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Land tenure regularization and state land grabbing in the municipality of Paragominas, Eastern Amazon

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Abstract

In the Amazon, the regularization of public and private lands is under discussion to reduce deforestation. However, this scenario is difficult due to land disorganization and divergent federal and state policies. The objective of this study was to analyze the importance of land data in federal and state public lands and private lands for the municipality of Paragominas, Eastern Amazon. In this study, we try to propose a diagnosis of land tenure structure, quantifying the Value of the Bare Land of the overlapping lands, state public lands on federal lands, as well as deforestation and forest conversion. The results showed that the area of federal publicly listed lands has drastically reduced. The reduced area is equivalent to the territory of Palestine, in the same database managed by the federal management agency. State public lands overlapped 16,153.32 ha on federal public lands, with a loss of US$5,529,927.57 for the federal government. Deforestation has increased on state public lands, driven by conversion to soy cultivation areas, and there is a trend towards stabilization of deforestation and agriculture on federal public lands.

Keywords: Deforestation, Land grabbing, Land Regularization, Land Use.
Abbreviations: SIGEF_Land Management System, SICARF_Land Registry and Regularization System, VTN_Value of Bare Land.

Introduction

In the Amazon, land tenure is a complex challenge that interpolates several instruments of public governance (Fisher et al., 2020) especially issues of conservation, deforestation, and regularization (Sunderlin et al., 2013). The absence of reliable information on the location of public lands not intended for agricultural activity, as well as private lands, encourages a race for resources with the establishment of livestock and agricultural activities as a backdrop for illegal deforestation and land grabbing (Azevedo - Ramos et al., 2020), which is reflected in the rights of access to possession and regularization of public lands (Brito et al., 2021). This race for land regularization exposes a fragile governance structure, federal and state public rules for access to property (Reydon et al., 2015), providing spatial data to society as a measurement factor, location of overlapping properties, especially without land title that expresses the location of possessions (Azevedo-Ramos et al., 2020). Land tenure regularization in the Eastern Amazon culminates in the creation of independent georeferenced systems, with the federal government operating two systems: the Land Management System (SIGEF), with collection; and the government of the State of Pará, with the Land Registry and Land Regularization System (SICARF), with its own and official land-based systems. Public land prices also do not escape this paradigm, with specific rules for the Valor da Bare Land (VTN), which differs between federal and state governments (INCRA, 2019; ITERPA, 2021b). Land regularization efforts in the Eastern Amazon, promoted by the federal and state governments, rely on the application of several programs and projects in the municipality of Paragominas, with emphasis on the state intervention initiated in 2010. This study aims to: (i) analyze the importance of land data on public lands of the federal and state government and private lands for the municipality of Paragominas; (ii) establish relationships for four scenarios, proposing a diagnosis of the land tenure structure, quantifying the Value of Bare Land (VTN) of the overlapping of state public lands on federal public lands, as well as deforestation and forest conversion for productive activities. To this end, the guiding questions on land regularization are: 1 – Can the available land databases be used for a reliable diagnosis? 2 – Are there overlaps between federal and state public lands? If yes, which VTN is transferred to the state or federal government? 3 – What is the effective deforestation in federal and state plots? Are there differences? 4 – Deforestation on public lands was converted into which agricultural activities?

Results and Discussion

Assessment of rural areas and grassroots

Paragominas has a rural area of 1,934,256.50 ha (19,342.57 km^2) and an urban area of 2,650.63 ha (26.51 Km^2), with 80% concentrated in the municipality seat and 20% in agricultural villages. The GFD and GFM overlapped by 16% in the Land Collection and SIGEF database groups, excluding urban areas and PAF from these analyzes. All GFD on the Land Collection were subdivided when compared with the

GFM of the SIGEF database. The GFD Carrapatinho, Paragominas, and Prainha had the largest subdivisions (9), and Cauaxi the smallest (3).

Comparing the sizes of federal plots between the data from the Land Collection and the SIGEF Database, the GFD showed a considerable size reduction (85%), ranging from 65% to 92%, which represents a reduction of 572,549.95 ha. The GFD Paragominas and Prainha had the greatest territorial reduction (92%), while Carrapatinho showed the smallest (66%) (Table 1).

