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TYPES OF LAND TENURE IN BRAZIL: THE FIRST ESTIMATE FROM AVAILABLE GEO-REFERENCED INFORMATION

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Abstract

The Brazilian efforts to create a unified land cadaster that can improve its Land Governance are quite large. The land Management System – SIGEF, created in 2013, is contributing to the formation of a georeferenced cadaster of rural land, comprising public and private areas, already showing significant quantitative results of rural, public and private property. The CAR, a private self-declared georeferenced cadaster, for environmental management purposes, has a large coverage of the private land ownership and possession around the country. Although recent advances were made towards a better Land Governance and control over the territory, there is still a lot of conflicting areas and rights, regarding what type of land use/occupation is allowed, where.

The main aim of this article is to present a portrait of the Brazilian land tenure reality, based on the different categories of domain, but also the reliability of the different cadasters information's that area available and who is the integration of its information. This initiative seeks to facilitate the understanding of where, what, how much, who and how land is used and occupied in Brazil.

Key Words: Brazil; Land Governance; Agricultural Atlas; Cadasters; Registers.



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Introduction

In Brazil, there is a twisted dynamic between the different cadasters and public agencies that manage them. At the federal level you'll see the cadasters CAFIR (Cadaster of Rural Properties), CNIR (National Land Registry) and CAR (Rural Environmental Cadaster), that are managed by independent public agencies, respectively, Federal Revenue Service (RFB), INCRA (National Institute for Colonization and Agrarian Reform) and MMA (Ministry of Environment). The Largest datasets are from INCRA, with the SNCR (National System of Rural Cadaster) and the RFB with the SINTER (National System for Spatial Information Management), being the two agencies responsible for the input and verification of data is in the SIGEF (Land Management System), still the most robust and accessible geospatial system for public access. Despite being important, all of those tools, either for cadaster or integration of data, are behind schedule.

Besides those, there are also other specific cadasters, from the FUNAI (National Indian Foundation) responsible for indigenous lands, the MMA for the Conservation Units and INCRA for the settlement areas, for example. Each of these systems act in a totally autonomous way and do not have their information systematically integrated, despite being legally obliged to do it. It should be added to this scenario the SPU (Secretariat of the Patrimony of the Union), which is responsible for the cadaster of public lands of the Union, but only the areas that have been already collected (legally recognized), the shores, riverbanks, strategic areas and other areas, such as "*Sesmarias*", "*aforamentos*" and similar. But what stands out the most is the inexistence of a public, easy access, integrated cadaster of all public lands, even federal public agencies have neither an integration of cadasters nor institutionalized mechanisms to consult each other's domains.

Although INCRA and the Federal Revenue of Brazil (RFB) have created conditions for the integration of information, its collection, availability and the establishment of partnerships with other federal agencies, these are not established. For example, there is no articulation between the three federative levels, the SPU, the municipalities and the State Institutes of Land, which all have their own geospatial information. The state public lands, under the management of the State Institutes of Land, hold a large part of the country's public lands, although it is yet not known precisely where they are and who is legitimately occupying them, since these lands are not in the SNCR.

Another important institution that is inherently linked to the problem are the Real Estate Registry Offices. "In Brazil, registry offices are private entities that provide a public function by delegation, have



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the function of registering private lands. Due to this way of acting, they had no integration with other public agencies, hampering the communication and the exchange of information in the institutional arrangement that involves land administration "(Reydon et al., 2017). It is also important to highlight that this framework of land management in Brazil is responsible for much of the overlapping responsibilities and attributions between institutions, bearing an important share of responsibility over land conflicts and fragile Land Governance that stands in Brazil nowadays.

A fundamental condition to understand this fragile Land Governance is the fact that the Brazilian public agencies do not have the tradition of registering their properties in the Real Estate Registry Offices, although it is legally required of them to do it, which greatly complicates the processes of identification, certification and regularization of public areas, to prevent them from informal/disordered occupation. The integration between the property registries maintained by Real Estate Registry Offices and the cadaster of public areas of the governmental organs, still is incompatible and in deficit.

The lack of integration between the registry (Real Estate Registry Office) and the INCRA's cadaster makes it impossible to geographically identify land rights and, consequently, to have an efficient enforcement of those rights (either public or private), since the literal information do not match the geographic data, nor reflects the reality seen on the ground, therefore, there are the occurrences of overlapping of land rights and inconsistencies of information, to say the bare minimum.

Better coordination between the two responsible institutions could provide greater legal certainty to property rights and give more legitimacy to rural land. Although, a lot of this scenario changed with the "Law 10.267 of 2001, that sets to the Real Estate registry Office the need to share their information with INCRA and the Federal Revenue Service in case of any alteration of the property registry" (Reydon et al., 2017). This was an important step towards the integration of national information, but it is still today underdeveloped and in deficit.

Historically in Brazil there is a disagreement between the legal obligation to register a deed and the custom of not doing so, a conflict between the owners of the property and the agencies of the Notaries Registry Office and the Registry of Real Estate. Part of the problem is due to the information needed to carry out the public deed, which are demanded and organized by the real estate office, which (before 2001) were not obliged to georeference the property boundaries. However, it was sought to reverse this scenario with Law n° 10.267, but the lack of a proper registry in many regions, a complete national cadaster of lands,



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and the harmonization between this two information's, results in a greater legal insecurity to property, enabling judicial conflicts, which appropriates time and resources.

