

AMAZON IN FLAMES: THE NEW AND ALARMING LEVEL OF DEFORESTATION IN THE AMAZON

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Introduction

Deforestation of forests in the Amazon has reached a new and alarming level in the last three years. The loss of forest between 2019 and 2021 exceeded 10,000 km² per year, a number 56.6% higher than the annual average of the previous period - 2016 to 2018. This increase reflects the elections of that year, which acted as a stimulus for the advance of forest clearing, corroborating the positive relationship between elections and deforestation (Rodrigues-Filho et al 2015). From that moment on, political and legislative facts resulted in the current fragility of the policies and institutions responsible for the environmental agenda, for command and control actions, mainly, in the federal sphere (Escobar 2019; Artaxo 2019). The increase in deforestation in the Amazon has been favored by measures such as: the weakening of environmental governance, resulting from budget cuts in the institutions responsible for enforcement; the replacement of directors and successful Ibama (Brazilian Institute of the Environment and Renewable Natural Resources) operation chiefs; changes in the process of charging and easing penalties for environmental violators; demobilization of instances of governance

Summary

- Annual deforestation from 2019 to 2021 was 56.6% higher than between 2016 and 2018 in the Amazon biome;
- Public lands concentrated 51% of deforestation in the last three-year period, 83% of these being federal domain;
- Undesignated Public Forests add up to almost 1/3 of the total deforested between 2019 and 2021;
- Deforestation in Protected Areas rose 80%, with Indigenous Lands having the greatest proportional increase (153%) and Conservation Units having a 63.7% increase;
- Amazonas surpassed Mato Grosso as the second state that deforests the most, Pará has remained at the top since 2017;
- Acre and Roraima had the largest increase between triennials: 104% and 122%. They were the ones that lost the most forest proportionally in 2021.

and social participation in public policies; and institutional disarticulation in command and control operations as a result of the empowerment of the Brazilian Army to carry out enforcement (Abessa et al 2019; Rajão et al. 2021; Lopes et al. 2021; Kleinschmit et al. 2021).

The destructuring of the environmental governance apparatus that has occurred since 2019 has influenced the increase in deforestation as a whole, both on private lands (rural properties and plots in rural settlements) and on public lands, especially in land categories with less restrictive protection (EPAs) and those without any destination. More than half of deforestation is occurring on public lands (Fellows et al. 2021; Alencar et al. 2021; Salomão et al. 2021). This deforestation in the Amazon, generally speculative for the purpose of illegal land grabbing, is the largest cause of forest loss in the region as of 2019 (Alencar et al. 2020). The main targets of land speculators have been the Federal Government's Undesignated Public Forests, with strong evidence of land grabbing and interest in illegal logging (Azevedo-Ramos et al. 2021; Alencar et al. 2021).

Although a considerable portion of deforestation is located on public lands, especially federal lands, environmental governance in the Amazon lacks action at all federal and private levels. The responsibilities of the federal, state and municipal governments, as well as the private sector in decision making for land use both in public and private lands, are fundamental for better planning and prioritization of command and control actions, starting with the most critical areas that demand urgent action. To this end, it is

necessary to understand the geographical distribution of deforestation in the main land tenure categories in order to be able to contribute, effectively and efficiently, to overcoming the current context of loss of this natural heritage.

In this technical note, we detail the places where deforestation has occurred in the last six years, focusing on a “before and after” change by the federal government, according to the different land categories in the Amazon biome.

By land categories we mean the distinct types of areas considered of public use and domain or of private use. The analyses were made using data from the annual PRODES program (Project for Monitoring Deforestation in the Legal Amazon by Satellite), of Inpe (National Institute for Space Research), in order to indicate which are the main focuses of attention of the States of the Amazon biome to combat deforestation, besides pointing out critical areas in which command and control actions should be intensified.

Method

The dynamics of forest cover loss by land tenure category by State was evaluated for the Amazon biome using the PRODES deforestation polygons for the period 2015/2016 to 2020/2021 (Inpe 2021). These polygons represent the gross area of deforestation, or forest suppression (when there is a cutting permit), mapped annually between the months of August of the previous year and July of the following year, and are available on the platform TerraBrasilis (www.terrabrasilis.gov.br).



The data were analyzed taking into account the triennium 2016-2018 (August 2015 to July 2018) and the triennium 2019-2021 (August 2018 to July 2021). For practical purposes, we use the PRODES reference year for each annual period analyzed: when we cite 2019 deforestation, for example, the reference is for the interval between August 2018 and July 2019, or 2018/2019. The raw data made available by PRODES present a minimum detectable area of 6.5 hectares and were circumscribed to the Amazon biome, therefore, **do not include areas in the states of Mato Grosso, Tocantins and Maranhão, which are part of the Cerrado biome, nor do they account for deforestation in types of non-forest native vegetation.**

There is a difference between the raw deforestation data (deforestation polygons) used in this study and the annual deforestation rate published by Inpe. This difference is due to statistical adjustments that seek to compensate for the lack of monitored area due to the presence of clouds in the calculations of the annual deforestation rate (Câmara et al. 2006).

We then combined the deforestation data with the main landholding categories, grouped according to dominiality (whether there is public or private use/management in areas affected by deforestation) and administrative competence (whether they are federal or state areas). Among the landholding categories classified as private use are the areas of rural properties that make up the set of polygons of properties registered in 2021 in the SIGEF (Land Management System), of INCRA (National Institute of Colonization and Agrarian Reform), and in

the REC (Rural Environmental Cadastre), by Sicar (National Rural Environmental Cadastre System) and by SFB (Brazilian Forestry Service), also in 2021. The rural settlements, despite having public domain, were considered in the category of private land use for this analysis.

In the case of public use, the categories were divided between Protected Areas (Indigenous Lands and Conservation Units¹), defined by Funai (National Indian Foundation) and ICMBio (Chico Mendes Institute for Biodiversity Conservation) database; and Undesignated Public Forests, of the SFB's National Forest Register in 2021, and Other Undesignated Public Lands (Salomão et al. 2021). Areas of public use were differentiated between federal, state and municipal domains, with the deforested area being calculated for each state only for the state portion present within the Amazon biome. Areas related to quilombola territories approved by INCRA were not included in the analysis because they represent a small proportion of deforestation (0.05%) in the biome over the average of the last six years.