Twelve GFM were identified, totaling 34,789.10 ha, certified in the 1st and 2nd Technical Standards for Georeferencing of Rural Properties (INCRA, 2003; INCRA, 2010), which are not on the SIGEF platform inherent to the 3rd Standard (INCRA, 2013), corresponding to 35% of the GFM. The 84% reduction exposes the difficulty of implementing efficient public policies in the GFD and GFM land domain.

The GFD had a reduction as a result of the federalization of lands in the states by the federal government through Decree-Law 1164/1971, which assigned INCRA with the management of vacant lands located in a 100 km-wide strip along the federal roads built, under construction, or planned in the Amazon (Brasil, 1971). The consequence was the application of a land policy that evaluated the titles issued by the state of Pará, prior to the Decree-Law 1164/1971, excluding them or requiring ratification of its expeditions.

Thus, the GFD in the municipality of Paragominas are not considered TPF areas in their entirety. Some authors describe that the complexity of using inadequate data in the land network results in the disarticulation of tenure, production, conservation and environment policies (Stabile et al., 2020).

Data should be reviewed, updated with formal agreements between the federal and state governments, to build a database that reflects public and private land management, where the use of GFD and GFM will convey information on the spatial distribution of plots with titles more transparently and; therefore, with the precision necessary for efficient land governance.

Several studies support the need for a more refined land data assessment where the current scenario requires an immediate paradigm shift to georeferenced data for public and private lands (Azevedo-Ramos et al., 2020). For Brito et al. (2021), the disorganization of state georeferenced data occurs due to the low adoption of technology and standardization of procedures, indicating that the land regularization processes were all physical until 2019.

The TIs are not georeferenced, which should be executed by FUNAI. The geometry and geographic data of the PAF were obtained by INCRA, initially through topographic surveys or registration in topographic maps. The TI and PAF correspond to 5.1% and 8.9% of the rural area of the municipality, respectively (Table 2).

The TIs do not have land demarcation and georeferencing in the municipality, which results in divergent territorial boundaries, causing land conflicts and ineffective planning. Pereira et al. (2020) reported that the Brazilian government has a disastrous policy for the demarcation of indigenous lands, which culminated in a political maneuver to withdraw the competence of demarcations of FUNAI and attribute to the Ministry of Agriculture. Due to lawsuits in the highest court in Brazil, it was unsuccessful.

The Federal Government recognizes the slowness of land regularization on public possessions and agrarian reform settlements, and established the Titula Brasil Program with municipalities responsible for georeferencing and adjustment of the base and titling by INCRA, starting in 2021 (BRASIL, 2020). The operationalization will include a new government entity that does not have rural land expertise, which can cause even greater land disorganization.

Assessment of state lands in databases

The GE totaled 359,615.80 ha, with the largest area for Cauaxi I, showing 70,180.95 ha, and the smallest for Candirú Açu, with 261.67 ha (Table 3). No GE was found in the database of the Land Collection Group or the SIGEF Database Group. The absence of a GE in the SIGEF Database reflects a legal non-compliance that, even so, the notary offices and titles issued by the State of Pará maintain in a recurring manner.

In Scenario I, using only information from the Land Collection Group, TPF correspond to 49% of the municipality and TSI correspond to 51% (Figure 1A). From the SIGEF Database Group, this percentage reduces to 19.5%, compared to Scenario II (Figure 1B).

The greatest reduction is inherent to the federal government's management land bases, referring to the GFM, inducing inappropriate public land governance policies, leaving 80.5% of the rural area of the municipality to the TSI. In this scenario I, the federal management area under INCRA's competence would be 35% reduced (Figure 1A), to 5.5% in Scenario II (Figure 1B).

Evaluating Scenario III, the federal management of INCRA, ITERPA and TSI correspond to 14.4%, 18.6% and 67%, respectively (Figure 1C). The federal and state governments provide spatial data on intended and unintended public lands, as a measurement and land governance factor, not requiring accounting of areas and titles among state entities.