In short, there is a significant number of constitutional, agrarian, civil, environmental, and planning laws, all of which are agglutinated in the three spheres (municipalities, states, and the Union) governing land relations in Brazil, attempting to establish and regularize land rights, its registration, documentation and other adjacent processes to integrate them into an “organic cadaster” (whose information is perishable and requires systematic updating). From this decentralized and disjointed perspective, the responsibilities of the respective agencies on the management of parts of the territory, in both, on the land cadaster jurisdiction and the recognition of rights associated to that parcel, through land regularization processes and registration in the registry offices.

The Agricultural Atlas

The “Atlas of Brazilian Agriculture” is an initiative from IMAFLORA (Institute of Forestry and Agricultural Management and Certification) and GeoLab (a research group from University of São Paulo specialized in geospatial information), that proposed the first complete and integrate map of the Brazilian areas, public and private. In order to do so, they gathered all the public lands information's (available due to the Public Access Law) and the private land information that were made available by the SIGEF and (more recently) by CAR. Because of the lack of integration between those datasets, there was a reasonable amount of overlapping between areas, therefore, to be able to present a unified version of the Brazilian territory, a hierarchy between cadasters was proposed to justify the preference of one lawyer over the other when a conflict is detected.

The objective of the Atlas is to present the land tenure situation of the country, using the different public data bases of the land cadasters that are available from the respective responsible institutions. The systematic organization of geospatial information was plotted into a map to obtain the closest picture of the reality of land tenure as possible, considering the knowledge of different institutions, with their respective jurisdictions, on the land administration within the territory.

This article will present the initial results of the Atlas, especially regarding the differences and overlaps between cadasters, besides that, it will also present the methodology for defining a hierarchy between the different cadasters as discussed earlier, to detail the reasons that justify a specific order. This



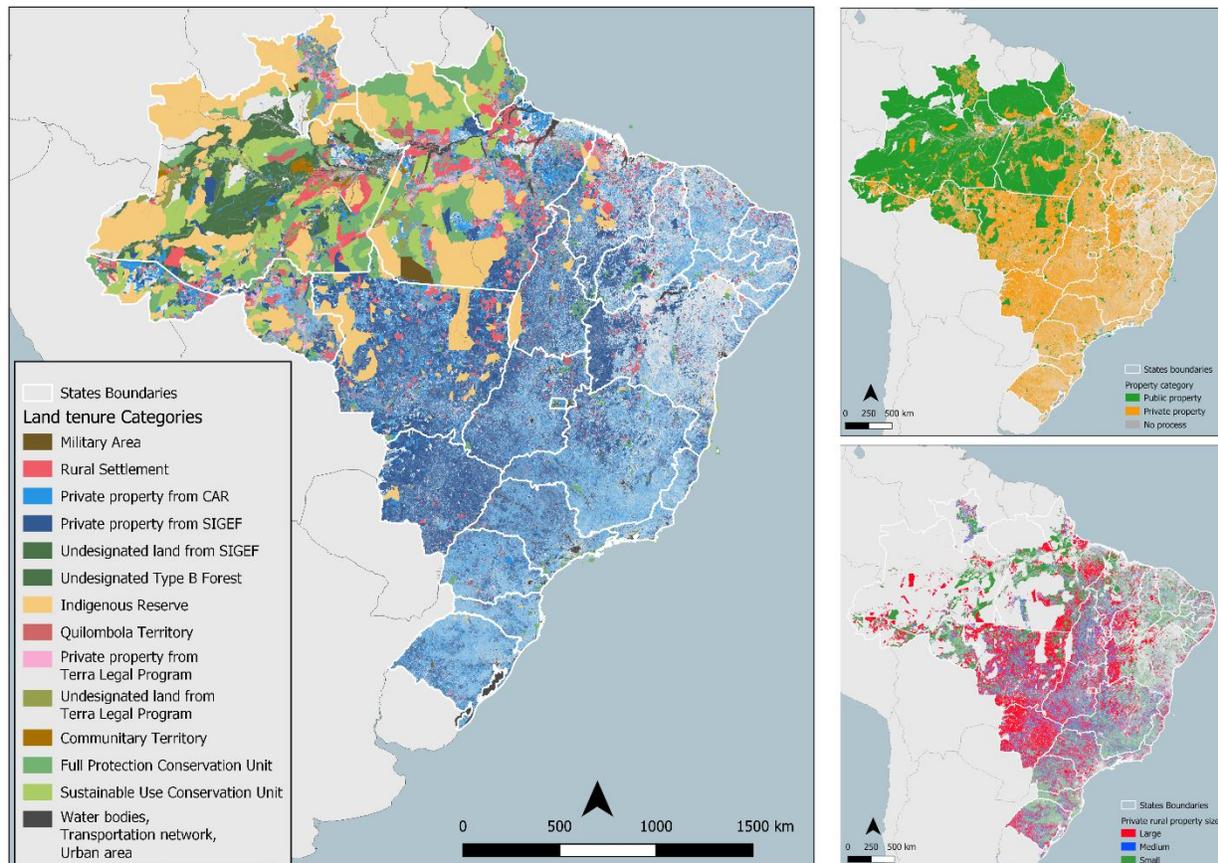
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proposal of organization of the different Brazilian cadasters was developed by the Atlas creators', IMAFLORA and GeoLab, in partnership with the Land Governance Group from UNICAMP, with specific knowledge from the Brazilian land administration system.