Results

Deforestation by land tenure category

In the 2019-2021 triennium, deforestation in the Amazon biome increased by an average of 56.6% over previous years, consolidating a new level of destruction in the region. Deforestation above double digits (more than 10,000 km² per year) had not occurred since 2008 (Figure 1). According to the raw deforestation data provided by Inpe, 32,740 km² of forests were converted in the region,

1. According to the delimitation of the National System of Conservation Units - SNUC, MMA. Available at: <https://antigo.mma.gov.br/areas-protegidas/unidades-de-conservacao/sistema-nacional-de-ucs-snuc.html>

Private or public use	Category 1	Category 2	Domain	Source
Private use	Rural properties	Rural properties		SIGEF (INCRA 2021); CAR (SFB 2021)
	Settlements	Rural settlements	State/Municipal	(INCRA 2021)
			Federal	(INCRA 2021)
Public use	Protected areas	ILs (Indigenous lands)	Federal	(FUNAI 2021)
		CUs (Conservation Units)	State/Municipal	(ICMBio 2021)
			Federal	(ICMBio 2021)
	Undesignated Public Lands	FPNDs (Undesignated Public Forests)	State/Municipal	National Forest Cadastre (SFB 2021)
			Federal	National Forest Cadastre (SFB 2021)
		OTPNds (Other Undesignated Public Lands)	State/Municipal	(INCRA 2021)
			Federal	(INCRA 2021)

Table 1.: Land categorization used in data analysis.

against 20,911 km² in the three-year period 2016-2018. Among the most affected areas in the last triennium were public lands, which accounted for more than half (on average 51%) of deforestation in the biome (Figure 1). On average, 5,550 km² of forest were lost in public lands per year in the period, of which 1,617 km²/year (29%) were in Protected Areas such as Conservation Units (CU) and Indigenous Lands (IL); and 3,933 km²/year (71%) in Undesignated Public Lands, such as Undesignated Public Forests (FPNDs)² and Other Undesignated Public Lands without cadastral information (OTPNds).

Deforestation on Undesignated Public Lands reached an area 78% larger than the sum of the area deforested in the previous three years. A total of 11,800 km² were cut between 2019 and 2021, against 6,637 km² of forest converted between 2016 and 2018 (Figure 1). Protected Areas experienced

an 80% increase in deforestation between the previous and the last three-year period, going from an accumulated 2,691 km² of forest cut to 4,850 km². This percentage of increase was 153% on average in Indigenous Lands (ILs) and 63.7% in Conservation Units (CUs), with ILs showing the greatest proportional increase in deforestation in relation to all categories (Annex 1). On public lands, the FPNDs are the most devastated category: in the last year of analysis they concentrated 30% of the area deforested in the biome (Figure 1).

When analyzing deforestation data on public lands of federal or state domain, it is clear that forest clearing has happened mainly on federal public lands: these concentrate 83% of the deforestation that occurred in the biome in the last three years in the public land category (Figure 2). Deforestation on federal public lands increased mainly

2. Undesignated Public Forests occur on lands collected by the Federal Government or by the States, registered in the National Registry of Public Forests. <https://www.florestal.gov.br/cadastro-nacional-de-florestas-publicas>

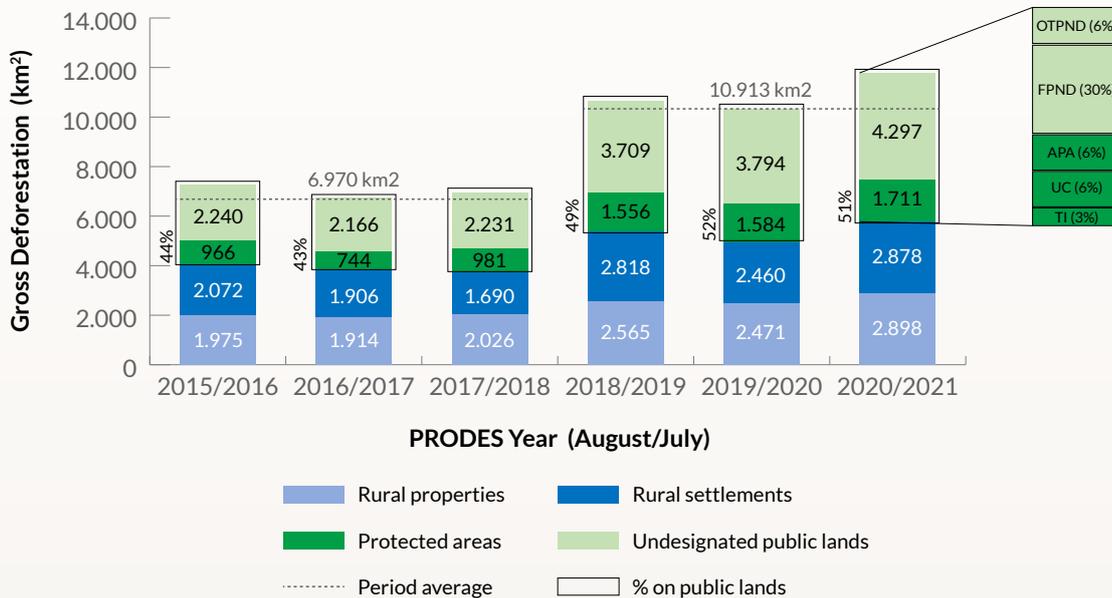


Figure 1. Area of gross deforestation by land tenure category in the Amazon biome in the last six years. Highlight for the distribution of deforestation on public lands in 2020/2021, including Protected Areas (ILs - Indigenous Lands and CUs - Conservation Units) and the types of Undesignated Public Lands (FNPDs - Undesignated Public Forests and OTPNDs - Other Undesignated Public Lands).

in FPNs as of 2018/2019 (Figure 2), in which the increase in deforestation in the comparison between the three-year periods reached 85% - going from 1,743 km² per year between 2016 and 2018 to more than 3,228 km² per year between 2019 and 2021. There was also an increase between the periods, although to a lesser extent, in deforestation in ILs, PAs, and OTPNDs (Figure 2). Noteworthy is the increase in deforestation in CUs of the EPA (Environmental Protection Areas) type, that concentrated, on average, 48% of the deforestation of the category of Conservation Units in the last triennium. EPAs were also the only category that registered a greater quantity of deforested area in areas of state domain than federal (Figure 2).

Although ILs still continue at a higher level of deforestation in the comparison between the three-year periods analyzed, this cate-

gory was the only one where there was an annual reduction in forest conversion from 2019 to 2021. Deforestation increased in all other land categories over the period.

Deforestation in the Amazon States

To evaluate deforestation in the Amazon in the last six years it is important to understand how deforestation has behaved in the states that are part of the biome. According to the gross deforestation data provided by Inpe, in the triennium 2019-2021, **Pará** concentrated 43% of deforestation in the biome, followed by **Amazonas** (18%), **Mato Grosso** (16%) and **Rondônia** (13%). States such as **Acre** (7%), **Roraima** (2%), **Maranhão** (1%), **Amapá** (0.03%) and **Tocantins** (0.03%) together accounted for 11% of deforestation in the biome. Of these, Acre is the one that lost