Thus, they began a race for land and cadastral bases, with emphasis on SIGEF, administered by INCRA, and SICARF by ITERPA. The perspective is intensified in the acquisition of SICARF by the states of Maranhão and Amapá, with the promise of establishing public databases for accessing and downloading georeferenced data on public and private lands, to become the main geospatial base used for procedural regularization analyzes land in the eastern Amazon.

Sunderlin et al. (2013) evaluated Reduction of Emissions from Deforestation and Forest Degradation (REDD+) projects in Brazil and explained that ownership and guaranteeing the issuance of bonds, could only be carried out with state governments. With the federal government, access was through the implementation of the Rural Environmental Registry (CAR) or Rural Environmental Licenses (LAR) or land regularization. Reydon et al. (2015) describe that access to the federal structure takes place through INCRA, the Union Heritage Superintendence (SPU) and FUNAI, with each state in the Amazon having its own land regulatory body.

For scenario IV, the TPs together have an area of 1,020,894.42 ha (52.7%), distributed in TP – 1964, with 49.5%, and TP – 2010 to 2020, with 3.2%. The distribution for Scenario IV includes TPF with 19.5%, GE with 18.6%, TP with 52.7% and TSI with 9.3% (Figure 1D). For information from the Building Collection Database and SIGEF, the reduction of the GFD and the way in which they were spatially distributed are directly related to the update in the registry office. Losses of GFD territories were identified as new GE and/or titles held by the state of Pará prior to 1964 were recognised.

The TP - 1964 areas demonstrate that the municipality was promoted through public policies of state land regularization in decades prior to the collection of the GFM. This intense

regularization has land databases that allow a clear separation of intended and unintended public lands under federal or state jurisdiction, notably private lands detached from each jurisdiction through the granting of property titles.

The LG has the registration period from 2011-2017, under the coordination of ITERPA (ITERPA, 2015a; ITERPA, 2021c). All GE do not have public land registration in the National Rural Registry System (SNCR); and therefore, do not present the Rural Property Certification (CCIR). Even though they are public lands, the mandatory presentation of the CCIR does not exempt them from the request of the georeferencing of properties in SIGEF. The overlaps between GFD and GFM, in turn, were reduced due to discriminatory measures carried out by INCRA in the 1980s and 1990s. The EG overlapped 16,153.32 ha in the GFM, with Cauaxi IV being the largest of the EG in the GFM (Table 4).

This reflects the conflict of land stratification data in the municipality, with policies that interpolate a race to collect collections and increase equity, without geographic and spatial criteria on the part of the state. For titles issued or to be issued in the overlapping GE, there will be illegality and land grabbing instituted. This federal and state land tenure regularization effort in the state of Pará maintains the lack of cooperation between the agencies for efficient land management.

With the creation of the program Titula Brasil, between INCRA and the municipalities, the federal government delivered 50,000 land titles in June 2021 (Brasil, 2021), while the state of Pará intensifies land titling operations with the State Environment and Territorial Planning Program (PEOT), with the promise of 10,000 rural and urban titles to be issued between 2019 and 2022. However, the Pará state government issued only 387 titles from 2011 to 2020, far from the tenure policy proposed by ITERPA (ITERPA, 2011; ITERPA, 2012; ITERPA, 2013; ITERPA, 2014; ITERPA, 2015b; ITERPA, 2016; ITERPA, 2017; ITERPA, 2019; ITERPA, 2020; ITERPA, 2021a).

For Williamson et al. (2010), the combination of human and technological resources based on organizational and operational procedures, with legal and administrative requirements, can only be achieved through the creation of a Territorial Management System in an integrated manner, with the various State bodies, with dissemination of information to society and respect for the concepts of tenure in each country.

The assessment of Scenario IV establishes a reasonable land diagnosis. Thus, the VTNs were calculated by computing a total value of US$ 36,229,859.32 for GFM and US$ 47,343,420.07 for GE (Table 5). However, the overlapping of GE in the GFM brings a loss to the federal treasury of US$ 5,529,927.57, with the sale of public lands and issuance of titles by the state of Pará at the cost of the overlaps, with an advantage for the state coffers of the United States ($2,126,584.58).

