MAPBIOMAS ALERTA

ANNUAL REPORT
ON DEFORESTATION
IN BRAZIL

PREPARED BY
MapBiomas

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LIST OF ABBREVIATIONS

ACPs	Public Civil Actions
ADEMA	Sergipe State Environmental Administration
APA	Environmental Protection area
API	Application Programming Interface
APNE	Northeastern Plants Association
APP	Permanent Preservation Area
ASV	Vegetation Suppression Authorization
BPAmb-FV	Green Force Environmental Police Battalion
BPMPA	Environmental Protection Military Police Battalion
CAR	Rural Environmental Registry
CIFF	Children's Investment Fund Foundation
CIMAM	Integrated Environmental Monitoring Center
CLUA	Climate and Land Use Alliance
CNAL	National Council for the Legal Amazon
CNUC	National Register of Conservation Units
CPRH	Pernambuco State Environmental Agency
CRQ	Quilombo Remnant Communities
DETER	Real-Time Deforestation Detection System
ex*	example
ESEC	Ecological Station
FECD	State Force to Combat Deforestation
FEMARH	State Foundation for the Environment and Water Resources of Roraima
FEPAM	Roessler State Environmental Protection Foundation
FES	State Forest
Flona	National Forest
FLOREX	Extractive Forest
Funai	National Indian Foundation
GEE	Google Earth Engine
GLAD/UMD	Global Land Analysis and Discovery of the University of Maryland
GWC	Global Wildlife Conservation
ha	Acre
IAT	Water and Land Institute of Paraná
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
IBRAM	Institute of the Environment and Water Resources of the Federal District
IC	Institute of Criminalistics of the Scientific Police of Paraná
ICMBio	Chico Mendes Institute for Biodiversity Conservation
ICS	Climate and Society Institute
ICV	Life Center Institute
ID	Unique Identifier of an Alert
IDAF	Institute of Agricultural and Forestry Defense of Espírito Santo
IDEFLOR-Bio	Institute of Forestry Development and Biodiversity of the State of Pará
IDEMA	Institute for Sustainable Development and Environment of Rio Grande do Norte
IEF	State Forestry Institute of Minas Gerais
IMA	Alagoas Environmental Institute
IMA	Santa Catarina Environmental Institute
IMAC	Acre Environmental Institute
IMASUL	Mato Grosso do Sul Environmental Institute
IMAZON	Institute of People and Environment of the Amazon
INCRA	National Institute of Colonization and Agrarian Reform
INEA	State Institute of the Environment of Rio de Janeiro
INEMA	Institute of the Environment and Water Resources
INPE	National Institute for Space Research
IPAAM	Amazonas Environmental Protection Institute
IPAM	Amazon Environmental Research Institute
ISA	Socioenvironmental Institute

CONTINUE

JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
JJ-FAST	Forest Early Warning System in the Tropics
LAI	Access to Information Law
LAPIG/UFG	Image Processing and Geoprocessing Laboratory at the Federal University of Goiás
LDI	Illegal Deforestation List
MMA	Ministry of Environment and Climate Change
MODIS	Moderate-Resolution Imaging Spectroradiometer
MP	Public Ministry
MPF	Federal Public Prosecution Service
MPMT	Public Prosecution Service of the State of Mato Grosso
MPPR	Public Prosecution Service of Paraná
NATURATINS	Nature Institute of Tocantins
NICFI	Norwegian International Climate and Forests Initiative
OEMAs	State Environmental Agencies
PA	Settlement Project
PAF	Forest Settlement Project
PARNA	National Park
PDS	Sustainable Development Project
PES	State Park
PF	Federal Police
PMFS	Sustainable Forest Management Plan
PMMAmb	Military Environmental Police
PRODES	Amazon Deforestation Monitoring Program
QGIS	Quantum GIS Software
RAD	Annual Deforestation Report
RDS	Sustainable Development Reserve
RESEX	Extractive reserve
RL	Legal reserve
SAD	Imazon Deforestation Alert System
SAD-Caatinga	Deforestation Alert System for the Caatinga biome
SAD-Cerrado	Cerrado Deforestation Alert System
SAD-Pantanal	Pantanal Biome Deforestation Alert System
SAD-Mata Atlântica	Deforestation Alert System for the Atlantic Forest biome
SCCON	Santiago & Cintra Consultoria
SEDAM	State Secretariat for Environmental Development of Rondônia
SEMA	State Secretariat for the Environment
SEMACE	Secretariat of Environment and Climate Change of Ceará
SEMAD	State Secretariat for Environment and Sustainable Development of Alagoas
SEMAD	Secretariat of State for Environment and Sustainable Development of Santa Catarina
SEMAPI	State Secretariat for the Environment and Indigenous Policies of Acre
SEMARH	State Secretariat for the Environment and Water Resources of Piauí
SFB	Brazilian Forest Service
SIAD	Integrated Deforestation Alert System for the Brazilian Amazon
SICAR	National Rural Environmental Registration System
SIGEF	Land Management System
SEMIL	State Secretariat for the Environment, Infrastructure and Logistics of São Paulo
SIMLAM	Integrated Environmental Monitoring and Licensing System
SINAFLOR	National System for Controlling the Origin of Forest Products
SIPAM/SAR	Integrated Deforestation Alert System with orbital radar
SIRAD-X	Deforestation Radar Indication System in the Xingu Basin
SIVAM	Amazon Surveillance System
SLAPR	Environmental licensing system for rural properties
SPU	Federal Properties Management Secretariat
SUDEMA	Superintendency of Environmental Administration of Paraíba
TCU	Federal Audit Court
TI	Indigenous Land
TNC	The Nature Conservancy
UC	Conservation Unit
UEFS	State University of Feira de Santana
UF	Federation Unit
UFRGS	Federal University of Rio Grande do Sul
UnB	University of Brasilia
WRI	World Resources Institute