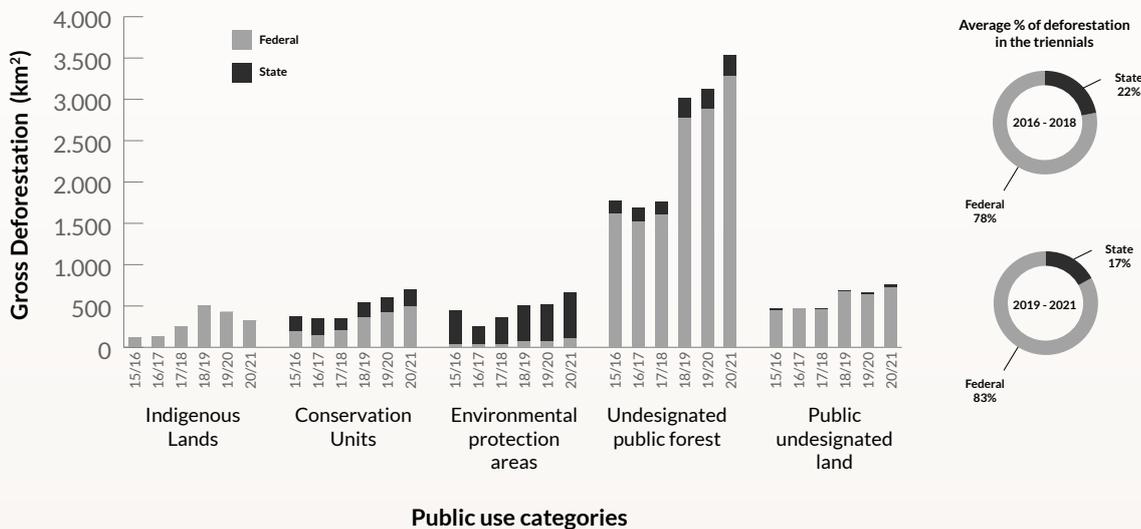


Figure 2. Annual deforestation in the main public use land categories by federal or state domain in the 2016-2018 and 2019-2021 trienniums. *Source: IPAM with PRODES data.*

the most forest area in proportional terms to its territory, and, along with **Roraima**, had the most significant increases in average annual area deforested among the three-year period analyzed. It is worth emphasizing again that the States of **Mato Grosso**, **Maranhão** and Tocantins only had the portion of their territory belonging to the Amazon biome analyzed, and that PRODES Amazon does not consider the mapping of deforestation in areas of non-forested vegetation such as campinaranas, grasslands and other types of savanna or grassland vegetation, as it occurs most prominently in the States of **Amapá** and **Roraima**.

In **Mato Grosso**, rural properties in the forest portion comprised 40% of deforestation of all rural properties in the Amazon, a figure similar to the proportion of this category in the biome (Figure 3A).

In **Pará**, rural settlements, Protected Areas and Undesignated Public Lands accounted for most of the deforestation in the respective landholding categories in the biome in 2020/2021 (Figure 3). Rural settlements in Pará, which represent 40% of the area destined for settlements in the Amazon, concentrated almost half (48%) of deforestation in this land tenure category, followed by the settlements in **Amazonas** (21%), especially those located in the south of the State, along the Transamazon highway and the BR-319 highway (Figure 3B and Figure 4). The Protected Areas in **Pará** are those that suffered most from deforestation in 2020/2021, concentrating 72% of the category's deforestation in the entire biome, with a focus on Conservation Units and Indigenous Lands in the Terra do Meio region and along the BR-163 highway, in the southwest of the state (Figure 3C and Figure 4).

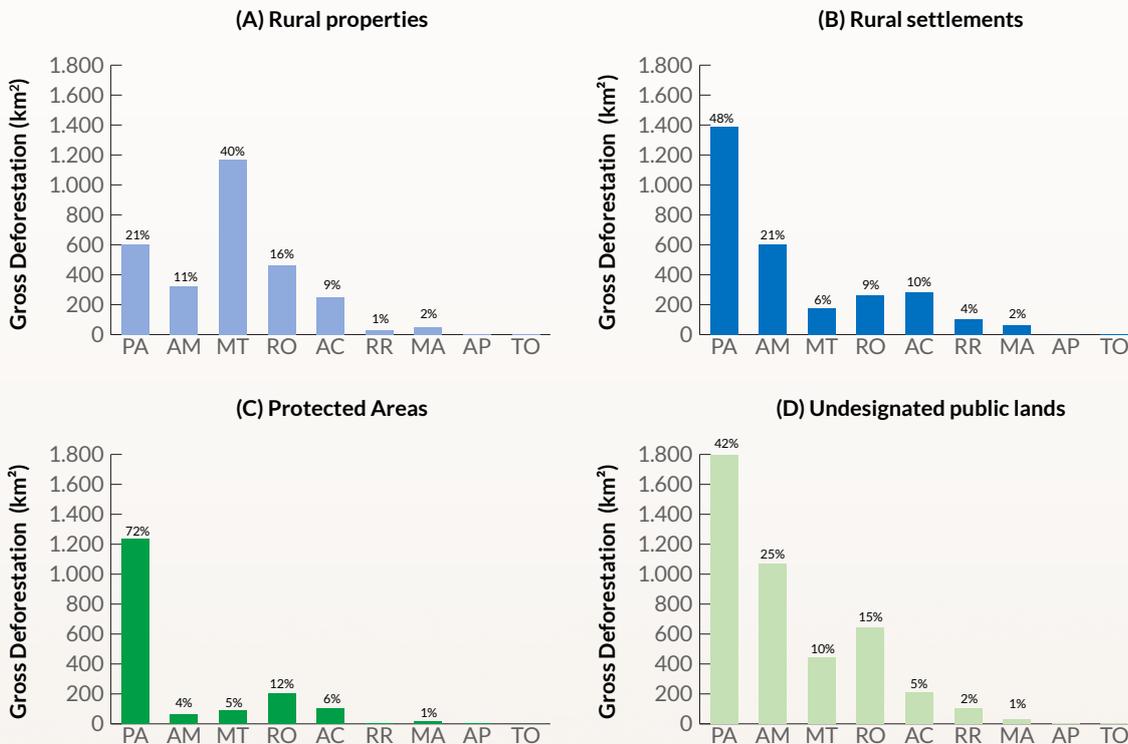


Figure 3. Gross deforestation from 2020/2021 by land tenure category: (A) Rural properties, (B) Rural settlements, (C) Protected Areas and (D) Undesignated Public Lands, and by state in the Amazon biome (PA - Pará, AM - Amazonas, MT - Mato Grosso, RO - Rondônia, AC - Acre, RR - Roraima, MA - Maranhão, AP - Amapá and TO - Tocantins). *Source: IPAM with PRODES data.*

Highlights are the Indigenous Lands Trincheira Bacajá, Apyterewa, Ituna-Itatá, Cachoeira Seca, and the Flonas (National Forests) Jamanxin and Altamira, in addition to the EPAs (Environmental Protection Areas) Triunfo do Xingu and Tapajós. It is worth mentioning the second place in deforestation in Protected Areas for the State of **Rondônia**, where the Protected Areas concentrated 12% of the deforestation that occurred in Protected Areas in the whole Amazon, despite representing only 4.3% of the territory occupied by the category in the biome.

The deforestation occurred mainly in the ILs and CUs near Porto Velho, especially

the Karipuna IL and Jaci-Paraná Extractive Reserve (Resex). In relation to Undesignated Public Lands, **Pará, Amazonas, and Rondônia** together registered the largest share (82%) of deforestation that occurred within this land category in the Amazon biome (Figure 3D).

