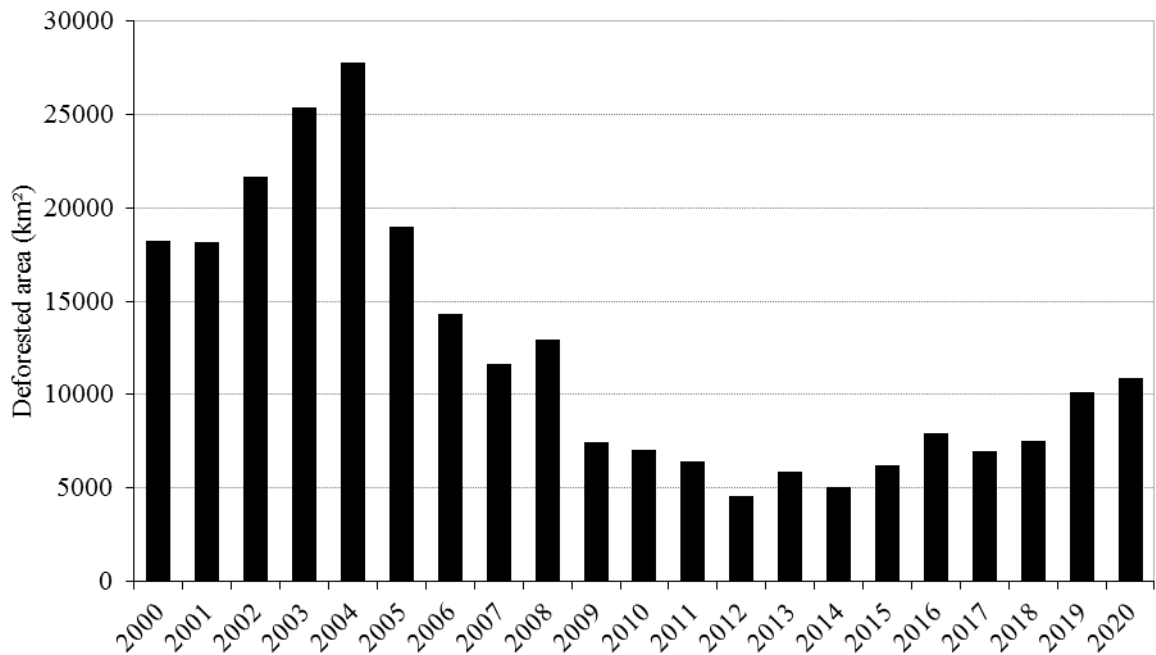
Source: INPE, 2022.

The beginning of the 2000s was marked by an increase in deforested area in the first four years, with 2004 being the most expressive year. Scholars analyze this rapid increase in deforested area with an emphasis on market factors such as the price of soybeans and the price of beef. Researchers refer to the beginning of the 2000s as the "Commodity Boom" period, which is marked by high prices of agricultural and mineral raw materials due to the expansion of emerging economies such as China (Barbosa, 2020). In other words, the high degradation of Brazilian forests was driven by an international economic scenario favorable to agricultural activity. Due to the social dynamics of Brazil, this activity finds in deforestation a way to expand its area of influence and economic production.

Figure 1 - Variation in soybean prices and deforestation

Source: World Bank, 2021.

From 2000 to 2004, the price of soybean rose by around 66% on the international market, while deforestation in the Amazon Rainforest increased by around 52%. Despite this, if the international market demonstrates favorable conditions for increasing deforestation to increase pasture or plantation areas, government instruments must represent a counterbalance to this practice, reducing the return of these agents or increasing the risk of this activity. This fact becomes clearer from 2006 onwards, when soybean prices started to show a trend of increase without deforestation following this trend.

Brazil had undergone an amendment to the Forest Code via a Provisional Measure made by the government of Fernando Henrique Cardoso in 2001. This measure proposed an increase from 50% to 80% in Legal Reserve areas on properties within the Legal Amazon (Brasil, 2001). This fact is important because it is a protective measure, which should reflect the control of deforestation in the region. In practice, however, deforestation accompanies the rise in commodity prices.

More effective actions to combat deforestation would only take place from 2004 onwards with the progress of environmental debates under the government of Luiz Inácio. Until that year there was no technological model for identifying deforestation activity, making inspection and punishment difficult. From the perspective of the explanatory variables elaborated here and based on the literature on the period, it is possible to state that this

increase in deforested area is mainly due to the great incentive promoted by market prices and the low repression of deforestation activity (Castelo et al., 2018; Ferreira & Coelho, 2015).

3.2 The start of a deforestation control plan (2004-2011)

A change in institutional practices became clear in the following years, especially from 2004 to 2008. This period is characterized by a strong advance in the containment of the practice of deforestation. According to Silva (2009), that is achieved through the use of variables of political influence as resources. If in the first four years of the 2000s market conditions were favorable and government action in the fight against deforestation was timid. It is from 2004 onwards that a major change in this logic takes place, with institutional variables linked to deforestation beginning to contain this activity. These include inspection, environmental protection policies, credit policies, and legislation on land tenure.