EXECUTIVE SUMMARY

RAD2023, the fifth Annual Report on Deforestation in Brazil, prepared by MapBiomas, presents a comprehensive overview of deforestation in all Brazilian biomes between 2019 and 2023, with a focus on 2023, and for different land use and land tenure categories. The report consolidates and analyzes deforestation alerts from multiple detection systems that are validated and refined with high-resolution images by MapBiomas Alerta (https://alerta.mapbiomas.org/) and examines indications of illegality and actions to combat deforestation by government agencies and financial institutions through spatial cross-references.

Deforestation Trends:

- In the last five years, Brazil has lost about 8.56 million hectares of native vegetation, with more than 85% in the Amazon and Cerrado. **In 2023, deforestation in Brazil decreased by 11.6%, totaling 1.83 million hectares.** (Figure RE).

- **Deforestation in the Amazon decreased by 62.2%**, with more than 400 thousand hectares deforested, while in the **Cerrado it increased by 67.7%**, driven by the MATOPIBA region. In 2023, for the first time, the Cerrado surpassed the Amazon, with 1.11 million hectares deforested.

- **The Pantanal showed an increase of 59.2%**, with around 50 thousand hectares of native vegetation loss, and the Caatinga of 43.4%, with around 200 thousand hectares.

- **The Atlantic Forest** (12 thousand hectares) **and Pampa** (1.5 thousand hectares) **showed reductions**, 59.6% and 50.4%, respectively.

- A new detection system was integrated, the SAD Cerrado/IPAM.

- The Pantanal had the largest average area of deforestation (158.2 hectares), with an increase of 35.9% compared to the previous year.

- **Agriculture is the main deforestation driver, accounting for more than 97% of the loss of native vegetation** in the last five years. Other drivers include mining, extreme weather events, urban expansion, and, in the Caatinga, solar and wind energy projects.

- **In 2023, for the first time, there was a predominance of deforestation in savanna formations** (54.8%) followed by forest formations (38.5%).

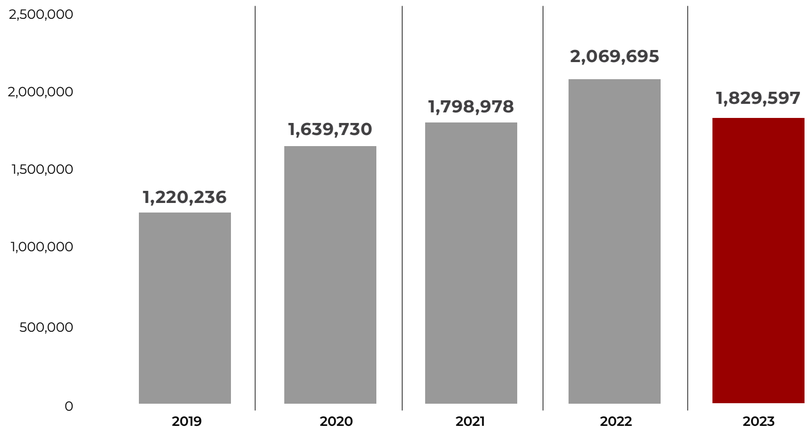


Figure RE Deforestation in Brazil in hectares (ha) in the last five yearss.

Deforestation in Protected Areas:

- In 2023, 96,761 hectares were deforested in Conservation Units (UCs), a reduction of 53.5% compared to 2022. **In Full Protection UCs, the reduction was 72.3%.**

- In 2023, 20,822 hectares of native vegetation **loss were observed within Indigenous Lands (TIs), representing 1.1% of deforestation in Brazil for the year**. There was a reduction of more than 27% in deforestation in TIs compared to 2022.