The recent history of deforestation by land tenure category reveals that in almost all States, with the exception of Amapá and Tocantins, the average annual deforestation rates were higher in the 2019-2021 triennium when compared to those of the 2016-2018 triennium (Figure 5). In absolute terms, the State of Pará was the one that presented the greatest difference between the avera-

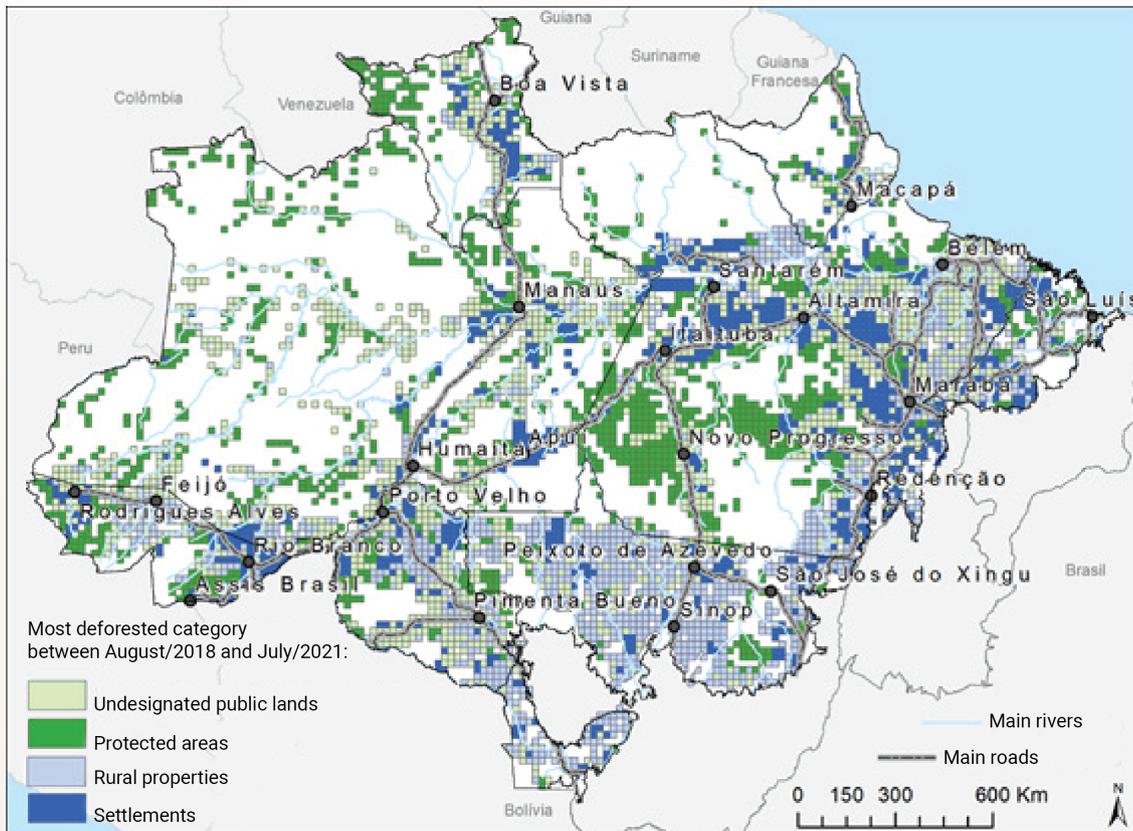


Figure 4. Dominant land tenure category for deforestation in the triennium 2019-2021 on 20 x 20 km grids in the Amazon biome, showing, in dark green, the dominance of deforestation in Protected Areas, in light green Undesignated Public Lands, in dark blue Rural Settlements, and in light blue Rural Properties. *Source: IPAM with PRODES data.*

ges for the first and second triennium (2,025 km²), followed by **Amazonas** (644 km²), **Mato Grosso** (464 km²), **Acre** (376 km²), **Roraima** (203 km²), and **Rondonia** (191 km²). In relative terms, the States that had an increase of more than 100% in the average annual area deforested between the first and second triennium were **Roraima**, with 122% and **Acre** with 104% (Figure 5). **Pará**, **Amazonas**, **Maranhão**, **Mato Grosso** and **Rondônia** presented a relative increase of 75%, 62%, 46%, 35% and 15%, respectively, between the first and second triennium.

There was also a difference between the evolution of deforestation in landholding

categories among the Amazonian states. In **Pará**, deforestation increased in all categories in the last three-year period. They were, on average, 4,693 km² cut per year in 2019-2021, compared to an average of 2,678 km² deforested per year in 2016-2018. In **Amazonas**, the increase was gradual over the last three years of the analysis (Figure 5). In this state, which still has large areas of conserved forest outside of Conservation Units, deforestation advanced especially in 2020/2021, when it showed a significant increase compared to 2017/2018, mainly in Undesignated Public Forests. The deforested areas are concentrated on the **Amazonas-Acre-Rondônia** border, a region known