This inconsistency becomes an attractive scenario for the local land market, since the state VTN is cheaper. However, legal uncertainty and a proposal for state land grabbing on federal land will have irreversible consequences for land management, making the land base unreliable, corroborating land accounting without criteria.

The values applied in this geography of federal and state public lands present several divergences. For INCRA, the PAF in the territory that still do not have certification and inclusion in the SIGEF base is in the process of regularization, leaving resources for georeferencing. This scenario is even more complex, as the Titula Brasil Program encourages the titling of medium and large rural producers in agrarian reform settlements, instituting a new character in a land network that until 2018 was managed by the federal programs of assistance to small producers and agriculture.

The titles of state plots are not computed clearly, which reveals a dubious and unreliable accounting engineering, directly reflecting on the monetary collection on public lands. Productivity and environmental liabilities are strictly linked to failure to comply with official information and the reality of the field. One of the consequences of this paradigm is in the land tenure regularization structure, despite the assessment of deforestation in MFT and GE related to agrarian production.

In Figure 2, the effective deforestation from 2008 to 2014 has a certain pattern between the GE and the GFM. However, there is a decrease in deforestation in 2014, 2015 and 2016 in the GFM, and in the GE there is an inverse result, which is an increase in deforestation in the same period. From 2011 to 2020, 387 land titles were published, whereas the highest number was in 2012 (142) and the lowest in 2018 (1).

Even with a drop in bonds from 2012 (142) to 2013 (26), there was an intensification in 2014 (25), 2015 (33), 2016 (47) and 2017 (61). The reduction from 61 titles in 2017 to 1 title in 2018 contributed to the reduction of deforestation in 2018 (Figure 2), being verified through the control of the federal government in the evaluation of environmental criteria as conditions for the mandatory and compliance with the clauses of the resolution, more strictly than the rules of the state government.

The history of state land tenure regularization comes from intense titling since the 19th century (with titles from 1960 to 1963) with an average area of 4,200 ha in the north-south and east-west regions of the municipality. With the publication of Federal Decree-Law 1164/1971 (Brasil, 1971), federal intervention in the region gained prominence with the creation of federal settlements, indigenous lands and federal lots, which were revoked in 1987, guaranteeing INCRA the management of the lands already registered in the name of the Union (Brasil, 1987).

The environmental perspective was decisive in land tenure regularization, through the integrated policy to combat deforestation. In 2008, due to the high rates of deforestation, an assessment was carried out by the municipalities, including the municipality of Paragominas in the List of Critical Municipalities (CML). In 2011, the municipality was removed from the LMC, mainly with the support of the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) and the Green Municipalities Program (MVP), with the registration of more than 80% in the CAR, deforestation below 40 km2, and the average below 60% of the 2004-2006 reference (Da Costa and Fleury, 2015).

After leaving the LMC, Paragominas was considered a success story in controlling deforestation in the Amazon, and the state of Pará intensified land tenure regularization in the recognition of property titles already issued, obtaining land in the name of the state and carrying out a new agrarian order in the municipality (Carneiro et al., 2020).

Table 2. Size of indigenous lands (TI) and federal settlement projects (PAF) in the municipality of Paragominas.

Category	Area (ha)	Total (ha)
TI Alto Rio Guamá	2,456.40	98,207.60
TI Barreirinha	95,751.20	
PAF Águia	6,211.70	
PAF Alta Floresta	3,988.70	
PAF Arapuã Simeira	6,466.70	
PAF Areia Branca	570.30	
PAF Bacabal	839.00	
PAF Camapuã	7,342.90	
PAF Colônias Reunidas	4,365.50	
PAF Glebinha	1,877.10	172,899.30
PAF Mandacaru	34,328.10	
PAF Nova Vida	34,326.50	
PAF Paranoa	3,289.30	
PAF Progresso	3,953.70	
PAF Rio Das Cruzes	31,972.40	
PAF Luiz Inácio	31,907.70	
PAF Paragonorte	1,459.70	