Among the most significant features of the period is the 2004 Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm). This Plan was established from a Permanent Interministerial Working Group, denoting an interdisciplinary approach in the elaboration of its guidelines and actions. Its authors recognize that the increase of deforestation in previous years has had varied factors. These include the advance of livestock as the predominant land use, logging, wood mining, expansion of mechanized cultivation, illegal occupation of public lands, opening of roads, and the creation of rural settlements (Castelo et al., 2018). The program is thus very successful in identifying the economic relations causing deforestation in previous years. In fact, this can be understood as a merit achieved by the interdisciplinarity of the Interministerial Working Group that conceived it.

Chart 1 – PPCDAm strategic guidelines selected by the author.

Selected Item	Guideline Description
i)	Valuing the forest for the purpose of conserving biodiversity, forest management of timber and nontimber products, and the provision of environmental services. These actions stand as one of the foundations of a new model of regional development, aiming at the quality of life of local populations, with the reduction of social inequalities, economic competitiveness, and environmental sustainability;
iii)	Taking urgent measures for land and territorial ordering, aiming at reducing free access to natural resources for predatory use and strengthening instruments for democratic and sustainable management of the territory. The focus is on prioritizing the fight against public land grabbing, land tenure regularization, enabling alternative land reform models suited to the Amazon, and creating and consolidating conservation

	units and indigenous lands;
iv)	Improving instruments for monitoring, licensing, and inspection of deforestation with innovative methodologies, along with incentives for the prevention of environmental damage and the adoption of sustainable practices among users of natural resources;
vi)	Promoting cooperation between federal institutions responsible for the set of policies on deforestation dynamics in the Legal Amazon, overcoming historical trends of dispersion and isolation of the environmental area;
viii)	Encouraging active participation of the different interested sectors of the Amazonian society in the management of policies for the prevention and control of deforestation. Supporting the feasibility of sustainable alternatives as a means to increase the quality of their implementation, with transparency, social control, and political appropriation.

Source: Brasil, 2004.

Chart 1 depicts the strategic guidelines of the Plan based on the view that the forest needs to be economically integrated through more sustainable activities. This is consistent not only with the synthesis of thought provided by the advancement of international debates on forest preservation, but also with economic planning that transforms the entire production process into sustainable. The strong environmentalist character of the Plan indicates the understanding of the Amazon territory as a tool for correcting social injustices and integrating different sectors of society, configuring an unprecedented character for government actions in that territory. The program defines its objective of reducing deforestation through a set of integrated actions of territorial and land management, monitoring and control, and promotion of sustainable productive activities.

The Ministry of the Environment (MMA) considers that a good part of the positive results obtained from 2004 to 2008 (period in which Phase I of the PPCDAm was in force) were due to the axis of action on Land and Territorial Planning. This axis was responsible for the creation of more than 25 million hectares of Conservation Units and the homologation of 10 million hectares of Indigenous Lands. In Phase II, from 2009 to 2011, the Monitoring and Control axis was largely responsible for the drop in deforestation rates. This was mainly due to the efficiency of the Project for Monitoring Deforestation in the Legal Amazon by Satellite (PRODES) commanded by the National Institute for Space Research (INPE). Decree No. 6,321, of 2007, stands as one of the reasons for the success of the monitoring axis. This is because it determined the periodic edition, by the Ministry of the Environment, of an ordinance with the list of municipalities identified as the main responsible for deforestation in the region (Brasil, 2007). In this way, integrated inspection actions carried out by environmental agencies, the police, and the army were more effective, as they became more constant and strict in the most deforested municipalities (Bizzo & Farias, 2017).

As of 2008, the government inaugurated another important project, the Sustainable Amazon Plan (PAS). Chart 2 shows the five objectives of this Plan, which seem to appear as an expansion of what the government of Luiz Inácio had already defined as the planning goal for this territory. Basic guidelines already shown in the PPCDAm are strengthened and expanded here, inaugurating a forest resource management plan that is coherent with the reduction of deforestation provided by the PPCDAm, attributing and promoting, therefore, new uses for the Forest.

Chart 2 – PAS objectives.

Item	Description
a)	Promoting territorial organization and environmental management to enable (i) the fight against land grabbing; (ii) the resolution of land conflicts and allocation of public lands; (iii) control over illegal and predatory exploitation of natural resources; and (iv) the protection of regional ecosystems;
b)	Promoting economic activities based on the sustainable use of natural resources with technological innovation, adding value, and enhancing biodiversity, geodiversity, and the knowledge of local populations to stimulate the generation of employment and income, food security, and greater competitiveness in regional, national, and international markets;
c)	Subsidizing the planning, execution, and maintenance of infrastructure works in the sectors of energy, transport, and communications, and supporting the installation of urban equipment, aiming at maximizing socioeconomic benefits and minimizing and mitigating the negative impacts of these interventions in the region;
d)	Strengthening social inclusion and citizenship through participatory public policy management processes and guarantees of access for the regional population to universal education, health, public security, and social security policies;
e)	Supporting the construction of a new financing model in the Amazon, aimed at reducing social and regional inequalities, and generating employment, income, and sustainable use of natural resources.

Source: Brasil, 2008.

Objectives A and B consider the consolidation of a sustainable development agenda for the Legal Amazon, in which reduction of deforestation is only the first step. Regional economic development is then guided and encouraged by sustainable activities, while deforestation activity is discouraged through strong inspection. Objectives D and E show that the sustainable development agenda provides for the inclusion and broad participation of civil society. Figure 3 indicates the incidence of PPCDAm (2004) and PAS (Brasil, 2008) from a temporal perspective, presenting the behavior of deforestation rates. It is noteworthy that from the year of implementation of each Plan, deforestation stands at a level below 50% in the following three years. This succession of positive results in the period caused deforestation in Brazil to decrease by about 83% between 2004 and 2012.