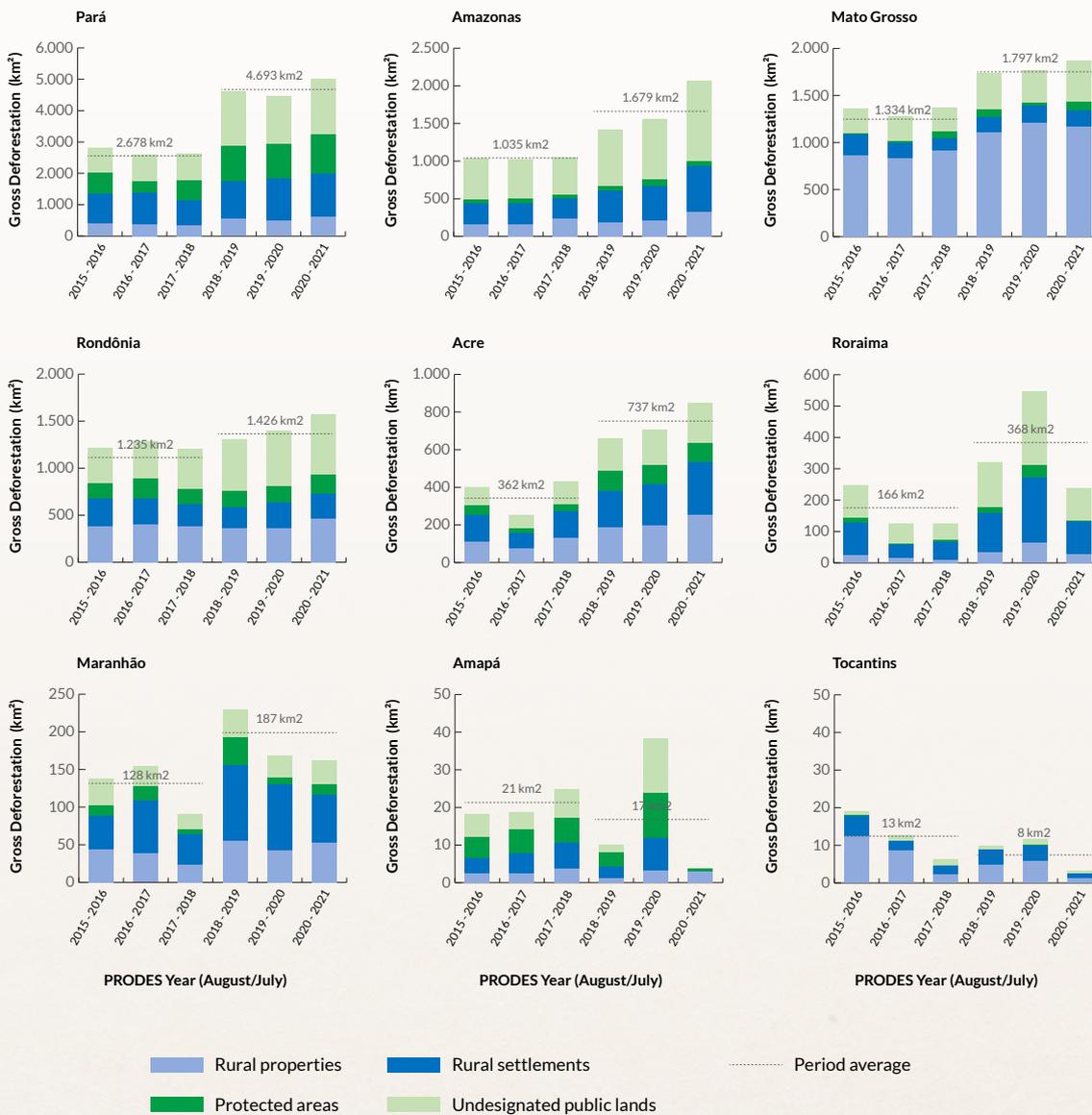


Figure 5. Deforestation by state according to land categories in the 2016-2018 and 2019-2021 trienniums. . Source: IPAM with PRODES data.

as Amacro, where large deforested areas have occupied Undesignated Public Forests and Protected Areas such as Conservation Units and Indigenous Lands (Figure 6). **Ron-dônia** followed the pattern of Amazonas with a gradual increase occurring mainly in Undesignated Public Lands. In **Mato Grosso** and **Acre**, the increase was stronger in rural properties and settlements, respectively.

In **Mato Grosso**, the last three-year period had a larger deforested area than the previous one: 1,797 km² versus 1,334 km². In Acre, there is a worrying tendency for a gradual increase between the years of the last triennium, especially in 2020/2021 (Figure 5). In **Maranhão**, even though the average deforestation rate was higher in the second three-year period analyzed, it showed a

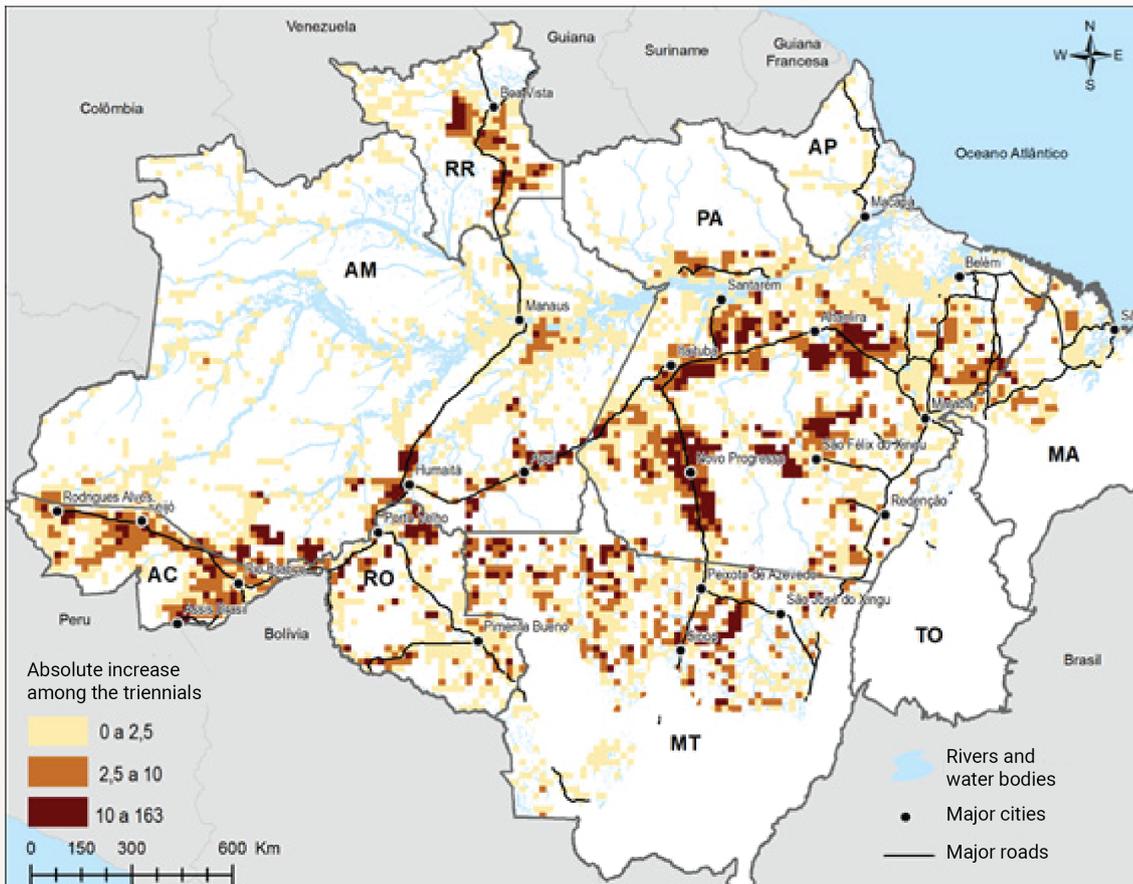


Figure 6. Critical areas (grid 20x20 km) of greatest absolute increase in deforestation in the last three-year period (2019-2021) compared to the previous three-year period (2016-2018). *Source:* IPAM with PRODES data.

tendency to decrease in the last three years, with special emphasis on the deceleration of deforestation in rural settlements. **Amapá** and **Roraima** had a deforestation peak captured in 2019/2020, and in Amapá this may be a consequence of the difficulty in obtaining cloudless satellite images for mapping deforestation, a frequent condition in the state.

Critical areas of deforestation

The areas of greatest absolute increase in deforestation in the Amazon in the last three-

year period (2019-2021) in relation to the previous three-year period (2016-2018), are critical areas of forest loss that have been concentrated in **Pará**, along the BR-163 highway, the Transamazon highway, and the Terra do Meio highway, in the municipalities of Altamira, São Félix do Xingu, and Novo Progresso, but also in the region of Portel and Pacajá (Figure 6). In **Amazonas**, they reach the region where the BR-319 and Transamazon highways meet in the south of the state, near Humaitá, and have important increases in Apuí, Lábrea and Boca do Acre. In **Rondônia**, the critical areas of deforestation are near the city of Porto Velho, in the

north of the state, also in the region of São Francisco do Guaporé and Costa Marques. In **Mato Grosso**, they are mainly in the northwest of the state, in the region of Colniza and Aripuanã. In Acre, these areas are in the regions of Feijó, Tarauacá, Sena Madureira and Rio Branco, and in the first three municipalities deforestation occurs more along the margins of the BR-364 highway. In **Roraima**, the critical areas are concentrated near Alto Alegre, Iracema, Mucajaí and Caroebe, in the southeastern region of the state, and near Rorainópolis, along the BR-174 highway (Figure 6).