Figure 1 - Image of the Atlas of Brazilian Agriculture



Source: Atlas da Agropecuária Brasileira – IMAFLORA, 2019.

In a first experiment in the construction of this map, several overlaps between the different land cadasters were identified, for example, in relation to the claims from CAR and public areas, something that was already expected due to the specific characteristics of these data sets. Therefore, a hierarchy was necessary and a methodology that would justify it, a neutral criteria that would give preference to one over the other, to obtain a single map with the complete coverage of the territory. The purpose of the methodology imposed by Atlas of Brazilian Agriculture was to consider the current laws and regulations



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of the land administration system in Brazil, clarify the differences and particularities of each of these cadasters and (based on legal standards) integrate all information in an orderly hierarchy.

To do so, it was important to present a summary on the Brazilian cadasters, their particularities and current legislations to understand with had a 'stronger claim' over the others when a conflicting area was detected. There are legal determinations of these cadasters, made by different institutions in different contexts, some of them are constitutionally determined as others are made by agencies to organize themselves. These legal determinations and characteristics had to be considered and justify the hierarchy proposed.

Brazilian Land Cadasters

On behalf of the National Rural Cadaster, INCRA is the autarchy responsible, linked to the Ministry of Agriculture, that aims to carry out the national land management through the following actions: "creation and implementation of sustainable rural settlements, land regularization of public lands, management of the country's land structure, allocation of public lands, demarcation and titling of lands occupied by traditional and *Quilombola* communities, discrimination of vacant lands, promotion of rural land cadaster and certification by georeferencing rural properties" (Law n°. 6.383, of 07 of December 1976). Therefore, besides the responsibilities related to land management, this institute is able to promote land regularization in public areas, which means provide real land rights to isolated communities.

Considering its responsibility over the rural land management, INCRA and the cadasters which the autarchy is responsible for, get an important focus in the hierarchy. Since INCRA is legally responsible for the management of the rural areas, its main system (the SNCR and the SIGEF) are the most important systems for the Atlas, that is specially because all formal rural properties have to have a CCIR (Certification of Cadaster of Rural Property), which means that (supposedly) all of the rural land owners would have to map, identify and formalize their properties with INCRA, a constant input of information to update the SNCR. Considering this arrangement, in theory, each change of owner and/or format of the property, would mean an instant change in INCRA's cadaster, but, besides that, since INCRA is also responsible for gathering information from other agencies, it is expected that on a certified property does not occur any overlap with other public areas.



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All of these information updates are systematized in the CNIR which is the spatial representation of SIGEF, both that are managed by INCRA (with inputs from CCIR) but also by RFB, which has its own cadaster the CAFIR. The CAFIR is a cadaster of rural properties based on Rural Land Taxes (ITR), which means that every effective owner (that is paying their taxes) are covered by CAFIR. Although, there is a diversion of concepts between systems, that is because CAFIR can consider adverse possession as long as the occupant is paying the ITR, a common practice for the occupant evidence its possession, therefore it is not possible to completely integrate the CAFIR and CNIR in a single database. Part of this issue is supposed to be solved by the SINTER, which will be the ultimate integrational system, not only between INCRA and the RFB, but also with the municipalities and other public and private agencies. The SINTER is still being regulated, therefore, it is still not available and fully-operational.

Currently, the most complete and integrated system still is the SIGEF, which make available all shape files (.shp) of all categories of land occupation available online, but also presents some of the available results on their website (SIGEF, 2019). Besides that, using information from SIGEF, it is possible to access specific information from each municipality, regarding every land owner, the size of their parcel and their legal status, using the public access system SNCR (SNCR, 2019).

To complete the Brazilian system of cadasters, there are also the ‘thematic’ ones, those which are specific to certain types of land destination. There are the environmental cadasters, such as CAR and CNFP, which are handled by the Brazilian Forestry Service (SFB) that is (now) linked to the Ministry of Agriculture, but there is also the CNUC, which is managed by the Institute Chico Mendes (ICMBio) in the Ministry of Environment. There are also the indigenous areas, which are responsibility of FUNAI, in a different cadaster within the agency. All of those, are supposedly to be aligned with INCRA, which is responsible for the spatial management of this information but, what we verify, is a compromised communication between agencies and a deficit between the information’s detained by the agencies and what is available in INCRA’s system.

There is one last important agency that deserves presentation, which is the Brazilian Institute of Geography and Statistics (IBGE). This is the main agency for official parameters of physical definitions, such as limits and boundaries of states, municipalities and public spaces defined by Law. The IBGE is responsible for the definition of perimeters of a municipality, but also the definition of other natural limits, such as large rivers or lakes. By this, the spatial information from this agency is important to define the limits of occupation for the territory, especially regarding the agricultural areas.