Figure 3 – Incidence of PPCDAm and PAS
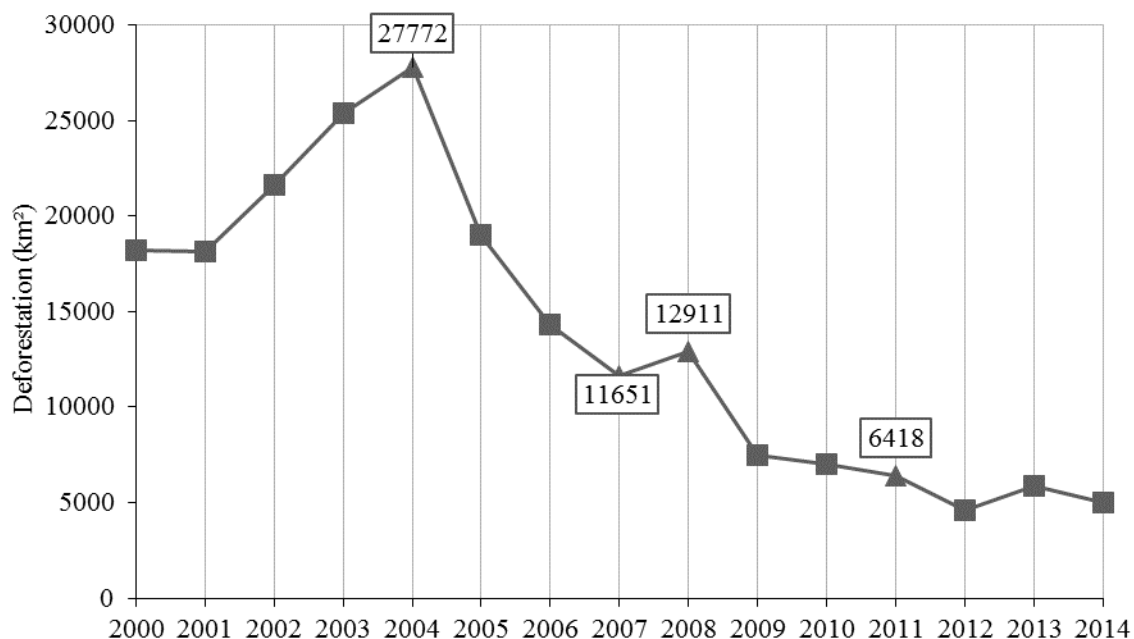
Source: INPE, 2022.

While two important Plans were launched and perfected, rural credit also appeared as a very important variable from 2008 onwards. In that year, the Brazilian Central Bank issued Resolution No. 3.545, which limited the granting of agricultural financing in the Amazon Biome by requiring documentation proving environmental compliance. The action can be understood as a result of the interdisciplinarity proposed by deforestation control plans, as it shows an incisive action by the Central Bank with a direct influence on deforestation. The Resolution made the presentation of the Rural Property Registration Certificate (CCIR), the nonexistence of embargoes in force on the economic use of illegally deforested areas in the property, and the documentation of environmental regularity in the region of the enterprise to become conditioning factors for granting funding. This reduced the possibilities of expanding the economic activity of those who practiced environmental illegalities on their lands (Fearnside, 2017).

The years from 2004 to 2011 thus seem to present a strong relationship between the incidence of the two Plans and the large reduction of deforestation. Regional control and monitoring through satellites has thus expanded the response capacity of environmental agencies. Moreover, credit as an incentive for sustainable economic activities in the Forest region and the nongranting of credit to rural landowners who carry illegal activities on their land certainly contributed to the figures for the period. This period is, therefore, marked by

the loss of importance of international prices as an explanatory variable, and the increase in the importance of institutional variables. As of 2011, there is a third logic in the relationships between market variables and political influence, which will be reported below.

3.3 Legal loosening and reduced inspection: incentives for deforestation (2011-2020)

Looking at deforestation from 2011 onwards means looking at a period in which the policies implemented in 2004 and 2008 started to get loose, with decentralization of some important processes. In this context stands out the enactment of Complementary Law (CL) No. 140, which is a key factor for the decentralization of environmental inspection in forest territory. In an attempt to reduce bureaucracy in environmental licensing, the CL defined that undertakings and activities that use effectively or potentially polluting environmental resources would be submitted to the approval of a single competent body (Brasil, 2011). The licensing body could now be in the competence of the Union, state, or municipality, decentralizing the environmental licensing process. The supposed gain in administrative speed meant that the Brazilian Institute of Environment and Renewable Natural Resources (Ibama) was only responsible for licensing projects with national impact, while projects with local impact would be licensed by the competent municipal body (Castelo et al., 2018).

In 2012 the New Forest Code (Federal Law No. 12.651/2012) appears. Among innovations and criticism, this tool accounted for changes that reduced the ranges of Permanent Preservation Areas (PPAs) along water courses. The text authorized the continuity of agroforestry, ecotourism, and rural tourism activities in PPAs within rural areas consolidated until 2008, which constitutes an amnesty for PPA deforesters until that date (Almeida; Castelo; Rivero, 2013). This supposed granted amnesty promotes the understanding of impunity for deforesters. From the perspective of deforestation as an investment decision, a legal decision granting amnesty to deforesters may lead to an expectation of a new amnesty in the future, indirectly favoring the increase of deforestation.