- In the last five years, Brazil has lost 1,215,096 hectares of native vege-

tation within **Legal Reserves declared in the Rural Environmental Registry (CAR). This corresponds to 14.2% of the entire area deforested in the country in this period.**

Deforestation on Rural Properties:

- Although **0.96% of properties registered in the CAR (the National Environmental Registry) had deforestation records in 2023** in Brazil, they accounted for 86% of the country's alerts.

- 4.9 million hectares were deforested after December 31, 2020, 57.3% in forest formations and 38.5% in savannas. Considering the new European Union Deforestation-Free Regulation, the restriction could affect about 230 thousand rural properties (3.1% of the 7.5 million properties registered in the CAR).

Indications of Illegality or Irregularity:

- **It is estimated that more than 93% of the area deforested in Brazil in 2023 had at least one indication of irregularity,** meaning that the deforested areas do not spatially intersect with authorizations or are within protected territories.

Actions to Combat Deforestation:

- Brazil: from 2019 to 2023, 1.3 million deforested hectares spatially intersect with authorizations, meaning that 15.7% of the total deforested area in the country was authorized. **In 2023, 41% of the entire deforested area had some authorization or law enforcement action.**

Deforestation in the States:

- Maranhão went from fifth to first position for the first time, with an increase of 95.1% and totaling a loss of 331,225 hectares of native vegetation. Maranhão is one of three states that do not have public databases of authorizations or law enforcement actions and did not answer the data requests for the preparation of this report.

- In 2023, Pará and Mato Grosso remained among the 5 states that deforested the most but showed a decrease: a reduction of more than 60% in PA and a reduction of more than 30% in MT. Mato Grosso maintained its rates of authorized or inspected deforested area above 60% in recent years.

- Bahia leads the deforestation in Caatinga and Cerrado, with 93,437 hectares - an increase of 34% compared to 2022. More than 400 thousand hectares deforested in Bahia in the last five years were authorized (51.8% of the total deforested).

- Goiás, which had a 125.3% increase in deforestation in 2023, also showed an increase in the percentage of deforested area with authorization or law enforcement action in recent years. It went from 58% of areas with authorizations or actions in 2021 and 2022 to 74.5% in 2023.

As part of the multi-institutional MapBiomas initiative (https://mapbiomas.org/), involving universities, NGOs, and technology companies, the MapBiomas Alerta project aims to contribute to the end of deforestation in Brazil through a system of validation, refinement, and generation of deforestation alert reports throughout the country (http://alerta.mapbiomas.org/). All alerts and reports generated are publicly available and free of charge on the MapBiomas Alerta platform (https://plataforma.alerta.mapbiomas.org/).

INTRODUCTION

For five years, MapBiomas Alerta has been publishing the Annual Deforestation Reports (RADs), providing an annual diagnosis of deforestation throughout the Brazilian territory for society, with transparency and the best technology available.

In order to achieve **zero deforestation,** it is necessary to monitor and publicize any and all loss of native vegetation and combat illegal deforestation, attacking impunity. The risk of being penalized and held responsible for the illegal suppression of native vegetation needs to be real and properly perceived by environmental offenders.

To achieve this, it is necessary to act on three fronts:

(i) ensure that all deforestation is detected and reported;
(ii) ensure that all reported deforestation, being illegal in nature, receives action to hold offenders responsible and punished (e.g., fines, embargo);
(iii) ensure that the offender does not benefit from the illegally deforested area and, at the same time, receive some type of penalty (e.g., suspension of the CAR, cancellation of land regularization, exclusion from production chains).

Brazil has a long tradition of monitoring deforestation. At the end of the 1980s, the Amazon Deforestation Monitoring Program (PRODES) was created at INPE and, shortly afterwards, the Atlas of Forest Remnants of the Atlantic Forest, in a partnership between INPE and the SOS Mata Atlântica Foundation. In 2004, INPE launched the Deforestation Detection System in Almost Real Time (DETER), a tool with monthly information on deforestation in the Amazon. Later, DETER was expanded to the Cerrado biome. Since 2006, it has also operated the IMAZON Deforestation Alert System (SAD), covering the Amazon biome. More recently, new SADs were created to fill gaps in monitoring deforestation alerts in other biomes , such as in the Caatinga (from Geodatin /UEFS), Pantanal (from SOS Pantanal and ArcPlan), Atlantic Forest (from SOS Mata Atlântica and ArcPlan), Pampa (from GeoKarten and UFRGS) and Cerrado (from IPAM). Currently, there are at least 11 national and international systems that monitor deforestation in Brazil, covering different biomes and with varying frequencies and spatial resolutions (Appendix 2).

MapBiomas Alerta initiative emerged at the end of 2018 with the aim of adding value to existing deforestation monitoring systems in Brazil. The objective is to verify, validate, refine and analyze, with high spatial resolution satellite images, each deforestation alert detected by automatic systems and provide, in a public, transparent and manner, detailed reports with territorial cross-references (Figure 1 - https: //alert.mapbiomas.org/). Furthermore, data on deforestation authorizations and inspection actions (e.g., fines and embargoes), carried out by federal and state environmental control bodies, are compiled and cross-referenced with deforestation alerts published on MapBiomas Alerta and made available on Monitor da Deforestation Inspection (https://plataforma.alerta.mapbiomas.org/monitor-da-fiscalizacao).