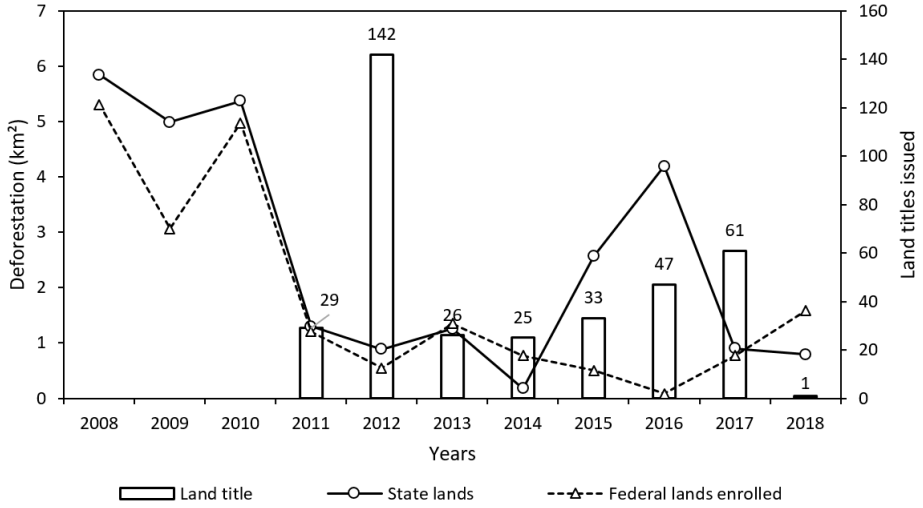

Fig 2. Annual effective deforestation from 2008 to 2018 in GE and GFM, with the issuance of land titles in GE from 2011 to 2018.

Table 3. Size of state plots (GE) in the municipality of Paragominas.

State Plot (GE)	Area (ha)	State Plot (GE)	Area (ha)
Alto Rio Guamá	2,388.52	Fazenda Chapada Grande	968.87
Amajari	11,973.35	Nazaré	14,366.98
Baixo Uraim	14,022.97	Nova Vida	3,712.63
Boa Esperança do Uraim	1,942.76	Nova Vida II	4,111.22
Camari	13,995.51	Nova Vida III	2,152.87
Camari II	16,107.11	Novo Horizonte	4,019.68
Candirú Açu	260.67	Paragominas I	27,737.60
Carrapatinho	12,334.70	Paragominas II	1,237.97
Carrapatinho II	3,853.31	Paragominas III	1,909.60
Cauaxi I	70,180.95	Prainha I	5,668.22
Cauaxi II	38,306.65	Prainha II	2,672.55
Cauaxi III	57,789.95	Rio Capim I	4,992.04
Cauaxi IV	12,047.74	Rio Capim II	7,499.65
Cauaxi V	2,010.37	Surubiju	1,729.46
Cauaxi VI	2,040.21	Uraim	4,531.02
Esmeralda	13,050.66	Total	359,615.80