Meanwhile, the PPCDAm entered its Phase III, from 2012 to 2015, with a new proposal for actions aimed at changing the process of verification of illegal activities in the forest. It happens that the deforestation pattern has changed in recent years, resulting in deforestation rates that are below the detection threshold of the Brazilian Real Time Deforestation Detection System (DETER) (Castelo et al., 2018). Amidst a need for more succinct actions for the detection of deforestation, the program ended up suffering major

budget cuts from that phase onwards in all axes of action. Table 1 depicts this scenario (Castelo et al., 2018).

Table 1 - PPCDAm expenses in reais.

Expenses by government	Lula (2007-2010)	Dilma (2011-2014)	Reduction
Planning	819,791,732.15	436,007,146.69	46.81%
Monitoring	958,543,436.49	702,757,840.85	26.68%
Promotion	4,584,385,418.44	637,786,544.98	86.08%
Total	6,363,720,587.08	1,776,551,532.52	72.07%

Source: Castelo et al. (2018).

At the end of the execution period of Phase III, the project for Phase IV was only launched in 2018. Phase IV of the PPCDAm was presented in an MMA document together with Phase III of the PPCerrado. This was the first time that the documents were presented together. The unification of policies between 2016 and 2020 brought about significant changes. In an attempt to integrate the two Plans, a Unified Executive Committee was established with several bodies that operate in the two Plans. Section 6 of the document explains these factors regarding the new form of governance. In section 5, the document states that the objectives of the Plans are the same as those proposed by the National Policy on Climate Change (PNMC) (Brasil, 2018). This means that in Phase IV the PPCDAm starts to have a mixed governance as well as objectives that are not specific to the program. Mischaracterization of both the form of governance and the objectives of the most successful Brazilian deforestation control plan may have contributed to the discontinuity of previous positive results.

Some environmental laws were made more flexible to favor certain sectors of society. Thus, the reduction of funds for various inspection actions begins to become noticeable from 2019 onwards. The budget of bodies such as Ibama and the Chico Mendes Institute for Biodiversity Conservation (ICMBio), mainly responsible for monitoring environmental crimes, is contradictory with the current situation of the territory. Deforestation rates thus start to rise again along with the recording of the lowest budgets authorized and executed by the bodies that monitor this environmental practice. Figure 4 shows how Ibama's discretionary budget suffers a perceptible drop as deforestation levels rise again. The reduction of funds for bodies such as Ibama may mean a reduction in their ability to fulfill their inspection functions, encouraging illegal deforestation activities.

Figure 4 – Ibama's Budget
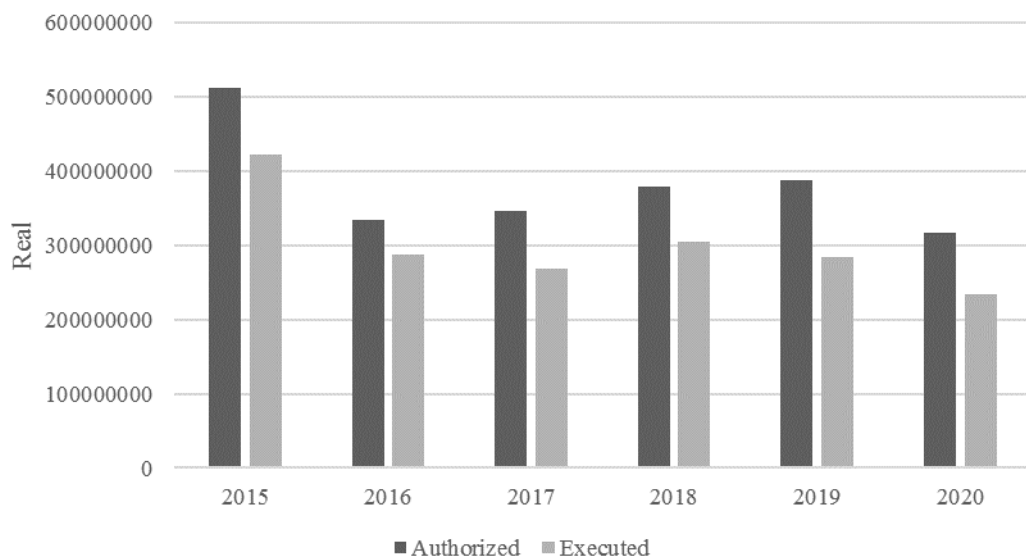
Source: Siop, 2022.

In addition to a smaller authorized and executed budget, important sources of financing such as the Amazon Fund also started to represent a problem. Created in 2008 in the same context of Phase I of the PPCDAm, the Fund ceased to receive support from its largest investors in 2019. Germany and Norway began to block transfers to the Fund after the interruption of monitoring and inspection activities that were financed by the Fund. The decision to stop these activities came from the MMA on the grounds that the Fund needed changes in its functioning and a kind of verification operation to investigate irregularities in transfers to institutions that carried out activities to protect the Forest. The posture, which came from the chief executive of the MMA, meant that in 2019 no project was approved. This resulted in the interruption of transfers, consequently interrupting a good part of the inspection activities in the Amazon territory.