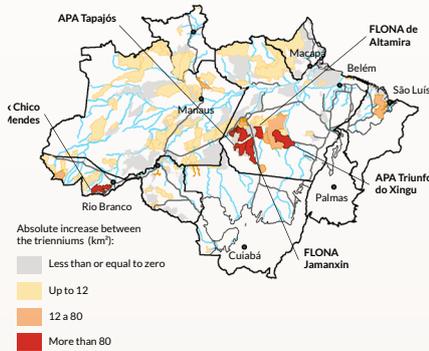
When analyzed individually, the Conservation Units that presented the highest absolute deforestation were: the EPA (Environmental Protection Area) Triunfo do Xingu, the Flona (National Forest) Jamanxim, the EPA of Tapajós, the Flona Altamira, and the Resex (Extractive Reserve) Chico Mendes. Com exceção da última, que está localizada no **Acre**, as outras estão no coração do Estado do **Pará** (Figura 7A). With regard to Indigenous Lands, the critical areas are in the Apiterewa, Menkragnoti, Ituna-Itatá, Trinchira Bacajá, Cachoeira Seca, and Kayapó Indigenous Lands, in **Pará** (Figure 7B). Regarding rural settlements, those that had a greater increase in absolute deforestation in the last triennium in relation to the previous one were the SP (Settlement Project) Rio Juma and the SDP (Sustainable Development Project) Realidade, both in southern Amazonas, the DSP (Directed Settlement Project) Anauá in **Roraima**, and the SDPs Terra Nossa and Divinópolis, in **Pará** (Figure

7C). These areas have been under pressure for the last three years and need structured, articulated command and control action, intelligence and permanent inspection to punish those responsible for environmental crimes and discourage the continuation of the practice. Incentive strategies for the sustainable production of socio-biodiversity are also fundamental to discourage deforestation in these territories.

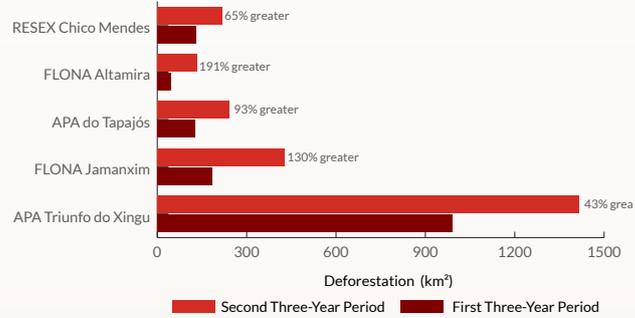
Discussion

Deforestation in the Amazon has reached a new and alarming level in the last three years - something only seen in the period before 2008. The return of devastation to 10 thousand km² between 2019 and 2021, common for a Brazil of 13 years ago, is a reflection of the setbacks in environmental policies and the destructuring of command and control agencies, practiced by the current management of the federal government, and the need to strengthen the States of the Amazon to act in the fight against environmental illegalities. The changes resulting from the lack of a structured action plan, integrated and articulated among the various federal entities, the institutional weakening of the command and control and its instruments of accountability, the lack of governance and allocation over public lands still undesignated and the lack of incentives and engagement of Amazon producers in a clear positive agenda to support good practices and sustainable forest-based economies, and low GHG (Greenhouse Gas) emissions, create conditions for environmental chaos that has as important indicators the

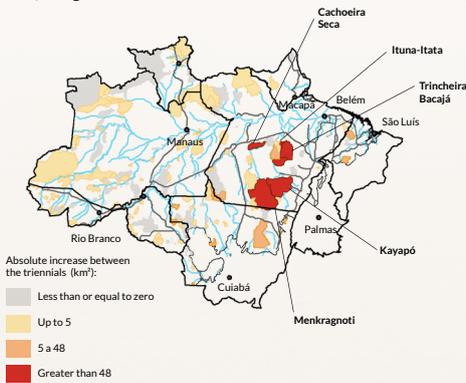
A) Conservation Units with Environmental Preservation Area



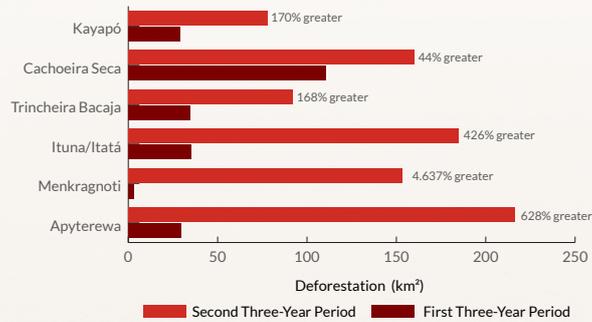
B) Deforestation of the Conservation Units and Environmental Preservation Area highlighted



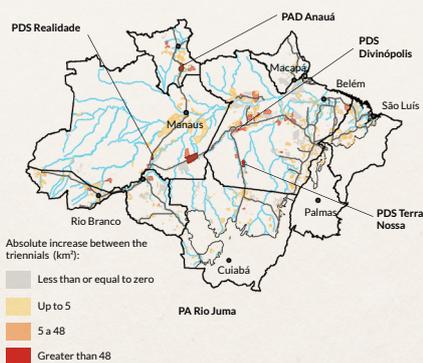
C) Indigenous Lands



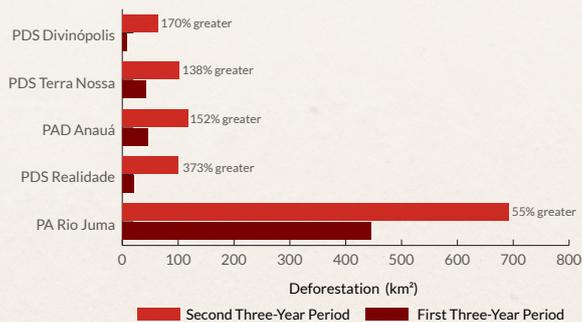
D) Deforestation in Indigenous Lands highlighted in (C)



E) Settlements



D) Deforestation in Indigenous Lands highlighted in (C)



— Main rivers — Main roads • Capitals

Figure 7. Absolute increase in deforestation in the last three-year period (2019-2021), compared to the previous three-year period (2016-2018) in: (A) Environmental Protection Areas, (B) Conservation Units, (C) Indigenous Lands, and (D) Rural Settlements.

increase in land conflicts, persecution of indigenous peoples and the advance of deforestation evidenced in the last triennium (2019-2021).

An increase that has begun to gain momentum since the 2018 election period and is likely to worsen as the 2022 elections approach.

