



**ARCHIMEDES OPERATION AND THE DESTRUCTION OF THE BRAZILIAN AMAZON FOREST  
WITH THE STATE CONSENT**

**OPERAÇÃO ARQUIMEDES E A DESTRUIÇÃO DA FLORESTA AMAZÔNICA BRASILEIRA COM  
A ANUÊNCIA DO ESTADO**

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**ABSTRACT**

*Archimedes Operation, launched by the Federal Police in the Amazon, whose purpose is to hinder the marketing of Brazilian native timber from fraudulent forest management plans, with the help of the corrupt forest engineers and environmental inspectors from the environmental management agency, has shown that criminal organizations settle in environmental agencies in order to legalize forest holdings based on fraudulent documentation and inspections. Most of the wood produced in this way comes from federal areas. Part of the wood is sold domestically, and part is exported to dozens of countries, maintaining a scheme of laundering money and goods. Telephone interceptions made public by the Public Prosecutor's Office show the reality of Amazon forests exploitation unknown to wood consumers. A qualitative and quantitative approach demonstrated that land fraud and frauds in the state control systems are significantly contribute to the gradual destruction of the Amazon Forest, with the consent of the Brazilian State and the innocence of consumers in imagining that the documentation of origin guarantees the idoneous origin of the wood.*

**KEYWORDS:** *Archimedes Operation. Land frauds. Corruption. Amazon Forest. Illegal logging*

**RESUMO**

A Operação Arquimedes, deflagrada pela Polícia Federal na Amazônia, com a finalidade de coibir a comercialização de madeira nativa brasileira oriunda de planos de manejo florestais fraudados, com o auxílio de engenheiros florestais e de fiscais ambientais corruptos do órgão gestor ambiental, permitiu demonstrar que organizações criminosas se estabelecem nos órgãos ambientais com o intuito de legalizar explorações florestais a partir de documentações e vistorias fraudulentas. A madeira assim produzida é proveniente na maior parte das vezes de áreas federais. Parte da madeira é comercializada no mercado interno e parte é exportada para dezenas de países, mantendo um esquema de lavagem de bens e de dinheiro. Interceptações telefônicas tomadas públicas pelo Ministério Público Federal mostram a realidade da exploração florestal amazônica desconhecida dos consumidores da madeira. Uma abordagem qualitativa e quantitativa demonstrou que as fraudes fundiárias e nos sistemas de controle estatais contribuem significativamente para a paulatina destruição da Floresta Amazônica, com a anuência do Estado brasileiro e a inocência dos consumidores ao imaginar que a documentação de origem garante a origem idônea da madeira.

**Palavras-chave:** Operação Arquimedes. Fraudes fundiárias. Corrupção. Floresta Amazônica. Exploração madeireira ilegal

**1. INTRODUCTION**

The Amazon Forest supplies a variety of products such as timber, rubber and Brazil nuts. These provisioning functions currently support local populations and represent missed opportunities for sustainable use when areas are deforested. Forest clearance has different implications for biodiversity and climate. To fight to save the last remnants of forest in heavily deforested areas is

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essential for biodiversity (FEARNSIDE, 2017). Brazil is the keeper of the largest biodiversity on the planet (ABRAMOVAY, 2019), but the current situation in the Brazilian Amazon is that the speed of loss of opportunities and biodiversity is greater than the speed of protection of this ecosystem.

A catastrophic collapse in human population, due to the consumption of natural resources, is the scenario of dynamic evolution based on current parameters (BOLOGNA; AQUINO, 2020). With the large-scale loss of trees comes a loss in equal measure of everything related to a rich and diverse environment. Species of animals and plants, medicines, livelihoods, weather patterns and natural beauty are all affected by the loss of forest areas (BENNETT, 2017). With the sole purpose of illicit profit, riches still unmeasured are destroyed forever in Amazonia. It is like killing the goose that lays the golden eggs.

The last Human Development Report (HDR) from the United Nations (UN) pointed out Brazil as one of the countries with the highest concentration of income in the world, and a Human Development Index (HDI) of 0,761 (CUNHA, 2021). The country, as well as poor managing of its wealth, also concentrates it in the hands of the few. Within this context, the Brazilian Federal Police conducts every year several operations to fight organized environmental crime in the Amazon seeking to protect the still poorly known biodiversity of the Amazon.

One of the largest operations, named "Archimedes", was launched in two phases (14/12/2017 and 25/04/2019), and identified civil servants, forestry engineers and holders of "sustainable" forest management plans, working as organized crime, with the aim of frauding forestry projects by supplying native wood to both the domestic market, as well as the European, American, and Asian markets. Although this is alarming it is already almost normal in the exploitation of Amazon Forest.

By adopting the combination of a deterministic and stochastic model it is concluded that the probability that our civilization will survive is less than 10% in the most optimistic scenario. At the current rate of population growth and consumption of natural resources, in particular the consumption of forest resources, we have only a few decades before the irreversible collapse of our civilization (BOLOGNA; AQUINO, 2020).

Deforestation as a major source of greenhouse gas emissions (GGE) was not initially addressed in the Kyoto Protocol. Even when countries commit themselves to signing this type of agreement, its implementation has different dynamics do not show in the reduction of deforestation rates but depend on specific environmental policies at the national level (ARMENTERAS et al., 2017).

Besides the possibility of a chaotic planet in a brief period of time due to the mismanagement of natural resources and GGE emissions, the continuity of deforestation in non-acceptable levels, with the consent of the State, through the action of corrupt public servants, will be analysed in this article, based on the documentation produced by Archimedes Operation, whose breach of confidentiality was made by the Federal Public Ministry.

The aim was to question the legislators and the environmental managers about the absence of transparency in environmental licensing processes for extraction of Amazonian timber, which disguise



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illicit activities as legal, producing fraudulent forestry guides (GF) or fraudulent document forest origin (DOF).