The absence of a containment plan and the reduction of inspection corroborate the data in Figure 5. The number of infraction notices applied over time by Ibama behaves abnormally. In moments of great deforestation activity throughout 2002 and 2005, fines seem to follow the amount of irregularities that occurred. However, when deforestation activities increase again, penalties seem to show a steady downward trend year after year. In this way, the amount of fines imposed seems to have more to do with Ibama's ability to apply these

fines based on its budget than with the environmental crimes that effectively occur on Amazonian soil.

Figure 5 – Infraction notices issued by Ibama
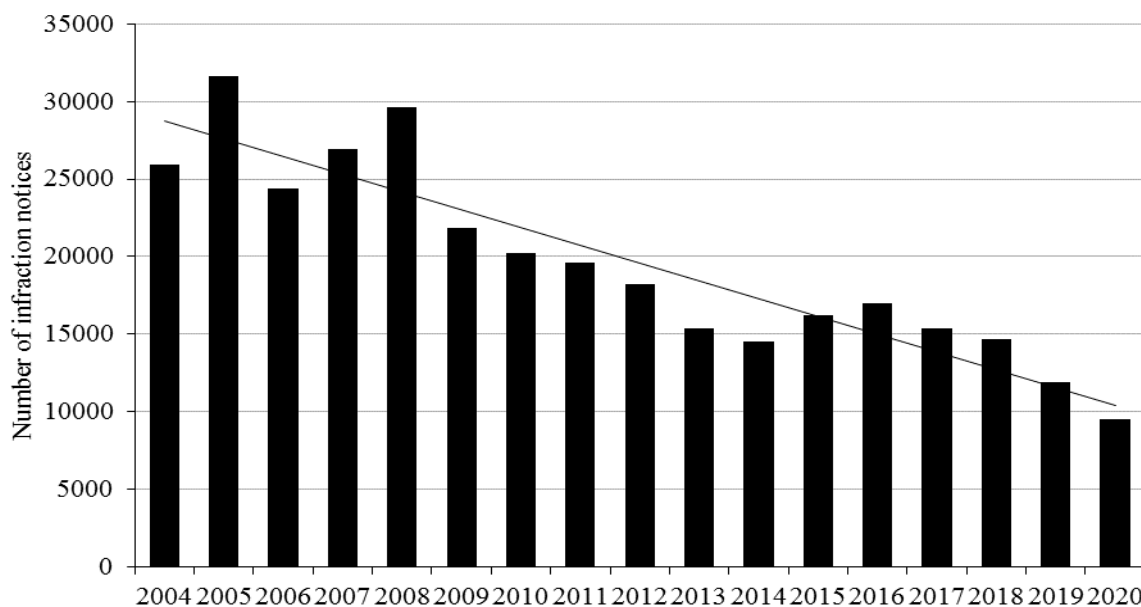
Source: Ibama, 2022.

The federal government then decides to reactivate the National Council for the Legal Amazon (CNAL), inactive since the 1990s. This council was appointed in 2020 with 19 military personnel and no members of academia or state governments, no representatives of the private sector or civil society, no representative of the National Indigenous People Foundation (Funai) or indigenous peoples, no representative of ICMBio or Ibama. The only information about CNAL's actions is a 2020 study that seems to outline a new policy for the Amazon Forest. The 23-page document explains how the CNAL and its Commissions work, indicating various strategic objectives. These objectives concern areas to be strengthened, such as preservation, protection, and sustainable development. The document also proposes original immediate actions such as a Social Communication Plan, the reactivation of the Amazon Fund, and other actions that seem to coincide with targets for reducing deforestation. Notwithstanding, the character of the document is that of a study that is just beginning, with poorly defined guidelines, poorly explained objectives, lack of deadlines, and no indication of means of financing, inspection, or any goals. Ibama and ICMBio are mentioned only once, in an excerpt that mentions their "restructuring" and eventual "doctrinal revision". In turn, PPCDAm is not mentioned once (CNAL, 2020).

The federal government launches another plan in 2020, this time through the MMA: the National Plan to Control Illegal Deforestation and Recover Native Vegetation. It is a 17-page document that relies on three transversal themes: business environment, innovation, and financing. The Executive Commission for the Control of Illegal Deforestation and Recover of Native Vegetation (CONAVEG) is now responsible for the governance of the plan. This body is composed only of federal ministers and will make its decisions on the establishment of guidelines and plans for the control of deforestation and reforestation based on Thematic Consultative Chambers. These Chambers will be established through a resolution by CONAVEG itself (BRASIL, 2019). Chart 3 shows the axes of action of the document, which rescues axes of action from old and successful projects such as the PPCDAm.

Chart 3 – Axes of action of the National Plan to Control Illegal Deforestation and Recover Native Vegetation

Item	Axis of Action
1	Zero Tolerance to Illegal Deforestation;
2	Land regularization;
3	Land use planning;
4	Payment for Environmental Services;
5	Bioeconomy.

Source: Ministério do Meio Ambiente, 2020.

Although the axes of action of this plan make sense according to the abovementioned plans (such as the PPCDAm and the PAS), the perspectives are not good. The documents exposed here by CNAL and MMA have a very embryonic and informal character. The document presented by CNAL is much more like a preliminary study for policies to be drawn up based on it. In turn, the document proposed by the MMA has a very informal character and is presented as a glimpse of what may be decided in the future. Both documents also indicate significant losses in the representativeness of civil society and scientists, in addition to little or no reference to bodies that were very successful in monitoring and enforcing illegal deforestation activities. Without goals, deadlines, or specific actions, the MMA document was never published in the Official Gazette, which denotes its informal nature.