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Methodology of Analysis of Overlaps

This article intends to describe in detail the criteria used for this hierarchy as the reasons that justify these choices. During the development of this methodology and criteria, these were discussed and agreed in a stakeholder meeting that gathered important agencies involved with this subject, such as, INCRA, SPU, Brazilian Rural Society (SRB), Brazilian Institute of Trees (IBA), UNICAMP, among others. The arguments then presented the criteria from the perspective of the proposed hierarchy, in order to allow us to obtain a realistic overview of the land tenure situation of Brazil, considering its legal framework.

It is also important to highlight that this is not a priority order based on environmental importance or land rights associated with land, the hierarchical order is based on the trust of available information, the legal recognition of rights over land and the possibility of change from its current occupation status. All legal background and relevant framework were also considered to propose the hierarchy, once that exist rights which overrule others when in conflict. Finally, the proposed criteria were based on four structural aspects: legal security of the right, accuracy of geospatial information, possibility to receive overlap and possibility of change in its domain.

Based on these aspects, the different cadasters were evaluated in relation to the quality of the information as being "High", "Average" or "Low". By relating the different evaluations of the 4 aspects, the cadasters were organized in a hierarchy and the position of greater advantage over other bases is supposed to have high legal security of the right, high accuracy of geospatial information, low possibility to receive overlap and low possibility of change its domain. The differences between the evaluations are based on the criteria proposed to organize the layers.

In order to evaluate the different cadasters under the aspect "legal security of the right" it was considered the different pertinent legislation that can interfere in the priority of use and/or occupation of a certain part of the territory (ex. the Indigenous Original Right over the lands that they traditionally occupy, constitutionally disposed in §4, article 231 of the Federal Constitution), but also the Legal Framework that regulate titling and land allocation procedures, especially the cadasters from agencies that act with land regularization and adverse possessions in public lands (such as INCRA and Terra Legal program). In addition, other legal aspects were considered in cases of conflicts resolution, as well as the specific positioning of each agency in this matter. Therefore, this aspect was characterized as " High " when the rights associated with the type of use from that parcel were clear, recognized and secured by a competent



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agency/institution, as well as the legal certainty that the respective domain have in case of an overlap with the other category.

In order to evaluate the different cadasters under the aspect "accuracy of Geospatial Information", we considered the technical procedures and specific aspects of each agency responsible for that specific cadaster, as well as the type of responsibility each has in organizing the information of the territory. For example, the process of certification of rural properties by INCRA, requires an engineer accredited by the agency, to make a georeferenced survey of the property perimeter, which characterizes the highest accuracy and reliability of the available information. On that matter, the reliability of the information available by this layer was characterized as "high", since it is known the quality of survey that is made to generate this information, the responsibilities of the agency and if the information is up to date.

In order to evaluate the different cadasters under the aspect "possibility to receive overlap", it was considered a first experience with the Atlas and the analysis of the results to detect the most recurrent overlaps. From these results and specific knowledge, it was possible to understand the reasons for these overlaps and then propose a categorization. For example, the overlapping of the category "Community Territories", which includes older settlements, with the Rural Settlements category is recurrent, because many of these settlements are in process of transition from one category to another and have not yet been updated in the system.

Another example also helps to explain why the occurrence of overlaps does not necessarily represent an actual conflict. For example, in the category "SIGEF/SNCI public" (which removes all other categories of public areas that were destined, such as UCs, settlements, Tis, Terra Legal etc.) there are the non-destined public areas. Thus, it was defined as "High" the possibility of the category "SIGEF/SNCI public" to receive overlapping from the other categories, since these areas are likely to be destined. This also happens with the "Forests Type B" from the SFB, which represent a large parcel of un-destined lands and, by that, are overlapped by many different categories.

In order to evaluate the different cadasters under the aspect "possibility of change its domain", special consideration was given to the overlapping of real property rights, over un-destined public lands, but also fragile (uncertified) rights areas conflicting with already destined with high legal certainty areas. A representative example are those areas earned by the "Terra Legal" Program (PTL) that have not yet been titled, those have a high possibility of change in domain since the guideline of the program is to regularize the legitimate adverse possessions that are in public areas, respecting the justification of Law for Land



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Tenure Regularization (Law 13.465/17). Therefore, processes of public land allocation were also considered, since recurrent overlaps were identified by that matter.

Considering these aspects of the criteria, the cadasters within the hierarchy were evaluated depending on the reliability of the information available and/or the knowledge of the procedures of data production and geospatial standards. Also, specific aspects of each agency responsible for producing and maintaining the obtained information were considered, to better construct this evaluation. Since each entity and system have operational peculiarities that foresee the occurrence of overlaps and cannot be ignored, then it was proposed a hierarchy of cadasters with a clear, recognized and verifiable methodology.