### 2. METHODOLOGY

This article used part of the documentation produced by the Federal Police's Archimedes Operation, launched in the Amazonas State and made available to the public by the Public Prosecution Service (MPF) at the electronic address <http://www.mpf.mp.br/grandes-casos/operacaoarquimedes/atuacao-do-mpf/acoes-penais>. The complaints of environmental crimes and active and passive corruption were analysed, through online access.

An inductive and deductive documentary analysis of the twelve complaints filed by the FMP, together with a quantitative study that revealed the frequency and extent of involvement of civil servants in fraudulent documents and environmental licensing processes. Although the operation was more comprehensive, only these complaints were made available. We selected the six objects of the action contained in the complaints that are related to environmental crimes with the names of the companies and persons being abbreviated.

### 3. RESULTS

The police investigation within the scope of Archimedes Operation revealed a complex and corrupt web of a criminal organisation, with actions ordered and articulated between loggers, civil servants and forestry engineers, to engage in active and passive corruption, illegal exploitation of native Amazonian timber, fraud in the control systems (SISDOF/IBAMA) for the illegal commercialisation of timber, and money and asset laundering.

Using special techniques of telephone interception, breache of telematic, bank and tax secrecy, relevant vestiges have been gathered in relation to the crimes under investigation. After selecting the targets of action in the allegations of the FMP and choosing a few important dialogues to this study, companies and individuals were classified in each of these targets:

3.1. Crimes against the environment and genetic heritage, tax frauds and money laundering - reported company A.M.N.A.:

- a) Issue and subsequent cancellation of a forestry permit (DOF), only to generate a physical document capable of giving the cargo of native timber the character of legality, thus bypassing inspection;
- b) Wood illegally felled from a location other than the one declared in the DOF (with irregular origin and ideological falsehood), affecting all cargoes, even if the information declared is apparently correct with the licensing process approved by the environmental management body;



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- c) The species declared in the DOF did not match the species transported, which indicates money laundering by hiding and disguising the timber resulting in a criminal offence;
- d) Lifting of tax confidentiality of the company detected tax fraud and money laundering;
- e) Active corruption: in one of the dialogues, the forestry engineer technically responsible for the interested party, the civil servant from the environmental management agency M. informed him that it would be possible to "fix" it, but that at the time he could not remove it from the hands of the from the hands of civil servant "E":

... M. said it can be fixed yes ... now I don't think I can get it out of E's hands.

### 3.2. Payment of bribe to public servant who accepted and received an improper benefit:

3.2.1 Accused C.A.H.N. (representative of several companies) and A.G.M.N. (public servant of the state environmental management agency):

- a) C.A.H.N. urgently requests approval for a permit for company A. and the interception records "maize" as being money:

I need an urgent authorization for A., I'm preparing it and I'll have it registered right away along with the "maize".

- b) C.A.H.N. requests the authorization of a patio, which corresponds to the approval of the cadaster of a lumber yard, and offers a bribe:

Approve G.'s lumber yard, the maize is already in hand.

3.2.2 Accused A.G.M.N. and I.S.S. (forest engineer). Receiving of a sum of money by the civil servant in order to facilitate the processes in which I.S.S. acted as consultant:

- a) In the interception of telephone conversations, I.S.S. talks about values that would be delivered to A.G.M.N. (2.5) and for other servers (15.7), when he says "upstairs":

"I.S.S.: He was going to pass me 2.5; he was going to pass 2.5 to you!

A.G.M.N.: Good!

I.S.S.: AND 15.7...

A.G.M.N.: Over there?

I.S.S.: YEAH! Up there, understand?"

- b) On one occasion I.S.S. complained that inspectors from the environmental management body were carrying out an inspection of a logging company where he was technically responsible:

They are angry there, as if I hadn't settled anything with them ...

- c) On 04/05/2018 I.S.S. advised that they would deposit money in his account only on Monday, therefore, he would settle the "debt" with AG.M.N. only on Monday or Tuesday:

Deposit in my account only on Monday ... so, Monday or Tuesday we'll settle everything.

- d) Fraud in the DOF validity extension at the moment when I.S.S. proposes the extension of 12 DOFs in exchange for "a bag of corn", which translated into one thousand reais:



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He needs this extension to happen by 2pm; that's 12 DOFs ... and when it's 1.30pm I'll file an extended validity for W. (4 DOFs) ... a bag of maize for the two of us ... is that okay?

3.2.3 Reported R.M.C. and S.R.B. (civil servants of the state environmental management body) and E.A.M. (businessman). The civil servants received a financial benefit offered by E.A.M. for the concession of an environmental permit for a Sustainable Forest Management Plan (PMFS). S.R.B. preferred to receive the value in kind than by bank transfer:

E.A.M.: Can I transfer?

S.R.B.: NOT IN MY ACCOUNT, NO!

E.A.M.: I can deliver it tomorrow if that's the case!

3.3 Falsification of information in a public system for the control of forestry products - accused R.S.A.:

a) No logging, but DOFs have been issued;

b) Cutting of unidentified trees; and

c) R.S.A. instructs his employee to hide the truckload of timber from inspection:

... you go in your truck, put it under the mango trees there, who will see it?

What will a helicopter see there, lad?

#### 4. DISCUSSION

Environmental protection has economic implications. Agricultural production depends on biophysical factors as the preservation of water resources, which in turn is linked to the conservation of forests and their related ecosystems (BOLTON, 2020). Forests are an important source of biodiversity, control the negative consequences of climate change, help to protect livelihoods and reduce the damage caused by floods (AHMED et al. floods (AHMED et al., 2015). As large areas of land become increasingly anthropogenic, above ground biomass and leaf area index decrease (SWANN et al., 2015).

Deforestation is happening all over the world. However, the vast majority occurs in tropical forests. By following environmentally based initiatives, forests can still be saved. The next generation, with a greater environmental conscience and ready to change things, could be the key to unlock the protection and preservation of the forests (BENNETTI, 2017).