The informality and little development of these two Plans indicate a delay in formulating policies to contain deforestation activity, in addition to the inability to continue executing the formula of Plans that have already shown good results. This characteristic became evident since the PPCDAm, in its Phase IV, was put into joint execution and

governance with the PPCerrado by the government of Michel Temer. From then on, there seems to be a great loss for the Plans for economic integration and control of deforestation in the Amazon Forest, caused by mischaracterization of past policies. This phenomenon seems to have occurred through changes in the form of governance. It expresses itself in the loss of representativeness of sectors of civil society, the reduction of funds for important environmental control bodies such as Ibama, and the lack of definition of clear objectives for new Plans. The results are an increase of around 137% in deforested area from 2012 to 2020.

4 FINAL CONSIDERATIONS

The history of the Amazon Rainforest is the history of how the State decided to exploit it economically. The period under study seems to tell the story of how the Brazilian State was very successful in identifying the variables that influenced the increase in deforestation until 2004. Then, it was very successful in synthesizing Plans for the control of deforestation and for sustainable economic integration of the Forest until 2008. This was motivated by a sustainable development logic, always indicated in the proposed Plans. However, a State is managed by a provisional government, and the continuity and elaboration of new policies depend on the government that is in power.

The continuity of governments from 2010 onwards seems to have chosen a gradual mischaracterization of the Plans that reduced Brazilian deforestation. This occurred initially in the form of sensitive changes such as spending cuts in Phase III of the PPCDam (2012-2015), which were justified by the way in which deforestation had adapted. From then on, however, environmentalists have faced successive defeats regarding environmental legislation. These consecutive defeats are magnified by budget reductions in inspection bodies, which reduces their operational potential.

The scenario of environmental losses at the legislative level, along with the loss of inspection and monitoring power, is then added to the discontinuity of the Plans. The result is the lack of elaboration and the discontinuity of initiatives that aim to reduce deforestation, now on the rise. The discontinuity of these policies becomes clearer when it is only in 2020 that the MMA and the CNAL prepare documents that design studies for deforestation in the country. The absence of policies to control deforestation acts on the forest in the form of deregulation. With the reduction of inspection operations and loopholes in environmental laws, international market prices are once again important for deforestation levels. This is

because the prices of agricultural commodities make the expansion of the agricultural frontier more viable, increasing deforestation. The synthesis of these economic and political relationships tells the story of how the country was very successful in its environmental preservation objectives from 2004 to 2011. However, it also contemplates how it then began to systematically abandon these objectives and deregulate forest exploitation, favoring groups with greater economy power in the region.

This study can be expanded by adding other perspectives for the same period and territory. Among these perspectives stand out the disputes between environmentalists and ruralists in government institutions, the disputes between traditional peoples, landless peoples, and large landowners in the Amazonian territory, in addition to deeper research on land regulation and credit policy. Understanding this time interval also means understanding the occupation of the Amazonian territory throughout its entire history. In this way, any historical approach on the integration of the Amazon also contributes to the understanding of the future of the forest. The ideological approach can also be taken, with the understanding of the main economic and social ideas that underpinned the various Plans throughout history. All these studies, if placed in a timeline, will be able to dialogue with each other and contribute to the understanding of the economic exploitation of the Amazon Forest beyond the perspective of the State and the market.

REFERENCES

ALMEIDA, O. T., CASTELO, T. B; RIVERO S. L. M. (2013). Avaliação dos stakeholders em relação às mudanças na legislação ambiental e reforma do Código Florestal Brasileiro. Desenvolvimento e Meio ambiente, 27, 163-177.

ARAUJO, C *et al.* (2009). Property rights and deforestation in the Brazilian Amazon. Ecological Economics, 68 (8-9), 2461-2468.

ARIMA, E *et al.* (2007). Fire in the Brazilian Amazon: A spatially explicit model for policy impact analysis. Journal of Regional Science, 47(3), 541-567.

BARBOSA, I. P. (2020). A alta das commodities agrícolas e o estabelecimento do milagrinho na economia brasileira no governo Lula. Revista Conjuntura Global, 9 (2), 145-146.

BIZZO, E; FARIAS, A. L. A. (2017). Priorização de municípios para prevenção, monitoramento e controle de desmatamento na Amazônia: uma contribuição à avaliação do Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal (PPCDAm). Desenvolvimento e. Meio Ambiente, 42, 135-159.

BRASIL (2001). Medida Provisória No 2.166-67, de 24 de agosto de 2001. Available at: https://legis.senado.leg.br/sdleg-getter/documento?dm=3460118&disposition=inline#:~:text=MEDIDA%20PROVIS%C3%93 RIA%20No%202.166,24%20DE%20AGOSTO%20DE%202001.&text=10%20da%20Lei%2 0no%209.393,ITR%2C%20e%20d%C3%A1%20outras%20provid%C3%AAncias. [27 may 2022]

BRASIL (2004). Plano de ação para a prevenção e controle do desmatamento na Amazônia Legal.   Available   at: http://combateaodesmatamento.mma.gov.br/images/conteudo/PPCDAM_1aFase.pdf [27 may 2022]

BRASIL (2008). Plano Amazônia Sustentável: diretrizes para o desenvolvimento sustentável da Amazônia Brasileira. Available at: http://www.mma.gov.br/estruturas/sca/_arqu ivos/plano_amazonia_sustentavel.pdf [27 may 2022]