The Hierarchy of Land Tenure Bases

The following hierarchy is proposed after analyzing the information presented, under the methodology described, considering all legal and technical characteristics of each database:

0. Urban, Transport and Water - IBGE

- Physical immutable aspects of the territory - They have the highest priority in the hierarchy, since they limit the physical occupation of the territory by people. Once the sum of these areas is removed, what is left is the "occupational" part of the territory, that is why it has a differentiated position within the hierarchy when analyzing all layers.

1. SIGEF / CNIR – INCRA

Represent a recognized legal right over land that is georeferenced and certified by INCRA, either private or public - The certification of a property by INCRA is based on the deed within the Registry Offices, because the cadastral information of the property arises from the obligation to have a georeferenced blue print of the property attested by a Registry Office. Besides that, it is required to respect the technical requirements of the agency regarding the geospatial survey (such as the need for an accredited engineer), which gives us greater credibility about the information and greater legal security on the perimeter and design of the property.

2. “Terra Legal” Program titled – CNIR/INCRA



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All properties that the PTL has already destined but are not yet in the SIGEF - knowing the titling process done by the PTL and the level of technical requirement according to INCRA, it has great legal security and reliability in the accuracy of survey done in the ground. This layer has a greater security of spatial information and about the rights associated with the parcels, which gives this category a high position in the hierarchy.

3. Quilombola – CNIR/INCRA

Represents all Quilombos certified by “*Fundação Palmares*” with management of the land cadaster by INCRA, which provides high security of the geospatial information and about the private land right of the association (the legal representation of the community and legal right holder) - Considering the management of INCRA on the land base (the main agency for land management in the county), there is greater control and verification of the information’s collected on the ground, so this land base gains a high level in in the hierarchy.

4. Homologated Indigenous Lands – CNIR/INCRA

Indigenous lands that were demarcated and homologated by FUNAI, with determination of boundaries of a territory associated with a certain ethnic group, legally recognized by decree - The emphasis of this cadaster for the hierarchy is given by the “Indigenous Original Right” over the recognized areas, which overrule any other property right in case of overlap and/or conflict. Because it is a land base under FUNAI’s control, eventually it is outdated compared to the others, due to the non-communication of new perimeters and/or changes in the IT perimeters, so, considering the proposed methodology, it has less confidence than other cadasters in control of INCRA (such as *Quilombola’s* areas, for example).

5. UC Integral Protection – CNUC/ICMBio

Land base under management of the ICMBio, assigned as the average security of the property right, because there are recurrent overlaps with private areas. Those have to compensate the environmental liabilities by reconstituting other areas of the same biome (Forest Code, 2012), so they have a high security of geospatial information, but average possibility of overlap and of change its domain – Spite having a standard legal framework for all the UC’s category, this one have a greater degree of safety against change its domain for not allowing any type of use or exploration in its area, although this difference exists, it is not sufficient to change the position in the hierarchy, only to be the first among the categories of UC’s.



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6. UC Sustainable Use – CNUC/ICMBio

Base form the same origin and characteristics of the other UC, under management of ICMBio is attributed with medium security of the property right, since is identified an overlap with private areas. They have high security of geospatial information, but average possibility of overlap and to change its domain – Spite having the same characteristics of quality and reliability on the informed data, the type of use that is allowed in this category defined its position among the UC's.

7. Military Area – Ministry of Homeland Security

Base under the management of the Armed Forces, but under the responsibility of the Secretariat of the Patrimony of the Union (SPU), with high security of the law, but less security of the geospatial information. Because of the military land information is kept unknown, this layer loses priority in the hierarchy from all other protected areas. Once the SPU real estate cadaster becomes public, this situation can change.

8. Rural Settlement – CNIR/INCRA

Despite the high reliance on geospatial information (given INCRA's latest surveys and demarcation of settlements) and the high security of associated rights, this category loses quality as a result of outdated information (especially in old settlements) and/or domain situations that are subject to change in the future – There is a recent possibility (because of Law n° 13.465/2017) that beneficiaries in the rural settlement after completing all clauses demanded, will be able to start a regularization process and will become private areas, therefore, may change domain in a future to come.

9. Community Territories – CNIR/INCRA

This category was created by the Atlas initiative from the category “*Florestas Tipo A*” from SFB cadaster, which embrace the federal and state rural settlements; rural settlements projects (PAE), forested rural settlements projects (PAF), Sustainable Development Projects (PDS), extractive rural settlements (PEAX), state projects for sustainable rural settlements (PEAS), state rural settlements (PARE) and rubber plantations – Many of those classes contemplate older forms of rural settlements and other types of communities demarcated by INCRA in the past, therefore, there is a high chance of overlap from this layer with the previous one (8. Rural Settlements), what justify its lower position in the hierarchy. There are also



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community territories that are in transition phase for titling or recognition as a rural settlement, this adds a high possibility of change its domain, but also decreases their preference in the hierarchy.

10. Non-homologated Indigenous Lands – CNIR/INCRA

Indigenous areas that already have their boundaries defined but are not homologated and, therefore have a low security over the land right and a medium reliance on geospatial information - Despite “Indigenous Original Right”, non-homologated ILs have a low position in the hierarchy, especially due to lack of (or badly done) confidence in the geospatial information by FUNAI. However, once properly demarcated and homologated, any overlap with this category is suppressed, and these areas "leapfrog" to one of the highest hierarchical levels in the proposed methodology.