The analyses presented in this technical note show that the political context of dismantling and discrediting environmental governance has had as its main result the increase in deforestation - especially on public lands, which concentrate 51% of forest conversion that occurred in the Amazon between 2019 and 2021. This means that if there is a priority to start fighting deforestation, it should be for these areas. The illegal occupation of FNPDs (Undesignated Public Forests), increasingly targeted by deforesters, is a clear expression that taking possession of public land, extracting economically viable timber from it, using the resource from the sale of this timber to cut down the forest, and establishing inefficient, disguised ranching, has been a lucrative business that has become the rule in many regions of the Amazon - a movement that legitimizes new deforestation fronts in the region.

Pará and Mato Grosso, which occupied first and second place, respectively, in the ranking of largest deforested areas since 2017, saw Amazonas approach and disappear from second place in 2020/2021. The situation in this state expresses, on a smaller scale, the expansion of the agricultural frontier on the border with Acre and Rondônia, in the region known as Amacro - this in-

volves 32 municipalities of the states and is considered the new deforestation frontier in the Amazon, characterized by uncontrolled forest conversion and a trend of increasing devastation every year. The advance of deforestation in Amazonas represents a risk to the most conserved and least fragmented forests in Brazil, since the state concentrates the largest areas of protected forests in the biome.

In Pará and Mato Grosso, it was noted that new deforestation has occupied, in addition to FPNDs, Indigenous Lands and Conservation Units - within the latter category, mainly EPAs (Environmental Protection Areas), with a significant increase in deforestation. The fact that the largest increases in deforestation in the Amazon are precisely in areas that should be cared for reveals the status of impunity in the face of environmental crimes in recent years (Brito et al. 2019, Azevedo Ramos et al. 2020, Alencar et al. 2021).

In addition to fighting illegal occupation of land that deforests and degrades the public patrimony for private benefits, it is necessary to invest in a positive agenda to encourage good practices in agriculture and cattle-raising in order to reduce the other 49% of deforestation that occurs in lands under private use (rural properties and settlements). Considering Brazil as one of the main food suppliers in the world, in order for the actions to prevent and combat deforestation to be effective, in the second place, it is necessary to urgently prioritize the change from the traditional agricultural system to a sustainable one (Stabile et al. 2020). Agribusiness accounts for more than ¼ of the GDP (Gross Domestic Product) of Brazil



(CEPEA/ESALQ and CNA 2021), and the implementation of sustainable techniques has proven to be able to reduce costs and increase productivity without the need to occupy new areas. Furthermore, the structuring of jurisdictional REDD+ (Reducing Emissions from Deforestation and Degradation) systems, payments for environmental services, valorization of the bio-economy, and the implementation of financing, development, and technical assistance lines for family agriculture and traditional peoples and communities complete the list of strategic actions that we recommend for Brazil to resume its national and international leadership in the environmental, social, and economic agendas with clear benefits for Brazilian society.

Finally, the increase in deforestation in the Amazon brings impacts far beyond the loss of forests and biodiversity. The so-called ecosystem services and their important role in the process of greenhouse gas emissions (46% of Brazilian emissions are directly or indirectly related to deforestation - SEEG 2021), still little internalized by society, are also highly affected by the destruction. Uncontrolled deforestation multiplies conflicts and affects land rights, indigenous peoples and traditional communities, threatening the health and food security not only of traditional peoples and communities, but of the whole society (Oliveira 2008, Fellows et al. 2021). Likewise, it has an effect on agriculture, causing changes in the hydrological cycle that lead to crop loss or the need for more investment (Rattis et al. 2021). Amazon deforestation impacts Brazil's business opportunities, imposes restrictions due to land and legal insecurity, and social and environ-

mental risks, causing reputational damage with considerable negative repercussions on agribusiness exports (Galuchi et al. 2018, Rajao et al. 2020).

Fighting deforestation is a collective effort. In this endeavor, the federal government and its institutions responsible for environmental governance; the legislature, which creates laws that impact the dynamics of forest clearing; the judiciary, which is more expeditious in judging environmental crimes; and the state governments are all key players in the gears that represent governance and socioenvironmental management for reducing deforestation in the biome. The organized civil society and the private sector are also important in the chess of forest conservation, whether by pressuring and influencing market players, proposing alternatives, supporting the construction of public policies or claiming and contributing to solutions for transparency in the supply chain of agricultural, livestock, and forest products. Therefore, in order to reduce the problems exposed, it is essential that the following objective recommendations be taken into consideration.

Recommendations

- **Re-establishment of the PPCDAM and support to the reformulation of the PPCDs**

The initial stage for controlling deforestation involves planning with clear and bold targets. In the past, the PPCDAM (Plan for Prevention and Control of Deforestation in the Amazon) was a fundamental tool to

indicate the priority areas and actions to reduce deforestation in the region. The PPCDs (State Plans for Prevention and Control of Deforestation), stimulated and supported by the Amazon Fund, also represented fundamental tools for engaging the various governmental entities in favor of reducing deforestation. The rescue, support and updating of the PPCDAM and the PPCDS with the re-agreement of objectives, strategies, actions and targets, and with the definition of institutional responsibilities and budgets, are necessary to establish a vision, leadership strategy and a clear governance structure to combat deforestation.

- **Institutional articulation and intelligent command and control**

The establishment of intelligent, focused and well-articulated inter-institutional command and control can reduce at least half of the deforestation in the biome, for example, deforestation on public lands. This means that the strengthening and articulation of the agencies that are active in enforcement, led by Ibama and the state environmental agencies, need to have intelligence support, such as well-equipped situation rooms with dedicated employees, and police force for operations such as the Federal Police, the environmental police and, when necessary, the National Security Force and the Army to function.

The return of operations focused on emblematic cases, with due accountability and transparency of their results, as well as the fight against organized crime are a practical educational exercise and end up discouraging a lot of environmental criminals from

committing environmental offenses. To reduce deforestation, punishment and accountability have to work through fines, embargoes, imprisonment and destruction of equipment. These strategies for repressing crime have to be strengthened and supported in all instances of government, starting with force against the gangs linked to land speculation, illegal logging, and the illegal occupation of Protected Areas.

- **Allocation of public forests for conservation and sustainable forest production**

The Undesignated Public Forests make up the land category with the greatest increase in deforestation over the last three years. The allocation of these areas to Conservation Units that are more restrictive than the Environmental Protection Areas takes these lands off the radar of the illegal land market and discourages illegal occupation. The cancellation of REC (Rural Environmental Cadastre) registrations overlapping these areas is also another sign that these areas will not be regularized for any purpose other than conservation and sustainable forest production.

- **Territorial security of Protected Areas (IL and CU) and support for forest-based economies:**

Guaranteeing territorial security in Indigenous Lands and Conservation Units, of indigenous peoples and traditional communities, with the removal of invaders and with support for the training of indigenous and community agents for the monitoring and management of their territories is also a

fundamental action for the protection of indigenous peoples, traditional communities and their territories. The structuring of value chains with sociobiodiversity products in order to benefit community businesses represents another important action to strengthen these territories so as to guarantee income and improvement in the quality of life for the populations that live there.

- **Economic Incentives for Conservation of private forest assets:**

Strengthening the implementation of the Forest Code through economic incentives for producers with legal environmental status, so that they can keep the forest standing and have easier access to differentiated markets, credit lines for good practices and other economic instruments, such as payment for environmental services, is another important point that can reduce deforestation on private rural properties.