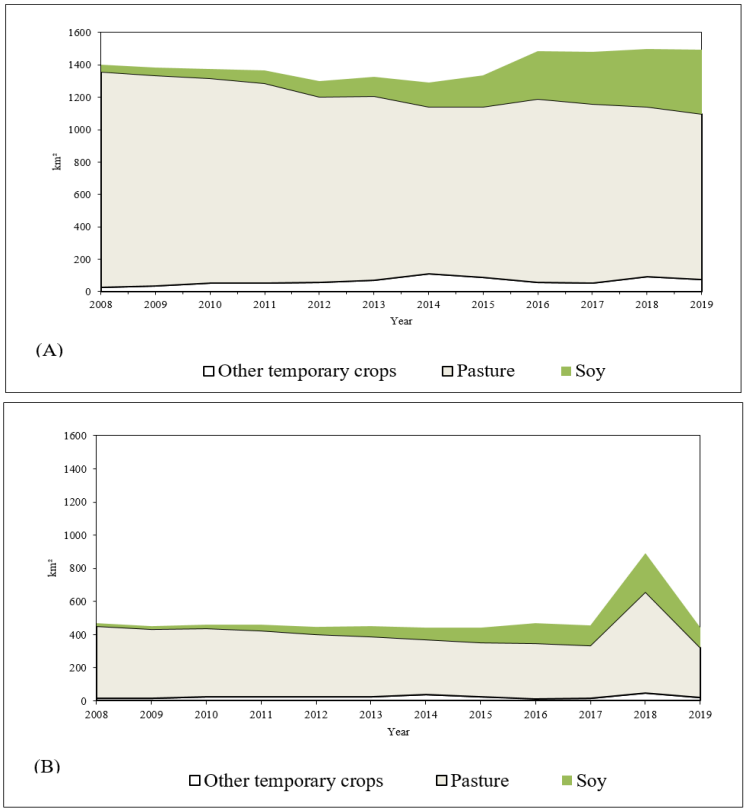

Fig 3. Land use for pasture, soy, and other crops on federal and state public lands from 2008 to 2019 (A) in GE. (B) in GFM.

Table 4. Overlaps of GE (state plots) in GFM (enrolled federal plots).

GE overlap	GFM with overlaps	Overlap area (ha)
Cauaxi IV	Cauaxi A-01	12,048.00
Carrapatinho	Carrapatinho A-06	1,583.75
	Carrapatinho A-03	75.74
Nova Vida	Carrapatinho A-08	1,937.81
Paragominas	Paragominas A-09	55.47
	Paragominas A-10	452.55
Total		16,153.32

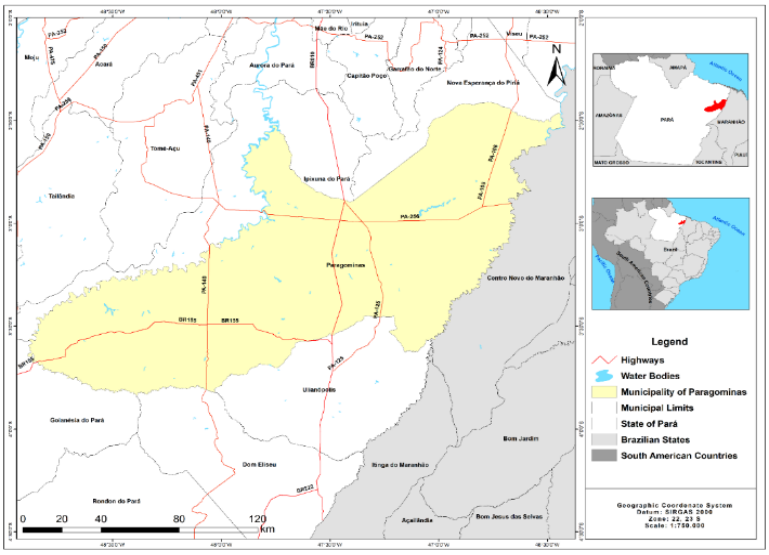

Fig 4. Location of the study area, municipality of Paragominas - Pará.

Table 5. Value of Bare Land (in USD) from federal and state tables with the overlaps and monetary collections of state plots (GE) over federally enrolled plots (GFM).

Public Plot	Area (ha)	Value of Bare Land (VTN) (USD)	
		Federal	State
Enrolled Federal Plots (GFM)	105,830.05	+36,229,859.32	
State Plots (GE)	359,615.80		+47,343,420.07
Enrolled Federal Plots (GFM) and Overlapped State Plots (GE)	16,153.32	-5,529,927.57	+2,126,584.58

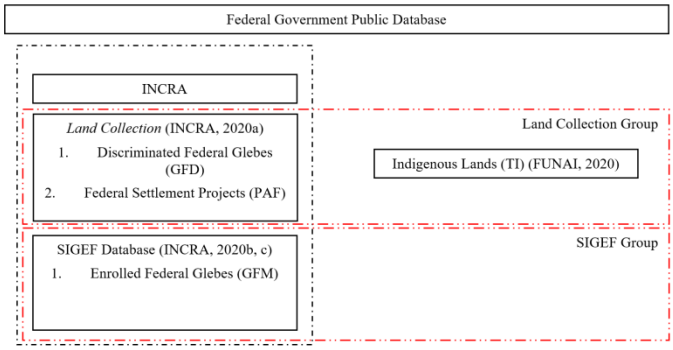

Fig 5. Groups and categories of information available in the federal government's digital land data platforms regarding federal public lands (TPF).