11. Private Areas, possessions and self-declared domains - CAR/SFB

For being a self-declaratory cadaster, under the management of the Brazilian Forest Service (SFB), this layer loses much of its reliability over the rights associated with the land, when overlaps are identified - Once the information declared is verified and the overlaps rectified, the CAR may gain more reliability regarding the geospatial information presented.

12. Legal Land not titled – CNIR/INCRA

These areas refer to public lands (in the Legal Amazon) that were georeferenced, collected, registered, but not yet destined - Because they are public lands contemplated by a program that aims at the regularization and destination of occupied areas, any overlap between this layer and the others indicates a potential use and destination. Since the orientation of the program is precisely to regularize the informal situation of areas within those un-destined areas, there is a very high possibility of overlapping and change in domain.

13. SIGEF / SNCI public – CNIR/INCRA

It is important to highlight that this category corresponds to the public SIGEF, without all specific categories of public areas (UC's, settlements, IL's and etc.) that were already incorporated in a level above, so what is left in this category has a high geospatial accuracy, but low security of rights associated, since few of these public areas were properly registered in a registry's office - despite the high degree of reliability regarding the geospatial information, usually when is identified an overlap from any category with un-destined public areas, the expected procedure is to detach the overlapping area and assign it to a proper



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function, considering its current occupation. In this way, this category is overlapped by almost all the others, although it is understood that the different forms of occupation and social use of the land prevails over this generic category.

14. Forests Type B – CNFP/SFB

This layer under SFB management, which compose part of the CNFP, are also considered un-destined public lands – This category was formed by areas from SIGEF/SNCI public and Legal Land not-titled, but also from areas surveyed by the State Land Institutes. It probably indicates a reasonable accuracy of the geospatial information; however, the responsible agency was not able to identify the legal status of the demarcated areas, which makes the information regarding the security rights over land very low. Considering the characteristics of these areas, there is a high possibility of change its domain in the future.

At the end of the analysis of the cadastral land bases following the methodology proposed by this report, it is obtained the following situation of hierarchy between cadasters, expressed in Table 1:

Table 1 - Hierarchy of cadasters after methodology applied

Databases of Land Cadasters / Criteria	Legal Certainty	Accuracy of Geospatial Information	Possibility of overlapping	Possibility of change in tenure	Overlapping priority
Private properties registered in the SIGEF/SNCI systems ³	H	H	L	L	1
Titled land from the <i>Terra Legal</i> Program	H	H	L	L	2
<i>Quilombola</i> Land	H	H	L	L	3
Homologated Indigenous Land	H	M	M	L	4
Fully Protected Conservation Unit	H	M	M	M	5
Conservation Unit for Sustainable Use	H	M	M	M	6
Military area	H	H	L	L	7
Rural settlement	H	M	H	H	8
Community Territory	L	M	H	H	9
Non-Homologated Indigenous Land	L	M	H	H	10
CAR	L	M	H	M	11



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Untitled land from the Terra Legal Program	L	H	H	H	12
Public properties registered in the SIGEF/SNCI systems	L	H	H	H	13
Type B Forest	L	M	H	H	14
Captions	H: High	M: Medium	B: Low	-	Position n°

Source: elaborated by the authors, 2019.

Result Analysis

Considering the hierarchy proposed, the overlaps were ‘cleaned’, considering that a preferential category would overrule the affected ones, then, a complete map of the territory was proposed and its analytical data organized in a more sensible way. For that, we separated private properties present in the SIGEF system, those in CAR (that are not correspondent to any in SIGEF), and “Terra Legal” Program (plots that were titled). But also, the categories of Conservations Units were merged and the Indigenous Lands also, considering that all non-homologated areas will be regularized in a near future to come. Besides that, the last two categories, still with no defined destination were merged into an ‘Unregistered’ category, meaning that those areas have a complete uncertain future. Similar to those, are the ‘Undesignated Land’, composed by un-tilted areas from Terra Legal Program, that are also left to different possibilities and outcomes of legislation.

Finally, after processing all the information available and organizing it in a reasonable way, the following results (Table 2) were obtained from the Atlas:

Table 2 - Land tenure categories in hectares (and percentages)

Private properties from CAR	173.844.446	20%
Private properties from SIGEF	188.782.796	22%
Private properties from Terra Legal Program	9.830.630	1,2%
Quilombola’s Territories	3.117.971	0,4%
Rural Settlements	41.736.096	4,9%
Communitarian Territories	1.779.373	0,2%



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Indigenous Reserves	112.412.239	13,2%
Conservation Units	93.403.026	11,0%
Military Areas	3.006.965	0,4%
Undesignated Lands	54.599.607	6,4%
Unregistered	141.454.569	16,6%
Transportation network, Urban area and Water bodies	26.310.500	3,1%
Total Brazil	850.278.218	100,0%

Source: elaborated by the authors, 2019.