Using data from MapBiomas Alerta, MapBiomas publishes the Annual Deforestation Report (RAD) annually. The first report was published in 2020, referring to deforestation in 2019. Therefore, this report is the fifth in a series that aims to consolidate and analyze information on all deforestation detected in the country, through the multiple alert systems available in the period between 2019 and 2023, but with a focus on this last year, in all Brazilian biomes, and which were validated and published by the MapBiomas Alerta initiative. This is the most complete and updated x-ray on deforestation in Brazil.

What is MapBiomas Alerta

1

MapBiomas Alerta is a **validation** and refining system for deforestation alerts based **on high-resolution satellite images.**

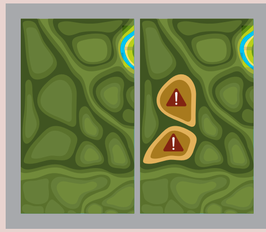
2

In a single platform, we bring together alerts from several detection systems for **all of Brazilian biomes.** We cross-reference them with relevant territorial data (e.g. municipalities, rural properties, protected areas, authorizations, embargoes, etc.) and provide **detailed ready-to-use reports** for each deforestation event in a free and open-acess way.

3

The MapBiomas Alerta initiative publishes **any and all losses of native vegetation,** without assessing the legality, regularity or responsibility for the suppression of the vegetation.

Every week you will find new deforestation alerts, validated for all Brazilian biomes, with several filter options for temporal and territorial analysis.



By selecting one alert, you can view high-resolution images of before and after the deforestation occurred.

Access the full report for each rural property that overlaps a deforestation alert and search by CAR code.

Access the website: https://alerta.mapbiomas.org/

Figure 1 Summary about MapBiomas Alert.

1.1 | Purpose and Scope

RAD2023, the fifth Annual Deforestation Report in Brazil, covers all Brazilian biomes and has three objectives:

- Present an overview of detected and confirmed deforestation for all Brazilian biomes since 2019, with an emphasis on data from the year 2023, based on alerts validated and refined from high-resolution images by the MapBiomas Alerta project.

- Present an assessment of the degree of legal regularity of deforestation and an estimate of the total deforestation with evidence of illegality.

- Present an overview of the actions carried out by government environmental control bodies and also by the financial sector to control and combat illegal deforestation.

It is worth clarifying that the deforestation data processed and analyzed in this report are limited to places where there were deforestation detection alerts, generated by the monitoring systems used as a source (e.g. DETER/INPE, SAD/IMAZON, GLAD/UMD, SAD Caatinga/ Geodatin , SAD Mata Atlântica/SOS Mata Atlântica/ ArcPlan , SAD Pantanal/ SOS Pantanal/ ArcPlan , SAD Pampa/ Geokarten /UFRGS, SAD Cerrado/IPAM and SIRAD-X/ISA and Xingu+ network). Therefore, the numbers presented here, despite being expressive, still underestimate, to some degree, real deforestation, as there may be deforested areas that were not detected by these systems.

1.2 | Concepts

Deforestation is the complete suppression of existing native vegetation in a given area.

The suppression or felling of isolated trees or some trees present in a portion of native vegetation, in which the rest of the vegetation remains standing, does not constitute deforestation. Therefore, selective logging, forest management and understory fires that can result in vegetation thinning or other processes of degradation of native vegetation do not fall under deforestation alerts.

The definition of deforestation covers a series of particularities that are clarified below, to accurately qualify the data and analyzes in this report.

- **Deforestation or Suppression of native vegetation** – deforestation is commonly associated with the complete suppression of forest vegetation. In this report, the term deforestation refers to the broader understanding, which includes any and all suppression of native vegetation, also covering the suppression of non-forest vegetation, such as fields and savannas . Therefore, in this report we deal with the suppression of native vegetation.

- **Primary or Secondary Deforestation** primary deforestation refers to the deforestation of the forest or primary native vegetation, and secondary deforestation refers to the suppression of secondary vegetation (area that was previously deforested and is in the process of vegetation regeneration).

  This report mainly addresses primary deforestation, as the alert systems used focus on areas of primary vegetation. However, areas of secondary deforestation, when verified, are also included in the MapBiomas Alerta data, but this report does not distinguish between primary and secondary deforestation.

- **Gross and Net Deforestation** – gross deforestation only considers the loss of native vegetation cover. Net deforestation or net loss refers to deforestation discounting the area where vegetation regeneration has occurred. In this report, we only address gross deforestation.