BRASIL (2011). Lei Complementar Nº 140, de 8 de dezembro de 2011. Available at: https://www.planalto.gov.br/ccivil_03/leis/lcp/lcp140.htm [28 may 2022]

BRASIL (2012). Lei nº Lei 12.651 de 25 de maio de 2012. Available at: https://legislacao.presidencia.gov.br/atos/?tipo=LEI&numero=12651&ano=2012&ato=a48QT VU1kMVpWT59b#:~:text=DISP%C3%95E%20SOBRE%20A%20PROTE%C3%87%C3%8 3O%20DA,AGOSTO%20DE%202001%3B%20E%20D%C3%81 [27 jun 2022]

BRASIL (2016). Pretendida Contribuição Nacionalmente Determinada (Indc) Para Consecução do Objetivo da Convenção-Quadro das Nações Unidas sobre Mudança do Clima. Available   at: https://antigo.mma.gov.br/images/arquivo/80108/BRASIL%20iNDC%20portugues%20FINA L.pdf [17 may 2021]

BRASIL (2017). Decreto Nº 9.073, de 5 de junho de 2017. Available at: https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/decreto/d9073.htm [17 may 2021]

BRASIL (Ministério do Meio Ambiente) (2018). Plano de Ação para Prevenção e Controle do Desmatamento e das Queimadas no Cerrado (PPCerrado) e Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal (PPCDAm): fase 2016-2020. Available at: http://combateaodesmatamento.mma.gov.br/images/conteudo/Livro-PPCDam-e-PPCerrado_WEB_1.pdf [27 may 2022].

BROWN, S; ZARIN, D. (2013). What does zero deforestation mean. Science 342, 805–807. [doi: 10.1126/science.1241277].

CANNAN, E. (1921) Reviewed Work: The Economics of Welfare. by A. C. Pigou. The Economic Journal. 31 (122), 206-214. [doi.org/10.2307/2222816]

CASTELO, T. B *et al.* (2018). Governos e Mudanças nas Políticas de Combate ao Desmatamento na Amaônia. Revista Iberoamericana de Economía Ecológica, 28 (1), 111-134.

CEPEA – Centro de Estudos Avançados em Economia Aplicada (2023). Pib-Agro/Cepea: após recordes em 2020 e 2021, Pib do Agro cai 4,22% em 2022. Available at: https://www.cepea.esalq.usp.br/br/releases/pib-agro-cepea-apos-recordes-em-2020-e-2021-pib-do-agro-cai-4-22-em-2022.aspx [14 sep 2023]

CNAL – Conselho Nacional da Amazônia Legal (2020). Plano Estratégico 2020-2030. Available at: https://acervo.socioambiental.org/acervo/documentos/plano-estrategico-2020-2030 [29 may 2022].

COASE, R. H. (1960). The Problem of Social Cost. The Journal of Law & Economics, 3, 1-44.

FAMINOW, M. D. (1998). Cattle, Deforestation, and Development in the Amazon, An Economic, Agronomic, and Environmental Perspective. Wallingford, UK: CAB International.

FEARNSIDE, P. M. (1999). Impactos Sociais da Barragem de Tucuruí. In: Ecologia de Reservatórios: Estrutura, Função e Aspectos Sociais, R Henry (ed.), pp. 219-244. Universidade Estadual Paulista (UNESP), Botucatu, São Paulo.

FEARNSIDE, P. M. (2008). Ameaça da soja. Scientific American Brasil Especial Amazônia (3), 44-51.

FEARNSIDE, P. M. (2017). Deforestation of the Brazilian Amazon. In: Oxford Research Encyclopedia of Environmental Science, H Shugart (ed.). Oxford University Press, New York, USA. doi:10.1093/acrefore/9780199389414.013.102

FERREIRA, M. D. P; COELHO, A. B. (2015). Desmatamento Recente nos Estados da Amazônia Legal: uma análise da contribuição dos preços agrícolas e das políticas governamentais. Revista de Economia e Sociologia Rural 53 (1).

FAO - Food and Agriculture Organization of the United Nations (2010). Global Forest Resources Assessment 2010: Main Report. Roma, Itália. Available at: https://www.fao.org/3/i1757e/i1757e.pdf [30 jul 2022]

IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (2022). Dados abertos do Ibama. Available at: https://dadosabertos.ibama.gov.br/dataset/fiscalizacao-auto-de-infracao [20 may 2022]

INPE - Instituto Nacional de Pesquisas Espaciais (2022). Monitoramento do Desmatamento da Floresta Amazônica Brasileira por Satélite. Available at: http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes [10 jan 2022]

KIRBY, K.R. et al. (2006). The future of deforestation in the Brazilian Amazon. Futures, 38, 432-453. [doi: 10.1016/j.futures.2005.07.011].

LAURANCE, W. F et al. (2001). The future of the Brazilian Amazon. Science, 291, 438-439. [doi: 10.1126/science.291.5503.438].

MAKARIEVA, A. M; GORSHKOV, V. G. (2007). Biotic pump of atmospheric moisture as driver of the hydrological cycle on land. Hydrology and Earth System Sciences, 11, 1013–1033.