The structuring of jurisdictional REDD+ (Reducing Emissions from Deforestation and Degradation) systems in Amazonian states is also important to strengthen legal-institutional structures and to mobilize national and international, public and private resources for the execution of actions to control deforestation. Restrictive measures, such as the REC suspension for those who deforest Legal Reserves and Permanent Protec-

tion Areas, also serve as instruments to discourage deforestation in these areas. In this sense, the engagement of market players in demanding products without a trace of deforestation is also an important tool to discourage the cutting down of forests on private rural properties.

- **Technical assistance and economic incentives for family farmers:**

Economic incentives, easy access to credit and, especially, to quality technical assistance are fundamental elements to support the production of family farming plots in the Amazon. The processing of the production and the creation of strategies for the commercialization of family farming products are other essential elements for the generation of income in this segment. If these incentives come together with the commitment not to expand the productive area beyond what is legal, but the improvement in productive efficiency, will have the effect of reducing deforestation.

- **Reviewing environmental policy setbacks forwarded by the Legislature:**

Finally, it is essential that the Legislative engage in the rejection of Bills that end up stimulating land invasion and illegality in rural activities, such as mining, logging and cattle ranching, especially at a time of

Suggested reference

Alencar, A., Silvestrini, R., Gomes, J. e Savian, G. 2022. "Floresta em chamas - O Novo e Alarmante Patamar do Desmatamento na Amazônia: Nota técnica No. 9. IPAM, Brasília - DF. Disponível em: <https://ipam.org.br/bibliotecas/amazonia-em-chamas-9-o-novo-e-alarmante-patamar-do-desmatamento-na-amazonia/>

weakened environmental governance. It is necessary to file the bills (PLs) 2.633/2020 and 510/2021, the Squatting Bill, which deals with land regularization, or the PL 2.159/2021, which modifies and makes the licensing process more flexible, and the PL 191/2020, which releases mining in indigenous lands. These are bills that have the potential to directly impact the increase in deforestation, and their progress has given a clear signal that everything will be allowed, and that several environmental crimes committed today will no longer be illegal in the future.

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Bibliographic references

- Abessa, D, Famá, A and Buruaem, L. 2019. The systematic dismantling of Brazilian environmental laws risks losses on all fronts. *Nature Ecol Evol* 3(4): 510–511. DOI: <https://doi.org/10.1038/s41559-019-0855-9>.
- Alencar, A., Moutinho, P., Arruda, V., e Silvério, D. *Amazônia em chamas - O fogo e o desmatamento em 2019 e o que vem em 2020: nota técnica nº 3*. Brasília: Instituto de Pesquisa Ambiental da Amazônia, 2020. Disponível em: <https://ipam.org.br/bibliotecas/amazonia-em-chamas-3-o-fogo-e-o-desmatamento-em-2019-e-o-que-vem-em-2020>.
- Alencar, Ane A., Isabel Castro, L Laureto, Carolina Guyot, M. C. C. Stabile, and P. Moutinho. 2021. "Amazônia em Chamas - Desmatamento e fogo nas Florestas Públicas Não Destinadas: nota técnica no 7." *Nota técnica/ Technical Note 7. Amazônia em Chamas*. Brasília, DF, Brasil: IPAM. Disponível em <https://ipam.org.br/bibliotecas/amazonia-em-chamas-7-desmatamento-e-fogo-nas-florestas-publicas-nao-destinadas/>.
- Artaxo, P. 2019. Working together for Amazonia. *Science* 363(6425): 323. DOI: <https://doi.org/10.1126/science.aaw6986>.
- Azevedo-Ramos, C., Moutinho, P., Arruda, V.L. da S., Stabile, M.C.C., Alencar, A., Castro, I., Ribeiro, J. P. 2020. Lawless land in no man's land: The undesignated public forests in the Brazilian Amazon. *Land use policy*. 99, 104863.
- Brito, B., P. Barreto, A. Brandão Jr., S. Baima, and P. H. Gomes. 2019. Stimulus for land grabbing and deforestation in the Brazilian Amazon. *Environmental Research Letters* 14.
- Câmara, G., D. D. M. Valeriano, and J. V. Soares. 2006. Metodologia para o Cálculo da Taxa Anual de Desmatamento na Amazônia Legal (PRODES Methodology). Instituto Nacional de Pesquisas Espaciais:1–37.
- CEPEA/Esalq e CNA. 2021. PIB do Agronegócio. Disponível em: https://www.cepea.esalq.usp.br/upload/kceditor/files/Cepea_PIBdoAgro_set_Dez21.pdf
- Escobar, H. 2019. Bolsonaro's first moves have Brazilian scientists worried. *Science* 363:330–330.
- Fellows, M., Alencar, A., Bandeira, M., Castro, I., Guyot, C. *Amazônia em Chamas - desmatamento e fogo em terras indígenas: nota técnica nº 6*. Brasília, DF: Instituto de Pesquisa Ambiental da Amazônia, 2021. Disponível em: <https://ipam.org.br/bibliotecas/amazonia-em-chamas-6-desmatamento-e-fogo-nas-terras-indigenas-da-amazonia/>.
- Fellows, M., V. Paye, A. Alencar, M. Nicácio, I. Castro, M. E. Coelho, C. V. J. Silva, M. Bandeira, R. Lourival, and P. C. Basta. 2021. Under-Reporting of COVID-19 Cases Among Indigenous Peoples in Brazil : A New Expression of Old Inequalities The Indigenous Context in the Brazilian. *Frontiers in Psychiatry* 12.



Annex 1 - Details of deforestation in the main land tenure categories by year in the first and second triennium, including the cumulative per triennium, the annual average for the triennium, and the percentage of increase between the triennium averages (continued on next page).

Land Categories	Land Categories			Second Triennium		
	2015/2016 (km ²)	2016/2017 (km ²)	2017/2018 (km ²)	2018/2019 (km ²)	2019/2020 (km ²)	2020/2021 (km ²)
Private Use	4051,4	3825,25	3719,47	5386,68	4934,53	5778,79
Settlement	2.072	1.906	1.690	2.818	2.460	2.878
State	7	8	6	8	6	5
Federal	2.066	1.898	1.684	2.810	2.454	2.873
Rural Properties	1.975	1.914	2.026	2.565	2.471	2.898
Public use	3.207	2.910	3.212	5.265	5.378	6.008
Protected Areas	966	744	981	1.556	1.584	1.711
UC	849	615	731	1.055	1.156	1.384
State	596	440	474	613	627	771
Federal	253	176	257	442	529	613
TI - Federal	118	128	250	501	427	327
TPND	2.240	2.166	2.231	3.709	3.794	4.297
FPND	1.777	1.691	1.762	3.018	3.127	3.541
State	163	171	163	247	240	265
Federal	1.614	1.520	1.600	2.772	2.887	3.276
OTPNP	463	475	469	690	667	756
State	12	10	12	18	26	27
Federal	451	465	457	673	641	729
Grand Total	7.258	6.735	6.931	10.651	10.312	11.787