Table 7. Values of bare land (VTN) in dollars per hectare for enrolled federal plots (GFM) and state plots (GE) in the municipality of Paragominas.

Jurisdiction	Categories	Value (USD/ha)	Source
Federal	Enrolled Federal Plots (GFM)	342.34	INCRA (2019)
State	State Plots (GE)	131.65	ITERPA (2021b)

The absence of a state policy for post-issue evaluation of titles and monitoring compliance with resolution clauses discourage rural producers to comply with legal obligations. The issuance of the title without any land or environmental governance tool may encourage agricultural activity to the detriment of deforestation that allowed by the registry office.

In GE, soy cropping was a strong driver of land regularization, establishing a loss of forest in 2014 to 2016 and areas historically used in livestock, stabilizing in 2017 and 2018 (Figure 3A), while for GFM there was stability in soy, livestock, and other temporary crops in the same period (Figure 3B).

The results converge to those of Probst et al. (2020), who studied the relationship of titles issued on federal lands, through the Terra Legal Program, describing that farmers reduced deforestation in their possessions one year before receiving the title, while after receiving of titles, deforestation was increased. The materialization of deforestation was occurred between 2 and 4 years, and the effect of regularized land responded more quickly to the agricultural market than land not yet regularized.

Materials and Methods

Study site

Paragominas is located in the southeastern state of Pará, Eastern Amazon, with an area of 19,342,565 Km^2, at coordinates Latitude: 2° 59' 51''S, Longitude: 47° 21' 13 ''W (Figure 4), constituting a reference for the registration of federal public lands. The region is very promising for agrarian activities and shows an effective increase in the areas cultivated with short-cycle crops, especially corn, sorghum, and soy (IBGE, 2021).

Evaluation of rural land bases

To assess the available base of federal (TPF), state (GE) and private (TP) rural land, a distinction was made between rural land and urban land by subtracting the areas corresponding to the 2019 urban area resulting from the MAPBIOMAS (2020) platform. There was the exclusion of urban areas referring to classes of urban infrastructure, consolidated urban areas and informal urban centers.

The evaluation of rural public lands was based on data generated by land management bodies (such as Federal Lots and Settlements - INCRA; Indigenous Lands - FUNAI; State Lots - ITERPA) with vector data in shapefile format. Federal Public Lands (TPF) included all Indigenous Lands (TI), Federal Settlement Projects (PAF), Discriminate Federal Plots (GFD) and Inscribed Federal Plots (GFM). The GFD are defined by Decree-Law 1164/1971, which instituted the federal lands that were 100 km from the axes of federal highways built, under construction or in planning, subject to a land discrimination process by INCRA (Brasil, 1971). The GFM originated from the process of land discrimination, separating those already titled from those suitable for federal collections, culminating in registrations in the land registry office (Brasil, 1973).

Since the information acquired for analysis does not have standardized spatial, tabular, geometric, and territorial precision data from public digital platforms, they were separated into 2 groups of TPF (Azevedo-Ramos et al., 2020). The Land Collection group (FUNAI, 2020; INCRA, 2020a) was categorized into: 1. Indigenous Lands (TI); 2. Federal Settlement Projects (PAF); and 3. GFD in the 1980s. For the

SIGEF Database Group (INCRA 2020b, c), the GFM categories were evaluated according to the property nomenclature and georeferencing certification in INCRA standards (Figure 5).
The GE refers to public lands, owned by the state of Pará, registered on behalf of the state in the administration of ITERPA. The GE registered in the registry and their characteristics of provision for rural land regularization were included, excluding those affected by traditional communities, settlements and/or nature conservation units.
The TPs were represented by lands that have title deed with or without registration or enrollment in a land registry office issued by the state of Pará. The title information (ITERPA, 2015a; ITERPA, 2021d) was evaluated, distinguishing: **a.** issuance of titles prior to 1964 (TP – 1964) and; **b.** land actions from 2010 to 2020 (TP – 2010 to 2020). The TP – 1964 were grouped into a separate category due to the absence of a legal obligation to detach plots, being excluded from the rules for dismembering large portions of registered public lands. The TP – 2010 to 2020 were gathered in blocks, respecting the detachment of state plots, safeguarding the rules that oblige the holder to comply with the inalienability clauses for 10 years and environmental standards. Areas without TPF, GE or TP information were considered as Lands Without Information (TSI), constituted by unassigned or unregistered public lands, or under regularization, or unregistered private lands. The TPF, GE and TP polygons that serve areas in the neighboring municipalities of the study area were separated, so that the corresponding areas were included only in Paragominas. The land network was adjusted by the jurisdiction of TPF, GE, TP and TSI to structure a tenure diagnosis (Table 6).