- **Deforestation alert and deforested area** – the deforestation alert refers to

an event or indication of deforestation in a specific location. The deforested area is the area effectively affected by the suppression of native vegetation. MapBiomas Alerta identifies and refines deforested areas, using as a starting point deforestation alerts from available monitoring systems, such as DETER, SADs and GLAD.

- **Date of Detection and Occurrence of deforestation** – the date of detection refers to the moment in which deforestation was detected and/or verified by the original detection systems. Occurrence refers to the period in which deforestation occurred (always a date prior to detection).

- **Observed deforestation area and Deforestation rate** – the observed area is the spatial extent quantified directly by comparing satellite images from different dates (before and after deforestation). The official PRODES deforestation rate uses information from the observed area to estimate the deforestation that occurred throughout the territory, including areas that could not be observed. MapBiomas Alerta works only with the concept of observed area.

- **Deforestation speed** – refers to the ratio between the total deforested area and the number of days that elapsed between the beginning and end of deforestation, usually expressed in hectares or km2 per day. In MapBiomas Alerta, the speed is underestimated, as the calculation is made approximately, based on the dates of the satellite images selected and available to best document the moment before and after the deforestation episode.

- **Deforestation and Degradation** – deforestation deals with the complete suppression of native vegetation, while degradation deals with the partial removal of areas of native vegetation. This report only deals with cases of deforestation.

METHOD

MapBiomas Alerta consists of a system for compiling alerts from different deforestation detection systems in Brazil, all based on remote sensing. The processing of this set of alerts involves the aggregation, validation and refinement of spatial limits in high-resolution satellite images (Planet Scope with 3.7 m spatial resolution), generation of reports and publication of the final results on a single platform, open access (https://plataforma.alerta.mapbiomas.org).

A detailed description of the deforestation detection systems used, as well as additional details on the validation criteria and the databases used can be found in Appendices 2, 3 and 4.

MapBiomas Alerta processing method , as well as some limitations of the method and differences in relation to official annual deforestation data (PRODES).

2.1 | Description of the Steps

The MapBiomas Alerta process involves the stages of compilation, validation, refinement, cross-referencing with public data, auditing and publication of alerts and deforestation reports (Figure 2).