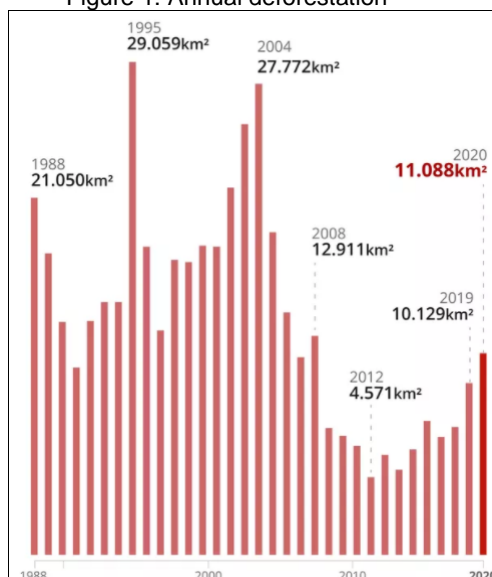
The significant decline in deforestation in the Amazon has been reversed since 2012. In 2015 and 2016 deforestation increased by 50% with respect to 2014 (ABRAMOVAY, 2019). The Decree nº 9578/2018 established the reduction of 80% in the annual deforestation rates, in relation to the average from 1996 to 2005, which is equivalent to 3,920 km<sup>2</sup> in 2020. However, the data from the Program PRODES/INPE program show that, in 2020, the deforested area was 11,088 km<sup>2</sup>, almost three times higher than the limit (figure 1).



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Figure 1: Annual deforestation



Source: PRODES/INPE – G1

Criminal organizations organize the logistics and take charge of the violence so often associated with illegal deforestation (ABRAMOVAY, 2019). Such groups use Bolsonaro's politics and declarations as a green light to destroy the forest and attack its defenders (BOLTON, 2020). The federal government has adopted policies of slackening laws and environmental monitoring (STRAGLIOTTO et al., 2020). The benevolence of the government signals to local players those illegal activities can be rewarding (ABRAMOVAY, 2019). The feeling of impunity is an incentive for illegal deforestation.

Any change in public policies in Brazil has a much greater potential impact positive or negative compared to other tropical countries (FEARNSIDE, 2017). Deforestation is the result of institutionalized tolerance and illegal practices, whose economic and social use is practically nil, and which compromises the future of the country (ABRAMOVAY, 2019).

The first phase of Archimedes Operation, launched on 14/12/2017, was prompted by a large number of containers of native Amazonian wood with irregularities in the origin, in the volume, in the identification of forest species and in the DOFs that regularized the transport of this of this wood.

With the deepening of the investigations, which culminated with the second phase of this operation, launched on 04/25/2019, it was proven that there was a criminal organization, which included forestry engineers, inspectors from the environmental management body (Institute of Environmental Protection Institute of Amazonas - IPAAM) and land grabbers<sup>1</sup> that legalized Amazonian timber extracted from public areas extracted from public areas (the patrimony of Brazilian society), sold them on the internal market and exported them to market of Europe, the USA and Asian countries.

<sup>1</sup> Land grabbers – people who use fraudulent documentation to legalize other people's land in their favor.



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Despite the large national production, Brazil does not stand out among the main exporters of sawn timber, which shows that most of the Brazilian production remains in the domestic market (STRAGLIOTTO et al., 2020). Criminal organizations responsible for timber trafficking often use adulterated forest licenses and documents to trade illegally acquired timber, even across jurisdictional boundaries (AZIZ, 2020). However, fraud in documentation cannot always be discovered and, therefore, it cannot be the only tool used by environmental agents and police officers in the work of uncovering criminal schemes that dominate the market for native Amazonian timber.

Deforestation has varied negative impacts on the environment (BENNETT, 2017). Illegal logging is a crime that has a multifaceted nature. One of the crimes of fraud that contributes to the increase of deforestation is the production of fraudulent forest inventories, where valuable noble woods are shown to be dominant regarding less desirable woods. As noted by PEREIRA (2020), nothing prevents the person responsible for executing the forest management plan from simulating wood list in the logging declarations, until the estimated volume foreseen in the authorization is reached.

Fraudulently produced forest credits are used to legalize timber extracted from unlicensed areas, conservation units, indigenous lands and unclaimed areas (SCHMITT, 2015). Vacant lands are lands not occupied by private individuals (REYDON et al., 2020). The inspection and investigation of the environmental licensing processes which generate these fictitious forest credits is the main action needed to stem the flood of fraudulent forest documents (DOFs and GFs).

There is no transparency in the circulation of these documents. The DOFs or GFs are issued and within a period of the two hours allowed by the system, the forestry documents can be cancelled, but after having been used to legalize the transport of forest products (sawn timber and logs), as detected during the investigations of Archimedes Operation and also in routine inspections. The access to the control systems (SISDOF and SISFLORA) by police officers is bureaucratic and difficult, which hinders the intervention of authorities and floods the internal and external markets with illegal timber.

A study conducted by CARDOSO and SOUZA Jr. (2020) showed that, of the total area logged without authorization, about 76% occurred in private areas, unclaimed or under dispute; another 17% in protected areas (Indigenous Lands and Conservation Units); and 8% in rural settlements.

BRANCALION et al., (2018) found that the deliberate overestimation of the commercial value of timber species at the time of conducting the forest inventory is a technique widely used to produce forest guides without backing, which are used to legalize high-value timber from unlicensed areas, such as the Ipê (*Handroanthus* spp.).

Environmental management agencies should select the targets to be surveyed by means of information intelligence in data analysis (PEREIRA, 2020). When suspicious information is detected after the analysis of environmental management agencies databases, steps should be taken immediately to ascertain the veracity of the facts.



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The inspection procedures contribute little to curb illegal logging, due to the large quantity of cargo being transported daily and the extensive network of roads and waterways in the Amazon. There is an intense trade in forest products, which are illegally generated through offences that occur at earlier stages of the timber production chain. One of the main cases of fraud is in the origin of wood credits, whether of a deforestation authorization for alternative land use (clear-cutting), or for forest exploitation through forest management (SCHMITT, 2015).

Police operations aimed at exposing fraud in environmental licensing processes are those that produce the best results, as shown by Operations Pharisaicos, Canafístula and Archimedes, carried out by the Federal Police. The investigations and forensic reports produced in these operations have sought principally to expose crimes committed in rural areas that served as the source of fictitious native timber log credits.