From those information's, it is possible to understand Brazil from different perspectives, but also, to propose different scenarios and outcomes, considering that there 23% of the territory still have an uncertain future. It is also important to highlight that all of this data is supposed to be updated as far as new forms of occupation of the territory take place. Besides that, from the information of the Atlas and other databases, it is also possible to understand the areas that are suitable for agricultural production and/or the historical process of occupation certain parts of the territory, but those results will need further analysis and improvement.

The direct results that are possible to obtain from this picture of the Atlas are the public and private areas, being 49% of the territory privately owned and 31% formally public (remembering that are still unregistered lands). It is also possible to know how much Protected Land (Indigenous Reserves + Conservations Units) is actually being protected by the State, being 24% of the territory. On this matter, it is important to highlight that initially, that summed Protected Areas should account for 27%, which means that there are conflicting rights (between land use and destination) in 25 million of hectares that should be native forests.

Considering the forested areas of Brazil's territory, from the results of the Atlas, it is expected that an average of 50% of private properties should be protected as native forests¹, which means around 420 million of hectares. That assumption also considers as private properties the Quilombos, Rural Settlements and Communitarian Territories, first because these categories allow agriculture production in their configuration, but also, considering the new Law nº 13.465/2017 that enable settlements in public areas to

¹ According to the Forestry Code, mandatory percentages of native forests in private properties range from 20% to 80% depending on the biome that the plot is set upon.



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be privately regularized after the concession clauses are fulfilled. From that perspective, we can better estimate what part of the county is currently being used for agricultural production, something that may change if the undestined and unregistered lands are actively occupied for that purpose.

This last assumption permits the proposition of three different scenarios, one prioritizing Natural Conservation, turning undestined and unregistered lands into Protected Areas, another more pessimistic, turning them into productive areas, and a middle ground, being undestined lands turned into productive areas and unregistered areas into conservation units. The differences between the Conservationist perspective and the Productive perspective can affect more than 20% of the territory, meaning 170 million of hectares, a very important discussion to be made considering the Global Climate Change and Brazil's position as a strategic stock of carbon to help mitigate the impacts of Green House Gas emissions.

A more detailed overview from the Atlas results can be found in the following table (Table 3), that establishes the Original Area set out for the land tenure category, but also, the amount of overlapping areas, with which categories and who prevails above the other considering the hierarchy proposed. By that, it is possible to have a clear vision of which cadastral systems are more conflicting than the other, also it makes more visible the most critical aspects of Land Governance in Brazil, which is the lack of control over territory information by evidencing improper claims over legally assured rights.



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Table 3 - Hierarchy of land tenure categories considering the overlaps (in hectares)

Land tenure category	Private property from SIGEF	Private property from Terra Legal Program	Quilombola Territory	Homologated Indigenous Reserve	Full Protection Conservation Unit	Sustainable Use Conservation Unit	Military	Rural Settlement	Communitary Territory	Non-Homologated Indigenous Reserve	Private property from CAR	Undesignated lands from Terra Legal Program	Undesignated land from SIGEF/SNCI	Undesignated Type B Forest	
Private property from SIGEF	190.443.973														
Private property from Terra Legal Program	626.078	10.555.073													
Quilombola Territory	175.837	963	3.375.146												
Homologated Indigenous Reserve	584.962	150.449	5	111.389.116											
Full Protection Conservation Unit	4.343.109	115.294	993.190	5.488.196	53.432.794										
Sustainable Use Conservation Unit	1.625.201	52.652	431.742	1.102.484	1.361.121	56.880.625									
Military area	52.756	15.252	51.942	1.902.926	472.139	1.971.208	7.795.942								
Rural Settlement	999.085	1.178.676	328.874	94.636	109.325	339.840	44	45.722.404							
Communitary Territory	74.534	32.865	35	35	228	226	253	13.634.475	15.561.892						
Non-Homologated Indigenous Reserve	293.751	14.434	5	3.306	1.644.511	1.990.037	176.454	51.524	3.379	6.566.938					
Private property from CAR	101.224	5.204.135	850.312	1.197.834	3.253.042	32.892.916	573.396	27.680.928	13.514.763	787.877	262.484.754				
Undesignated land from Terra Legal Program	13.478.891	3.297.795	23.214	11.886.295	12.859.237	7.390.050	2.389.978	874.058	728.765	802.906	48.997.285	125.266.008			
Undesignated land from SIGEF/SNCI	1.373.960	625.032	53.849	551.250	368.515	384.525	3.146	553.703	87.164	18.648	8.154.782	72.454.970	92.792.127		
Undesignated Type B Forest	1.315.418	41.857	10.779	347	2.414	34.327	49	110	0	19	3.404.113	9.156.786	20.433.358	65.274.762	
Legend:		original area of land tenure category					conditional formation to show higher and lower values								

Source: Made by the authors, 2019.



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Considering the previous results presented, some aspects of it deserve specific notifications, such as, the high degree of overlapping of some categories' when compared to others. On that matter, it is visible the great amount of overlaps detected over 'undesigned areas from Terra Legal Program', spite being an alarming result at first sight, it is important to remember that those areas are usually occupied and are going through a phase of destination and/or regularization, therefore, many categories overlap with these areas, such as protected areas or private property claims. In general, that statement is also true for the rest of undesigned lands (such as SIGEF's and 'Type B forests'), which is not necessarily linked to a direct conflict, but areas that are in 'phase of transition'.