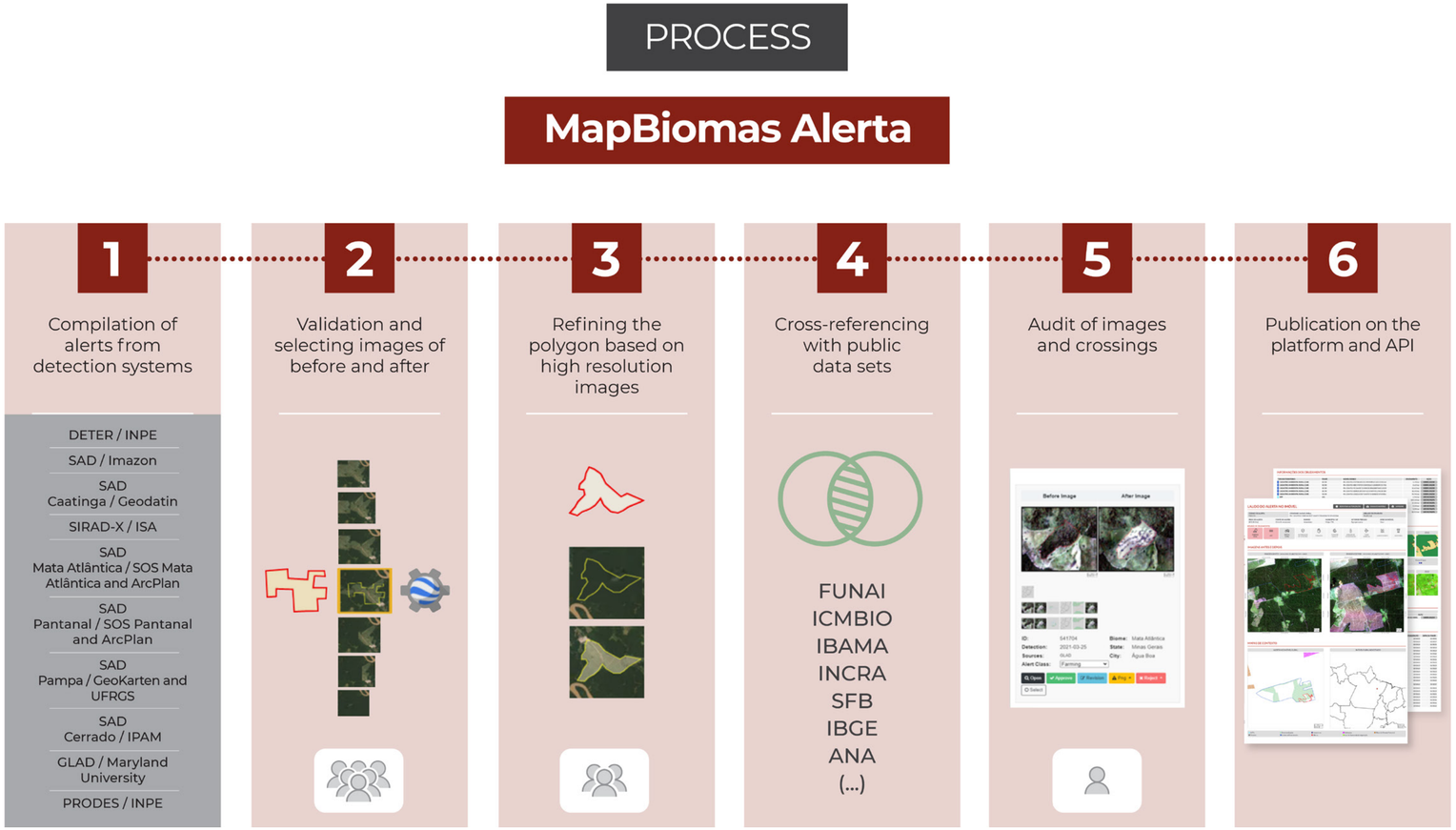


Figure 2 MapBiomas Alert methodological process for compilation, validation, refinement, data cross-referencing, auditing and publication of deforestation alerts in Brazil.

Step 1 | Compilation of alerts from existing systems for all Brazilian biomes.

MapBiomas Alerta consults, organizes and consolidates information produced by the various official and independent systems, which monitor deforestation in Brazil and generate deforestation alerts based on images of 10 m, 30 m or up to 60 m spatial resolution (Table 1). For the year 2023, MapBiomas Alerta consulted monthly the alerts made available by the following information sources and existing systems:

Board 1 DEFORESTATION AND SOURCE DETECTION SYSTEMS USED IN BRAZILIAN BIOMES CURRENTLY IN MAPBIOMAS ALERTA.

Name	Source	Biome	Link
DETER*	National Institute for Space Research (INPE)	Amazon and Cerrado	https://terrabrasilis.dpi.inpe.br/
SAD	IMAZON	Amazon	https://imazon.org.br/categorias/sad/
SAD Caatinga	Geodatin	Caatinga	at.
SAD Atlantic Forest	SOS Mata Atlântica and ArcPlan	Atlantic Forest	https://www.sosma.org.br/iniciativas/alertas
SAD Pantanal	SOS Pantanal and ArcPlan	Pantanal	at.
SAD Pampa	GeoKarten and UFRGS	Pampa	at.
SAD Cerrado**	Amazon Environmental Research Institute (IPAM)	Cerrado	https://sadcerrado.ipam.org.br/
SIRAD-X	Instituto Socioambiental (ISA) and Xingu+ network	Xingu Basin region in the Amazon and Cerrado	https://xingumais.org.br/siradx
GLAD	University de Maryland	Pampa	https://glad.umd.edu/
PRODES***	National Institute for Space Research (INPE)	Amazon, Cerrado, Pampa and Pantanal	https://terrabrasilis.dpi.inpe.br/

*Only DETER deforestation alerts. Alerts of degradation, fire or logging are not analyzed.
**In 2023, all deforestation alerts generated by SAD Cerrado between January and June were considered, and from July to December only alerts with areas larger than 10 hectares were validated and refined.
*** PRODES polygons are incorporated later to avoid omissions.

The alert detection systems used since 2019 by MapBiomas Alerta can be consulted in Appendix 2.

GLAD monitors the loss of tropical forests globally and weekly with Landsat images. DETER Cerrado and Amazon mainly uses CBERS-4 images (with a resolution of 64 m) for weekly mapping of deforestation areas in biomes. SAD uses images from Landsat and Sentinel satellites (with 30 m and 10 m spatial resolution) to detect deforestation in primary forests in the Amazon. SIRAD-X complements data from SAD and DETER with monitoring of deforestation using radar images from the Sentinel-1 satellite in the Xingu Basin, in the Amazon and Cerrado biomes. SAD Caatinga was developed by Geodatin in partnership with the State University of Feira de Santana (UEFS) to detect deforestation with a focus on dry forests in the Caatinga biome, which may include some areas in the Cerrado and Atlantic Forest. SAD Mata Atlântica and SAD Pan-

tanal were developed with a focus on forest and savanna formations , in the respective biomes, by SOS Mata Atlântica and SOS Pantanal in partnership with ArcPlan. SAD Pampa was developed by GeoKarten in partnership with the Federal University of Rio Grande do Sul (UFRGS) and is in operation to detect deforestation in forest environments and in tests for rural environments (not yet included in 2023). SAD Cerrado was developed by IPAM, in partnership with the Image Processing and Geoprocessing Laboratory of the Federal University of Goiás (LAPIG-UFG) and MapBiomas , focusing on forest, savanna and grassland formations in the Cerrado biome. All biome SADs use Sentinel-2 images with a resolution of 10 meters.