It is necessary that public forestry agents are able to recognize the incompatibility between the volume declared in the control system and the forest volume that was actually exploited. There is always the possibility that the volumes registered as exploited in the official forest control systems are deliberately inaccurate, that is, that they are overstated (PEREIRA, 2020). The overestimation of the volume provides the credits needed to exploit unlicensed forest areas, indigenous lands, and protected areas.

Volumetric fraud is only one of the frauds detected in forest exploitations in the Amazon. The name of Archimedes Operation comes from the immense volume of lumber that had to be examined (more than 700 containers in the ports of Manaus, Amazonas). Given the impossibility of measuring with a measuring tape, the Archimedes Principle was used, a methodology that proved to be very effective in determining the volumes of the timber loads in such conditions.

In this way, a good part of the wood extracted is covered up by fraudulent forest credits that end up legalizing its illicit origin, but that is difficult to detect when inspecting a cargo on a highway or river (SCHMITT, 2015). The inspections carried out during the transportation of wood in logs or sawn timber can only detect irregularities such as: forest species declared different from those transported, use of the transport document after the expiry date, incompatible routes, and divergence of volumes greater than 10% as stated in Article 53 of Normative Instruction (IN) 21/2014 - IBAMA.

There is negligence and absence of environmental agencies in the inspection of exploitation in the Amazon (PEREIRA, 2020). According to the Transparency Portal of the State of Amazonas (2021), IPAAM, in July 2021, had 90 environmental analysts in its staff. Thus, it is clear that there is no lack of environmental inspectors, but management of technical personnel.

At the State Secretary for the Environment of Pará (SEMAS/PA, 2021) the conditions are even worse. Public exams are held to fill vacancies for environmental management technicians on a temporary basis. There is no lasting attachment to the department.

Fraud occurs when the environmental authorities permit forest exploitation and there is excessive generation of wood credits per area unit ( $m^3$  of logs per hectare), from the authorization of credits from areas where there has already been exploitation to areas that will not be exploited, from





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public areas, of suspect land ownership, or by intentional error on the part of the public official of the environmental management body, when credits are entered into the computerized systems, producing DOFs and GFs without backing (SCHMITT, 2015).

Without the corrupt civil servants within the Brazilian environmental management agencies there are no means to produce fraudulent documentation that legalizes forest by-products from the forests. It is not possible to affirm that forest concessions for exploitation of public forests are free from fraud, since civil servants also participate in them.

However, PEREIRA (2020) found that, for the same number of trees harvested, the exploitation in the form of forest management in public forests presents lower volumetric yield than those of private forests, suggesting that the latter are a source of illegally extracted Amazonian timber. Virtual forest credits contaminate official forest control official forest control systems. This compromises the maintenance of the forest for future generations.

The official control of forest extraction does not reflect reality and the official data cannot be used as a basis for scientific studies regarding the current and future condition of the Amazon Forest. ABRAMOVAY (2019) states that current forest monitoring and control systems do not make it possible to guarantee the legal origin of the wood, since forest by-products are covered by legal documents, generating a false sense of legality.

There is great divergence between the data on timber production from native forests presented by the institutions and organizations responsible for their publication. A discrepancy in the values presented by the Brazilian Forest Service (SFB), the Brazilian Institute Geography and Statistics (IBGE) and the International Tropical Timber Organization (ITTO) is due to the difficulty of making these data available and also because of the procedure for collecting them, which should not be the same (STRAGLIOTTO et al., 2020).

Without the credibility of the data produced, there is no possibility of carrying out any type of planning, forecasting and management of timber resources, which leads to a knowledge vacuum in relation to the habitats already lost to deforestation.

Deforestation implies habitat loss, which results in species loss and thus, the loss of biodiversity (BENNETT, 2017). There is a pressing need for policies that target the main drivers of disturbance-induced biodiversity loss (BARLOW et al., 2016). Reducing the deforestation of the Amazon Forest has direct implications in the conservation of the enormous biodiversity present in this region, which still has great unexplored potential (STRAGLIOTTO et al., 2020).

Once habitats are lost on a large scale, it can be very difficult for local species to recover, especially endemic species, which are common in tropical forests, which is why such areas are called "hotspots" (BENNETT, 2017). The permission of deforestation of only 20% of each property in the Amazon Forest has not resulted in better development or quality of life for the region's inhabitants (MOUTINHO et al., 2016). The natural consequence is the loss of 20% of habitats as well as an unknown amount of biodiversity. In addition, the relationship between the humidity generated in the



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Amazon and rainfall in the center-south of the country, may compromise Brazilian grain crops in the medium term.

With changes in land use, the surface energy dynamics are modified. A forested surface has higher evapotranspiration rates compared to a surface covered by grasses (SWANN et al., 2015). Amazonian evapotranspiration is fundamental to the rainfall that ensures the viability of agriculture in south-central Brazil (ABRAMOVAY, 2019).

Dark forests are being replaced by relatively more reflective grasses. Changes in these properties lead to a change in absorbed solar radiation. Although a forested surface absorbs more sunlight causing warmer temperatures, water fluxes of a mature tropical forest are higher, providing more area for transpiration and access to water from a deeper root system (SWANN et al., 2015).

It is important to achieve the ambitious goal of zero deforestation in the next decade, but policies and actions are lacking. Political leaders and decision-makers must realize that socio-economic cannot be achieved without preserving the forest's capacity to generate ecosystem services. It is time to understand that preservation is easier and cheaper than restoration (MOUTINHO et al., 2016). The recent and much more frequent water crises is just one of the one of the consequences of the mistreatment of forests and water sources in one of the countries with the largest quantity of fresh water on the planet.

### 4.1 Challenges for the conservation of the Amazon Biome

Initiatives to conserve the Amazon must address both deforestation and forest disturbance. Measures to combat deforestation, help only to limit disturbance of the landscape. It is necessary to reduce the effects of landscape fragmentation through the zoning of development activities to ensure the conservation of large areas of forest remnants in all biogeographic zones (BARLOW et al., 2016). The forest must be approached in a broad and complex ecosystemic sense. The fragmentation of the Amazon Forest compromises the gene flow and consequently its existence. Orbital images prove the intense fragmentation of the Amazon biome.