Assessment of public land overlaps
To evaluate the overlaps between the TPF, the difference between the GFD and GFM areas was calculated, according to equation 1:

$$DTPdm = aGFM - aGFD \quad \text{Eq. 1}$$

Where:
DTPdm: difference in areas between the GFD and GFM groups;
aGFD – original area of the GFD;
aGFM – detached area of the GFM.

Equation 1 described the results which can assume positive or negative values. For the positive values, the analysis refers to the gain in areas, and the negative values to the area reduction between GFD and GFM. The percentage values were calculated using the data obtained from the DTPdm, whose values are expressed in area reduction or attainment according to equation 2, where negative values are interpreted as the percentage of reduction between GFD and GFM and positive values on the proportion of land increase.

$$DTPdm(\%) = \left(\frac{aGFM\ x\ 100}{aGFD}\right) - 100 \quad \text{Eq. 2}$$

Where:
DTPdm – difference in areas between the GFD and GFM groups;
aGFD – original area of the GFD;
aGFM – detached area of the GFM.

To assess the overlapping of federal and state public lands, spatial information from GFM and GE was used. In this analysis, GE were used in the GFM, due to the fact that the GFM were registered prior to the GE. The overlapping area for GE in hectares and the Value of Bare Land (VTN) in USD were calculated to verify the possible loss of territory and VTN of the GFM due to GE (Table 7).
To compose the agrarian diagnosis, 4 scenarios of agrarian grid were considered: i. Scenario I: Data from the Land Collection group (GFD, TI and PAF) and TSI; ii. Scenario II: Data from the SIGEF database group (GFM), land tenure group (TI and PAF) and TSI; iii. Scenario III: Data from the SIGEF database group (GFM), land tenure group (TI and PAF), GE and TSI; iv. Scenario IV: Data from the SIGEF database group (GFM), land tenure group (TI and PAF), GE, TP (TP – 1964 and TP – 2010 to 2020) and TSI.

Deforestation and land use conversion on public lands
For deforestation and land use on public lands, the effective annual deforestation from 2008 to 2019 was analyzed using PRODES data (INPE, 2020) from the Terra Brasilis platform (Assis et al., 2019) in the GFM and GE. For GE, the issuance of title deeds by the state of Pará from 2011 to 2018 was added in the deforestation analysis (ITERPA, 2011; ITERPA, 2012; ITERPA, 2013; ITERPA, 2014; ITERPA, 2015a, b; ITERPA, 2016; ITERPA, 2017; ITERPA, 2019; ITERPA, 2020; ITERPA, 2021a, d). Deforestation areas and their land use conversion in GFM and GE were quantified, identifying the information layers of Pastures, other temporary crops and soy from 2008 to 2018 (MAPBIOMAS, 2020).

Conclusion

The divergences in the agrarian database of public and private lands cause erroneous diagnoses. The absence of accurate information causes the state to lose control of public assets, promoting inefficient land accounting, with the overlapping of current real estate records of state public lands on federal lands.
The new form of land grabbing was implemented on federal public lands, instituted within the scope of the state government and formalized in the registry offices, with a loss of US$ 5,529,927.57 to the federal public patrimony. This land grabbing produces a financial advantage, as the value of bare land in the state of Pará is lower than in the Union, with the issuance of property titles.
Deforestation was higher on state public lands than on federal lands due to the lack of a state land and environmental policy that equalizes deforestation and compliance with the obligations of the resolution clauses of state titles, which contributed to the increase in deforestation.
For an efficient planning of land tenure regularization in the Amazon, the interaction of information between land agencies and registry offices is necessary, generating a single database with common rules, with a realistic land diagnosis and establishment of a single land accounting.

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