In addition to monthly alert sources, annual deforestation data sources were also included to reduce omissions (mainly PRODES/INPE in the Amazon (2019-2020, 2020-2021, in the Cerrado (2019-2020) and tests with small quantities in other years and biomes; Atlas of Forest Remnants/SOS Mata Atlântica and INPE in the Atlantic Forest).

Step 2 | Validation and selection of before and after images

The validation process takes place in two stages. The first stage is done automatically, eliminating all deforestation alerts already detected in previous surveys. The second step is done through visual inspection by trained analysts organized into teams by biomes, with the support of monthly mosaics of high-resolution images from the Planet satellite constellation (images with 3.7 m resolution). At this time, alerts that correspond to cases of false positives can also be discarded, with the corresponding record of the reason for rejection (e.g., forestry, agriculture, seasonality). The alert is considered valid only when visual inspection actually detects the deforestation event. At that point, two satellite images are selected and acquired, with project resources: an image where it is possible to visualize the native vegetation before deforestation and an image where it is possible to see the area that was deforested. Obtaining the images considers a minimum area of 500 by 500 m, covering the area of deforestation and its surroundings to help contextualize the deforested area.

Step 3 | Validation and refinement on high-resolution images

After confirming the deforestation associated with each alert, and selecting the pair of high-resolution images, it is necessary to refine the spatial limits of the area actually deforested. This refinement is done through automated classification processing that guarantees greater precision in defining the contours of the area where native vegetation has been removed. The generation of the refined polygon is done using a supervised classification algorithm (Random Forest), which is processed on the Google Earth Engine platform through Workspace , a processing application developed by MapBiomas . The classification is carried out by collecting training samples from high-resolution images, both to represent the deforested area and neighboring non-deforested areas. The final classification results in a refined polygon that goes through a simplification process to remove excess vertices. Based on images from before and after deforestation, the interpreter also identifies and records the deforestation driver that may have caused the deforestation event (mining, mining, urban expansion, agriculture, extreme weather events or others).