The cross-referencing of processed satellite images with official data is also an important mechanism for rapid detection and control of inconsistencies in management plans. Such tools allow to identify potential failures in environmental control systems, weakening possible fraud schemes (CARDOSO; SOUZA JR., 2020). With labour becoming more expensive, the use of the most modern technologies of the Geographical Information Systems (GIS) allows good results in combating illegal logging.

There is, however, damage caused by illegal selective logging and fraudulent forest management which in many occasions cannot be detected through orbital images. Even if there is no clear-cutting of the forest, the exploitation that targets only the most valuable species is creating another type of forest, which can only be known through on-site inspections.

Little is known about the different dynamics in terms of losses and causes of different forest types at sub-national levels. The implementation of deforestation monitoring systems is an excellent



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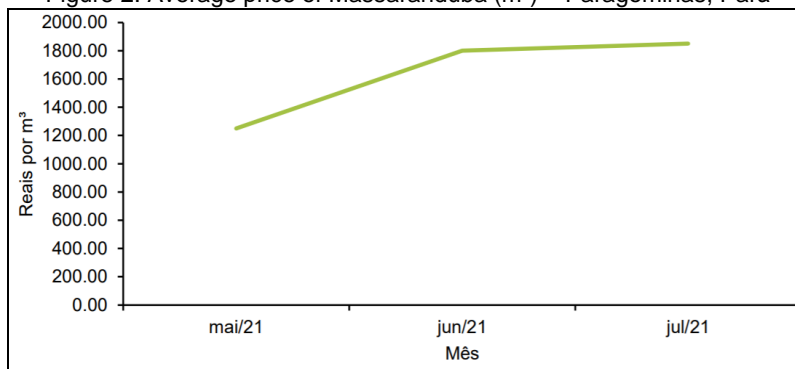
tool (ARMENTERAS et al., 2017). In the case of the Amazon, in addition to the annual impact, the vast extent of remaining forest gives additional importance to the deforestation processes because these can result in much higher future GHG emissions. However, in countries where little forest remains, deforestation will decline and end soon, regardless of policy changes (FEARNSIDE, 2017).

Investment in forest restoration can improve connectivity and protect remaining forests from edge effects (BARLOW et al., 2016). The connectedness of forest fragments, besides increasing the protection to fauna, favours the exchange of genetic material and, therefore assists in the conservation of the Amazon Forest, at a time when solutions are being sought for the cancer of illegal deforestation of the Amazon biome.

Many companies are trying to make commitments to remove deforestation from their commodity supply chains. Current international initiatives are underpinned by the assumption that having access to finance and markets will motivate action to not deforest, but this assumption remains largely untested (SEYMOUR; HARRIS, 2019).

This solution, however, comes up against the high prices reached for tropical hardwoods since the beginning of this century. In the deforestation of the Amazon Forest, the high prices of hardwoods Ipê (*Handroanthus* spp.) and Massaranduba (*Manilkara huberi*) capitalize the exploiter, as revealed in the CEPEA bulletin - Forest Sector (2021); the price per cubic meter of logs of Massaranduba reached R\$ 1,800.00 (U\$ 348.00) in July/2021 (figure 2).

Figure 2: Average price of Massaranduba (m<sup>3</sup>) – Paragominas, Pará



Source: CEPEA bulletin (2021)

When evaluating only trees with DAP (diameter at 1.30 m from the ground)  $\geq 45$  cm, the volume of this species can vary from 2.72 m<sup>3</sup>/hectare (HIRAI; PINHEIRO, 2008) to 13.62 m<sup>3</sup>/hectare (BARROS et al., 2000). Considering the average of 8.17 m<sup>3</sup>/hectare of Massaranduba, and the value per cubic meter of the other species at R\$ 725.00 (U\$ 140.00), as determined by Decree n° 52/2018 - SEFAZ/MT, we see that for an average productivity of 121 cubic meters/hectare (ANDRADE et al., 2015), the gross income per deforested hectare would be R\$ 96,507.00 (U\$ 18,666.00).



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Criminal organizations take advantage of the large volume of financial resources that generate to carry out money laundering by concealing and disguising the wood from illegal deforestation, as proven by breache of tax secrecy during Archimedes Operation. This indicates that it is not enough just to make a large financial and human investment to achieve the reduction of annual rates of illegal deforestation.

Hence, reducing forest loss rates requires a thorough understanding of the local causes of change under varying conditions (ARMENTERAS et al., 2017). The forest cover of the Brazilian Amazon biome occupies almost 356.3 million hectares or 68.93% of the natural forest in Brazil. Within and around this space there are complex interactions of organisms and physical factors, which produce an ecological dynamic and interdependent ecosystem services in nature (AGUIAR, 2016). Therefore, the treatment given to each distinct region of the Amazon requires knowledge of the region. One cannot think of the Amazon Forest without considering the natural variations in climate, soil and forest species.

One of the options proposed by FEARNSIDE (2017) for reducing the loss of environmental resources is to maximize the creation of new protected areas. This is necessary to get larger areas larger areas before the opportunity to do so is excluded. However, ABRAMOVAY (2019) argues that the expansion of protected areas was not accompanied by public policies that would guarantee their integrity and, therefore, the ecosystem services that justify their protection, but was accompanied by illegal land grabbing and logging.

Protected areas represent a symbolic government presence, with a significant effect on inhibiting deforestation because their legal conditions decreases the likelihood of encroachers succeeding in obtaining land titles in the future (FEARNSIDE, 2017). This mechanism has already been used by the Brazilian government in the last century, but these areas have become the new targets of illegal extractors (including deed-falsifiers), due to the reduction of timber in private areas.