Besides that, a large amount of conflicting areas is originated from CAR's database, which has presented overlapping areas with all the others categories, some that are expected (such as overlaps with PTL) and others that may imply in a direct conflict and/or improper claims. As previously explained, overlaps between CAR and PTL are expected, but that is also true for overlaps with this category and rural settlements and commentary territories, which may indicate plots that are going through h a transition phase, from one category to the other. It is also important to say that these overlaps might be expected, but there is also a reasonable probability of improper claims over these categories, meaning that people are claiming land (through CAR) over areas that already have been destined for a different category, configurating an illegal action.

Another important analysis of these results are the overlaps between CAR and Conservations Units (both, Sustainable Use and Full Protection), which should not occur but some are justifiable, considering the legal characteristics of these areas. Because many Conservation Units were made after previous occupation, the State should financially compensate those who would have to evict these areas, even though they are occupants of good-faith, not squatters. For that, many of those evictions did not occur, especially because of the public financial crisis that do not destine enough resources to compensate those how would need eviction. Therefore, many title holders are still within protected areas and will remain so until the State pay them a generous fee. Considering this scenario, it is understandable many of these overlaps, but it may also be referent to possible illegal occupants and improper claims.

Regarding the CAR data base, the most alarming result is regarding the overlaps against homologated indigenous areas. That is a different situation from the Conservation Units because once an Indigenous Land is homologated, the eviction of overlapping properties should be immediate, considering



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that there is only compensation for what has been done (planted or constructed) over the area, not the value for the land itself. On a minor degree of problem intensity are the overlaps on Indigenous lands that are yet not homologated, which means a latent conflict, considering those who will be evicted. Considering this result, an important outcome (and potential explanation) for this result is that people might be using indigenous areas, which are densely forested, to mitigate or compensate environmental protection areas that are mandatory by law, meaning that private neighbor form Indigenous areas are overlapping their CAR declaration to guarantee their percentage of mandatory forests while exploring a larger parcel of its original property by bypassing the CAR monitoring system. This may also happen between overlaps of CAR against Conservation Units.

Beyond these results, a general overview of the chart (Table 3) represents to us one of the largest problems of the Brazilian agricultural and environmental occupation of the territory, which is the lack of control by the state of who owns what, where. That statement is proven by the work presented by the Atlas, but what is most important to notice is that this lack of control over the territory and property (public or private), ease up the deforestation process and improper claims over land. The ideal scenario would be a complete cadaster without overlapping areas/categories, but as presented by this study, many overlaps are expected due to the legal configuration that the occupation of the territory took place, which compromises policies, actions towards sustainability and agricultural production of this important sector of the Brazilian economy.

Final Remarks

It is important to recognize the advances made in the Brazilian Land Governance since the Law nº 10.267/2001 that legally demanded private owners to georeference their properties at any change in their deed in the registry office, a decisive step towards the construction of this unified cadaster was made. Not only this advance, but also SIGEF and CAR that made possible to have a clearer and more certain image of the territory occupation, and the CNIR that allowed us better quality standards for certification process and made possible the link between cadastral information and the registry offices. Besides that, there are still undergoing improvements regarding the interconnectivity of land use information, specially with the advance of SINTER, the control over the territory by the State will improve very much, still hard to estimate how much.



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The existence of geo-referenced information on public real estate, settlements, conservation units, public lands, indigenous lands, among others categories, is fundamental to proceed with the construction of a multi-purpose cadaster. What the Atlas evidenced is the great possibility for Brazil to achieve such cadaster in a near future to come, considering the majority of the areas covered and managed by specific actors/agencies. Although, many overlaps and data discontinuities were also evidenced by this study, something that compromises Land Governance and the planned occupation of the territory. On that matter, it is important to improve the current existing systems, to eliminate any conflicting areas/rights, but also to improve the communication and information exchange between agencies, something that would facilitate the identification of conflicts and improper claims/occupation of lands.

First it is necessary to reaffirm that the land governance of the country is still quite fragile despite the advances of recent years. The information over land for the country still has many deficits and there is still need for deep knowledge of the changing legislation impacts, the cadaster's agencies rational and the reality observed on the ground, not only to update the Atlas whenever there is a land use change, but also to enable an accessible representation of the land occupation for the most important categories. To secure the quality of this type of information can provide the State, investors and the civil society strategic information's for a better performance of the agricultural sector and vulnerable areas, socially or from an environmental perspective.

On the other hand, this exercise shows that with the available information is possible to make significant progress in building a land cadaster in the country and there is no need to have an agency that controls all the information, only the need for cooperation between the agencies. The construction of a cadaster integrating the information of the different existing agencies is also predicted by the Polycentric Governance (see Reydon 2017) and this is a proposed way forward. To do that, there is need for an agency above all other ministries and other agencies, to be able of articulating them and guaranteeing that they will share the necessary information for the construction of an integrated cadaster. That is still an important bottleneck to be overcome, but most certainly, the setting-up of this Atlas represents an advance in the knowledge regarding the Brazilian territory occupation.

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