MARGULIS, S. (2004). Causes of Deforestation in the Brazilian Amazon. World Bank Working Paper No. 22. Washington, D.C., U.S.A.: World Bank. Available at: https://documents1.worldbank.org/curated/en/758171468768828889/pdf/277150PAPER0wb wp0no1022.pdf [10 jan 2022]

MATTOS, M. M; UHL, C. (1994). Economic and ecological perspectives on ranching in the eastern Amazon. World Development, 22, 145-158. [doi: 10.1016/0305-750X(94)90066-3].

MERTENS, B *et al.* (2002). Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: The case of Sao Felix do Xingu in South Pará. Agricultural Economics, 27, 269-294. [doi: 10.1111/j.1574-0862.2002.tb00121.x].

MMM - Ministério do Meio Ambiente (2017). PPCDAm. Available at: http://redd.mma.gov.br/pt/acompanhamento-e-a-analise-de-impacto-das-politicas-publicas/ppcdam [10 jan 2022]

MMM - Ministério do Meio Ambiente (2020). Plano Nacional para o Controle do Desmatamento Ilegal e Recuperação da Vegetação Nativa (2020-2030). Available at: anexo-ao-resumo-informativo-no-3_de-29-5-2020.pdf (www.gov.br) [26 may 2022]

NOBRE, A. D. (2014). O futuro climático da Amazônia: relatório de avaliação científica. São José dos Campos, SP: ARA: CCST-INPE: INPA.

PFAFF, A. S. P. (1999). What drives deforestation in the Brazilian Amazon? Journal of Environmental Economics and Management, 37(1), 26–43. [10.1006/jeem.1998.1056].

PFAFF, A. S. P *et al.* (2007). Road investments, spatial spillovers, and deforestation in the Brazilian Amazon. Journal of Regional Science 47(1), 109– 123. [doi: 10.1111/j.1467-9787.2007.00502.x].

PPCDAm (2004). Plano de Ação para Prevenção e Controle do Desmatamento da Amazônia Legal. Fase I. Brasília, DF: Casa Civil. Available at: http://redd.mma.gov.br/images/publicacoes/PPCDAM_fase1.pdf [25 may 2022]

PPCDAm (2009). Plano de Ação para Prevenção e Controle do Desmatamento da Amazônia Legal. Fase II. Brasília, DF: Casa Civil. Available at: http://redd.mma.gov.br/images/publicacoes/PPCDAM_fase2.pdf [26 may 2022]

PPCDAm (2012). Plano de Ação para Prevenção e Controle do Desmatamento da Amazônia Legal. Fase III. Brasília, DF: Casa Civil. Available at: http://redd.mma.gov.br/images/publicacoes/PPCDAM_fase3.PDF [26 may 2022]

REI, F. C. F., GONÇALVES, A. F; SOUZA, L. P. (2017). Acordo de Paris: reflexões e desafios para o Regime Internacional de mudanças climáticas. Veredas do Direito, 14(29), 81-99.

SALATI, E *et al.* (1979). Recycling Of Water In The Amazon Basin: An Isotopic Study. Water Resources Research, 15, 1250–1258.

SAMUELSON, P. A. (1954). The Pure Theory of Public Expenditure. The Review of Economics and Statistics, 36 (4), 387-389 [doi.org/10.2307/1925895]

SANT'ANNA, A. A; YOUNG, C. E. F. (2010). Direitos de propriedade, desmatamento e conflitos rurais na Amazônia. Economia Aplicada, 14(3), 381-393.

SILVA, J. H. G. (2009). Economic causes of deforestation in the Brazilian Amazon: an empirical analysis of the 2000s. In XXXVII ENCONTRO NACIONAL DE ECONOMIA. Foz do Iguaçu: Anpec. Available at: https://en.anpec.org.br/previous-editions.php?r=encontro-2009

SEEG - Sistema de Estimativa de Emissão de Gases de Efeito Estufa (2021). Análise das emissões brasileiras de gases de efeito estufa e suas implicações para as metas climáticas do Brasil (1970-2020). Available at: https://seeg-br.s3.amazonaws.com/Documentos%20Analiticos/SEEG_9/OC_03_relatorio_2021_FINAL.p df [15 may 2022]

SIOP - Sistema Integrado de Planejamento e Orçamento do Governo Federal (2022). Lei Orçamentária Anual (2015-2020). Available at: https://www1.siop.planejamento.gov.br/siopdoc/doku.php/acesso_publico:dados_abertos [20 may 2022]

SOARES-FILHO, B. S *et al.* (2006). Modeling conservation in the Amazon Basin. Nature 440(23), 520-523. [doi: 10.1038/nature04389].

SOUZA, M. C. O; CORAZZA, R. I. (2017). Do Protocolo de Kyoto ao Acordo de Paris: uma análise das mudanças do regime climático global a partir do estudo da evolução dos perfis de emissão dos gases de efeito estufa. Desenvolvimento e Meio Ambiente, 42, 52-80.

SPAROVEK, G *et al.* (2019). Who owns Brazilian lands? Land Use Policy, 87, 104062.

VIOLA, E. (2002). O regime internacional de mudança climática e o Brasil. Revista Brasileira de Ciências Sociais, (17)50, 25- 46 [doi: 10.1590/S0102-69092002000300003]

WORLD BANK (2021). Commodity Prices - History And Projections. Available at: https://datacatalog.worldbank.org/search/dataset/0038238/Commodity-Prices---History-and-Projections [22 jan 2022]

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4) participação na aprovação da versão final do manuscrito.	X	X	X