The historical pattern of deforestation has changed over time, creating additional difficulties for control measures. While the 1990-2005 period involved deforested areas (>100 ha) for the establishment of pastures on private lands, it is now often characterized as occurring in small (<50 ha) and fragmented areas, mainly on public lands. Deforestation is increasing in these areas, so in addition to the inherent evils, illegal deforestation is still being used to "legitimize" unclaimed land and profit from the increased price of deforested land. (MOUTINHO et al., 2016).

The factors that lead to the invasion of these areas include the absence of a firm policy in relation to the exploitation of protected areas. These areas may have the same end that its surrounding areas, without any social benefits being achieved. It is only necessary to enforce environmental and land legislation, without the loosening of the existing legal framework.

Different forest types are affected by different factors, and this knowledge is crucial in developing policies to address forest loss in each of them (ARMENTERAS et al., 2017). Hence the need for a holistic approach to the causes and solutions related to the deforestation of the Amazon forest. Drier areas allow for better road conservation and the implementation of agriculture in those



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areas that have more fertile soils. As Amazonian soils are very weathered and poor, pastures become the preferred path for invaders. ABRAMOVAY (2019) wrote that the pastures are of very low productivity, with less than one head/hectare.

Franca & Mendonça (2016) state that, due to its great extension, the spatial distribution of rainfall in the Amazon region displays heterogeneity. In general, the analyses allow us to conclude that the extreme north of the Southern Amazon is characterized by huge volume of annual precipitation and a less prominent dry season. In its southernmost region, and in its eastern and western extremities, the annual rainfall volume is lower.

The relationship between deforestation and dry season intensity may be confused by other non-random factors. Deforestation is mainly concentrated in the drier regions of the southern and eastern Brazilian Amazon. This region is not only naturally drier than the mid-western part, but it also has more infrastructure. Deforestation increases in years with a more intense dry season. On average, the conversion of one hectare of forest to cropland would cause a reduction of 0.5 million litres per year of evaporated water that subsequently falls on Amazon during a dry season (i.e. during the months when evapotranspiration exceeds precipitation). The feedback between drought and deforestation has increasingly impacted the dynamics of this important ecosystem (STAAL et al., 2020). In this way climate also influences annual deforestation rates, it is a factor to be considered when prevention measures are applied.

Pastures are related to the loss of 71.2% of forest areas and with 71.6% of the forest carbon losses in South America, followed by commercial agriculture that contributed 14% of deforested areas and 12.1% of forest carbon losses (DE SY et al., 2015). These pastures receive no fertilizers or cultural treatments, as they serve only to guarantee possession of the land.

Commercial agriculture proportionally contributed more to the loss of forest area than of forest carbon, indicating that this land use as well as reforestation occurred more in ecological zones of low forest biomass in comparison with pastures (DE SY et al., 2015), i.e. agriculture is concentrated in the Cerrado biome (Savannah) areas. For this reason, the Amazon is not known for extensive soybean plantations in exploited areas, but for degraded pastures with low livestock capacity.

In the soya bean production comparison elaborated by Canal Rural (2020) it is possible to see that the Amazonian states that produce the most soya are Rondônia and Pará, which contributed only 2.5% of the 2018/2019 harvest (figure 3). It is necessary to relativize production in Mato Grosso, where, according to the State Secretariat for Economic Development - SEDEC (2021) about 35% of the soya bean produced comes from the Amazon biome area, which yet makes this state the largest soybean producer state in the Amazon Forest. Therefore, it is possible to conclude that around 12% of the soya produced in Brazil is of Amazonian origin.



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Figure 3: Comparison of soybean production by region.

Comparativo de produção de soja			
REGIÃO/UF	PRODUÇÃO (Em mil toneladas)		
	Safra 18/19	fev/20	jan/20
<b>NORTE</b>	5.924,8	6.380,1	6.352,4
RO	1.109,2	1.138,6	1.138,6
PA	1.708,9	1.809,4	1.769,2
TO	2.931,5	3.238,9	3.253,2
<b>NORDESTE</b>	10.553,4	10.979,0	10.811,0
MA	2.917,7	3.074,7	3.029,9
PI	2.322,1	2.380,1	2.478,9
BA	5.309,1	5.520,0	5.298,0
<b>CENTRO-OESTE</b>	52.637,5	56.531,0	55.209,0
MT	32.454,5	34.214,0	33.406,5
MS	8.504,0	10.002,9	9.492,4
GO	11.437,4	12.053,3	12.053,3
<b>SUDESTE</b>	8.091,8	8.971,4	9.078,3
MG	5.074,3	5.299,2	5.410,4
SP	3.017,5	3.672,2	3.667,9
<b>SUL</b>	37.822,4	40.388,4	40.774,5
PR	16.252,7	19.908,8	19.740,1
SC	2.382,6	2.426,0	2.426,0
RS	19.187,1	18.053,6	18.608,4
<b>BRASIL</b>	115.029,9	123.249,9	122.225,2

Source: Canal Rural (2020)

One of the ways to curb illegal deforestation is the certification of sustainable products originating from the Amazon Forest; both products obtained from extractivism and those that respect environmental legislation. Thus, purchasing countries could tighten local legislation on products whose origin can be linked to illegal deforestation.

Products with sustainability certificates do not yet promote substantial increases in market prices. Corporate commitments have not yet been translated into political pressure to change high rates of deforestation. For rainforest protection to become a viable policy proposal financial and market incentives must be expanded to promote greater awareness of the many benefits that forests offer, both locally and globally (SEYMOUR; HARRIS, 2019).

The low performance of breakdown of logwood for producing sawn lumber, due to low technological investment and unskilled labour, combined with illegal commercialization, is a cause for concern, since more than half of the logs are not used. The low yield in sawn wood increases the amount of residues. Most of the waste produced is not consciously made use of, which leads to serious environmental damage and reduced profits for companies. The higher the yield, the smaller the area to be exploited. Sawn timber and processed wood, when exported, is generally in the form of products with low aggregate value. Thus, investment in furniture industries to add value to pieces of sawn lumber in the country is a key point to promote the progress of the timber sector (STRAGLIOTTO et al., 2020).

Programs to foster science and technology aimed at the exploitation of timber, fish and biodiversity resources should be a government priority, as a way of protecting forests and for social and economic return. The shift from a culture of exploitation to a culture of sustainability has become a global necessity.

Giving a very broad meaning to the concept of cultural civilization, as being a civilization not strongly governed by the economy, we suggest that only civilizations able to change from an



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economic to a "cultural" society in a timely manner, can survive (BOLOGNA; AQUINO, 2020). Macroeconomic changes can be produced in a short period of time, while cultural changes require at least a generation. ABRAMOVAY (2019) states that reducing deforestation does not lead to reduced production.

Less industrialized countries are highly vulnerable to the impacts of climate change, and, in addition, degradation is a growing challenge. Population density negatively influences the forested area. Therefore, there is a strong need to revisit the policies related to population indicators (AHMED et al., 2015). To tolerate the continuity of deforestation for supposedly social reasons is to perpetuate predatory activities, often illegal and associated with degrading working conditions (ABRAMOVAY, 2019).

The employment generated by illegal forest exploitation in the Amazon has all the characteristics of illegality and it could not be otherwise. Organized crime takes advantage of the absence of the State to exploit local labour, ill-prepared, without prospects and, therefore, without any claiming power.

Other countries with tropical forest areas can serve as a basis for reflection on the future of the Amazon Forest. MIYAMOTO (2020) reveals that in Indonesia poverty levels in Indonesia have remained high following the conversion of native forests to agricultural areas. In this country deforestation was high when these three conditions were met: high poverty rate, high agricultural income and high forest cover.

It is not realistic to think that the population decline in a situation of strong environmental degradation would be a non-chaotic and well-ordered decline (BOLOGNA; AQUINO, 2020). There still remains about 80% of the Amazon Biome in Brazil; it is still possible to reverse a chaotic situation of proportions that are still immeasurable, by means of political measures based on scientific knowledge. MIYAMOTO (2020) stated that deforestation slowed down in Malaysia when poverty by itself was removed. The most common strategies for reducing deforestation are policies that limit these activities directly, including land use zoning, protected areas and moratoria.

### 4.2 Land Governance

The protection of Amazonian lands is urgent, as they are not legally delineated and become the object of the action of land grabbers and deforesters (ABRAMOVAY, 2019). In the fight against illegal extraction of Amazon wood, legal instruments alone are not enough, but their use should be considered. There must be sufficient means of personnel, infrastructure, and financial resources, with the right strategy for action.

Deforestation in the Amazon is an economic activity that generate income and legitimize the occupation of new owners in the short term, principally creating the expectation that there will be demand for land, provoking a substantial rise in the price (AGUIAR, 2016). In this region, there are different interests involving occupation, access to and permanence on the land. The war that the



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traditional populations wage on a daily basis with loggers, cattle ranchers and large projects in the Amazon reaches alarming proportions (OLIVEIRA; BENATTI, 2016).

The limitations in knowledge and effective control over land ownership and use is still a major problem, especially considering the impacts resulting from illegal land use in the deforestation of the Amazon region. Many of today's institutional deficiencies were inherited from the Brazilian state's historical ineptitude with regard to land governance. Thus, it has not been possible to map all private lands and the registration of these lands have always been open to contestation by private occupants (REYDON et al., 2020).

The peoples of the forest, or Amazonians, have historically been characterized as occupants without rights to any titles or legal guarantees of ownership, in conditions of extreme vulnerability, in a period of great tension and under the gaze of the large landowners and external policies for Amazonia. In many hypotheses they were seen only as cheap labour (OLIVEIRA; BENATTI, 2016), as evidenced by operations Psalm 96:12 and Archimedes, conducted by the Federal Police. Land irregularities are not an impediment to deforesting the Amazon that occurs with the endorsement of the state environmental management bodies.

The institutionalization of the Public Land Registry in 1900 was the main step towards the creation of the property registration system that prevails to this day. This decision stated that all land users should demarcate and register their rural or urban properties, although they did not have to establish any formal auditing procedures (REYDON et al., 2020). There are diverse realities regarding the fragility of the maintenance of public use of public lands, whether by question of misappropriation or irregular appropriation, as well as the permission of transfer of public lands for private uses (MOREIRA, 2017). The transfer of public land in this case needs to comply with several norms that are either neglected or masked by the use of fraudulent documentation.

The state would also need to demarcate and register its unclaimed lands, but in reality, these lands are defined by a process of elimination. Consequently, the state itself is acting illegally by not comprehensively registering its own lands. This lack of registration has the effect of increasing the possibility of fraud in registry offices (REYDON et al., 2020). The deforestation of the Amazon is intrinsically linked to the problematic land situation. However, many parliamentarians act to protect the land grabbers and environmental criminals.

The model currently adopted is atomized, that is, formed by watertight units. The mostly records are physical and not interconnected with databases that enable a mass response to a particular request for information (ASSAD, 2016). A spatial compartmentalization is, in many cases, the result of logic and pressure of social and political groups in different historical periods, which accentuates the current challenge of land management (FONSECA et al., 2016).

The Brazilian state is acutely aware of its inability to regulate land use, including the dysfunctionality of its land registry. The National Institute for Colonization and Agrarian Reform (INCRA) was created in 1970, but there is no single institution that centralizes the registration of





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properties or establishes links with the judiciary bodies responsible for property rights (REYDON et al., 2020).

There is dispersion of data, as each government agency (INCRA, FUNAI, MMA, for example) is responsible for organizing and managing its own database and, in this process, intrinsic peculiarities to the internal management of each body are observed. Several aspects regarding the availability, quality and accuracy of data still need to be overcome (FONSECA et al., 2016). The centralization and transparency of land databases would bring more institutional security and would weaken crimes of land grabbing.

Law nº 13097/2015 brought important changes to the Brazilian land registry, with potential gains for legal certainty and land governance, by introducing the principle of public-faith registration, more effectively protecting persons who acquire rights by relying on the information contained in the registry and increasing the reliability of the information provided for the public by the registry. However, it is still not possible to affirm that the information offered by the land registry be fully reliable (LAGO, 2016).

This type of problem also occurs with the Rural Environmental Register (CAR), but it is more useful to have some kind of information, which can be audited, than to remain in obscurity and insecurity. Oliveira & Benatti (2016) state that the current context is one of extreme land insecurity and this involves conflicts of interest regarding the occupation of lands in the Amazon.

Moutinho et al., (2016) predict that when fully implemented, the CAR will represent a powerful tool to prevent illegal deforestation. Reydon et al., (2020) state that the Brazilian government has been forced to take steps to improve land governance. One of them was the creation of the CAR, under the auspices of the Brazilian Forest Code, with the intention of obliging owners to geo-reference their properties in order to identify them as well as their owners.

The SINTER - Integrated Territorial System, established by Decree 8764/2016, came with the purpose of centralizing land information in a single database, but its objective remains inapplicable. It is possible to create a multi-foundation cadastre, integrating the SINTER with the Brazilian Registry System. This registry could be made available to the real estate registry office by electronic means, making the contents public (BARBOSA, 2017). Paragraph 1 of Article 8 of Decree nº 8764/2017 reads that:

Art. 8 SINTER will aggregate registry, cadastre, fiscal and geospatial information from agencies and entities of the direct and indirect public administration of the Union, the States, the Federal District and the Municipalities, public registry services and public registry services and private-law legal entities.

§ 1 Each property shall have a unique identifier at national level, with a structure specified in the Operational Manual.

There are sectors within government agencies that have proven themselves capable of developing innovative ways to curb illegality and land grabbing, which is remarkable and should be strengthened. The state must develop and implement effective policies to ensure reasonable governance over its own lands and, through these policies, reduce fraud and land grabbing. The



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Brazilian government has made slow progress in enforcing the rule of law over its own lands (REYDON et al., 2020).

The real estate cadastre is an inventory, a set of information needed by the State for the pursuit of a certain activity or interest. The register is responsible for the physical determination of the property. The registration is responsible for the legal determination of the rights over the property. It is the competence of the judiciary to issue general rules, of eminently technical nature, regulating the notarial and registry activity (ASSAD, 2016).

The legal possibility of regularizing the possession of vacant land has existed in Brazil for centuries. In addition to special adverse possession, which establishes that the squatter can regularize his property after a variable period of time, the federation units themselves occasionally guarantee ownership with or without title deeds. These informal or semi-formal niches are one of the historical factors that have made it almost impossible to establish an effective cadastre that would ideally allow for defining, registering and permitting the use of unclaimed lands through agrarian policies (REYDON et al., 2020).

The federal government's Agro-extractive Settlement Projects (PAE) were areas of public forests designated for agrarian reform purposes. The State transferred the responsibility of conserving natural resources to the occupants, but it has not provided sufficient conditions for the rules to be respected. In the same way, in the Conservation Units (UCs), called Extractive Reserves (RESEX), management plans take time to be approved or do not contemplate all the demands of the extractivists, generating conflicts of management resources (OLIVEIRA; BENATTI, 2016). The rural settlement initially needs technical support and infrastructure resources for the settlers. Without such elements, they deforest in search of profits from timber and make extensive, low-income livestock farming their means of subsistence.

The areas allocated to UCs, Indigenous Lands (T. I.), Rural Settlements and Quilombola Territories are considered assigned lands. They occupy more than 300 million hectares, which is larger than Argentina's 278 million hectares. This shows its relevance in the context of Brazilian land planning and the enormous collective interest in constituting reliable cadasters and consistent databases (FONSECA et al., 2016). These areas are veritable ramparts for the conservation of the forest and biodiversity, which are beginning to be cut down as a result of the advance of deforestation and land grabbing.

Over the years, conflicts in rural areas have intensified and taken on new faces and proportions, marked as much by land grabbing as by the devastating exploitation of Amazonian territories. The main issue is the land disorganization and the fight for land (OLIVEIRA; BENATTI, 2016).

We are at a turning point, of a gradual abandonment of techniques historically employed for the adoption of electronic database systems. For the development of a registration system that effectively guarantees the legal security of property, the next step is to develop an electronic land registry system in Brazil. The opaqueness of the reality of land ownership urgently requires interaction



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between registry and cadastre, in addition to the development of legal security institutions. It is necessary to operate with existing technologies such as digital certificates, mass processing of data and repositories of data and images (ASSAD, 2016).

A consistent and up-to-date database represents an important tool for land governance. Being public and available to the whole society, it would allow not only the technical basis for new decisions, decrees and governmental acts, as well as an effective collective participation in the formulation and implementation of public policies directed to the use and occupation of the Brazilian territory (FONSECA et al., 2016).

A large proportion of agrarian problems that are not resolved in the administrative level, end up in court. These cases usually take years to prosecute. In the deforestation of the Amazon the biggest problem is associated with Brazil's weak system of land governance in Brazil, which is the result of a historical process that led to legal inadequacy. Only with land governance and the implementation of a legal framework will it be possible to reduce deforestation and use the land appropriately. Insecure property rights, especially on public lands, result in land grabbing and deforestation (REYDON et al., 2020).

In view of this role of land as a speculative asset, being responsible for generating profits even when not used for productive purposes, quality land governance is fundamental to ensure market functionality and guarantee property rights (FELÍCIO et al., 2016). Land stripped of the social factors that shape it is that which could be commercialized. When land becomes a territory for maintaining the culture and autonomy of a social group, it leaves the market (OLIVEIRA; BENATTI, 2016).

### 5. FINAL CONSIDERATIONS

It is possible to state that the destruction of the Amazon Forest without even a little knowledge about it is proof that the Brazilian development path for this region is mistaken. The Archimedes Operation was able to show that although most of the wood that is commercialized internally and the wood that is exported are accompanied by the proper documentation, the fraud that has been taking place since the illegal occupation of the land and that continues with the frauds in the documents and inspections, indicate that we are only legalizing illegal actions. With this, the Brazilian and foreign society believe that are enjoying tropical wood exploited in a sustainable way, but in reality, we are all accomplices to these crimes, either by omission or by ignorance of the reality.

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