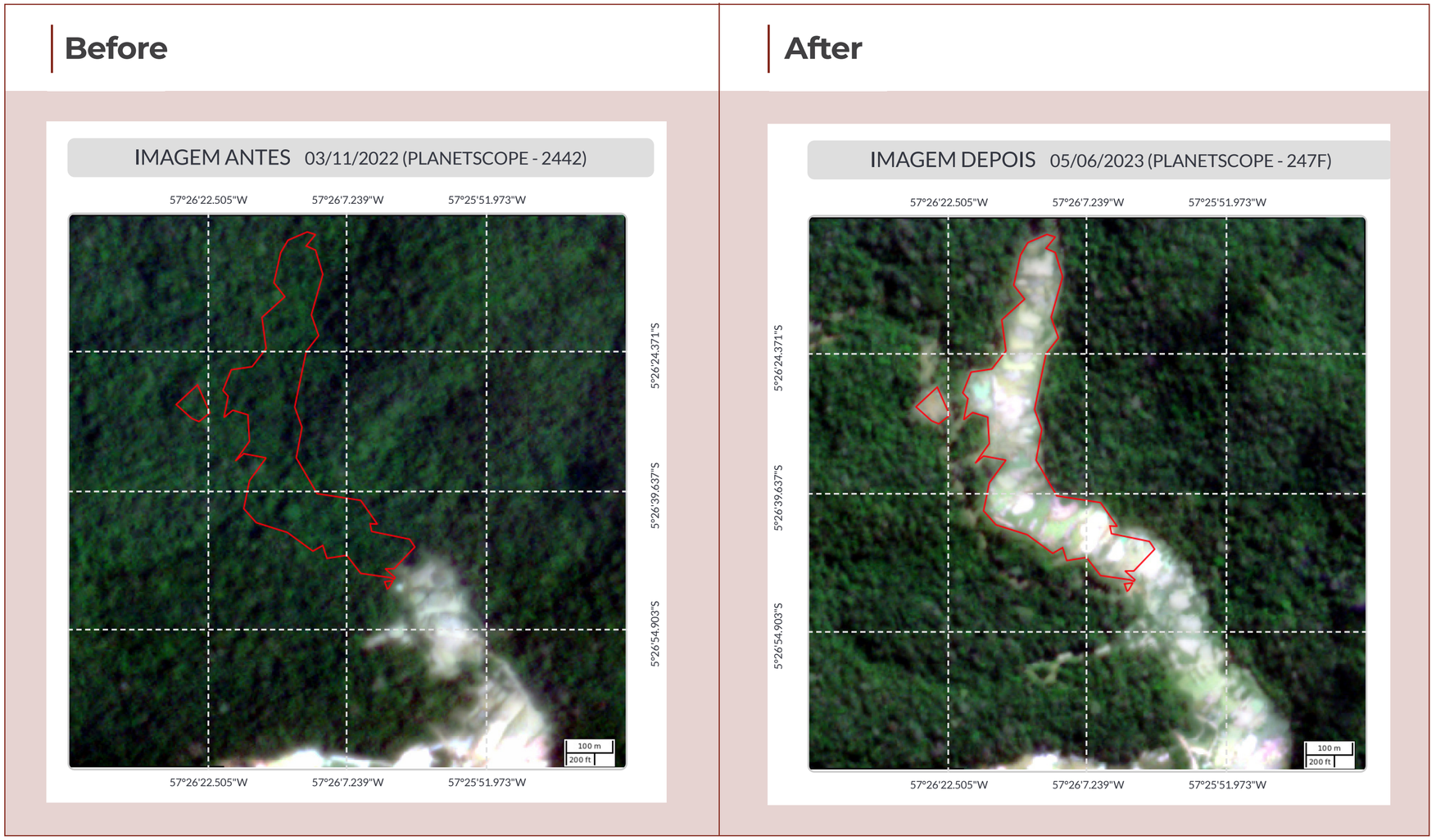


Figure 3 Example of Planet images before and after deforestation and the refined polygon from the Code 927577 alert of 2023.

Observation:
For SAD Cerrado, steps 2 and 3 are carried out together within the Workspace application , using Sentinel-2 images with 10 m resolution to validate and refine the detected polygons. This procedure was developed to speed up the image selection stage, considering the large volume of alerts generated by SAD Cerrado.

Step 4 | Cross-referencing with public territorial databases

The refined polygons, containing the precise delimitation of the deforested area, are spatially overlaid with land and inspection spatial information, including boundaries of Indigenous Lands (TIs), Conservation Units (UCs), quilombola territories, rural settlements, areas registered in the Rural Environmental Registry (CAR) – including declared Permanent Preservation Areas (APPs) and Legal Reserve (RL) –, in addition to areas embargoed by environmental agencies, suppression authorizations and forest management plans from IBAMA's Sinaflor. Alerts are also linked to geographic boundaries such as those for munici-

palities, states, biomes and river basins. Cross-references with special territories are also considered, such as the Brazilian Amazon, area of application of the Atlantic Forest Law, MATOPIBA, AMACRO, Biosphere Reserves and others. Furthermore, this year, intersections with archaeological sites were included. These cross-checks qualify alerts and allow technical reports to be generated based on information that is relevant to user institutions. The tables detailing all the databases used, as well as the cross-referencing rules, are in Appendix 4.

Step 5 | Audit

Each refined polygon goes through a final audit process carried out by the technical supervisor of each biome. At this stage, the possible need to redo any adjustments before the final publication of confirmed deforestation is assessed.

Step 6 | Publishing

All confirmed deforestation polygons are published on the MapBiomas Alerta Platform (https://plataforma.alerta.mapbiomas.org), updated weekly. Reports are available for each confirmed deforestation and for each cross-referencing of an alert with a property registered with CAR, SIGEF and SNCI (with an area greater than 0.1 ha). The reports contain the following information:

- deforestation alert code;
- original source of the alert (detection system);
- Biome, State and Municipality;
- deforestation area;
- deforestation area that intersects with the property;
- property code;
- image and date from before deforestation;
- image and date after deforestation;
- overlapping of deforestation with: APP, Legal Reserve, springs, Indigenous Lands, Conservation Units, Sustainable Forest Management Plan, embargoed areas, authorization to suppress vegetation, and others;
- simplified description of the coordinates of the deforestation polygon;
- MapBiomas land use and coverage in the assessed area;
- data sources used in the cross-references.

2.2 | Cancellation and rectification of post-publication alerts

In certain situations, alerts published on the MapBiomas Alerta Platform may be rectified, or even cancelled. Whenever there is a formal note or a reasoned request indicating possible errors associated with alerts, whether by environmental agencies or platform users, the technical team performs a new and thorough technical analysis of these alerts.

This analysis is carried out by checking Planet images, but also, if necessary, various other complementary information such as images from other satellites (Sentinel , Landsat , etc.), high-resolution satellite images available on Google Earth, in addition to annual maps of land cover and use from MapBiomas . In cases where it is confirmed that the published alert is not in fact a deforestation/conversion of native vegetation event (regardless of woody yield, regularity or responsibility), the alert is cancelled. This means that it is removed from the platform's map and statistics, indicating the reason for cancellation. The polygon of the removed alert is kept in the database for individual consultation only using its identifier code, where the reason for its cancellation is recorded.

In some cases, corrections may be made to the spatial delimitation of the alert, always with the aim of better representing the deforestation event in question. Likewise, if an error or problem is related to the images linked to the alert polygon, new images can be selected and updated on the platform. All rectifications are recorded in the system and the information is publicly available on the platform, including the date on which the alert was rectified.

Before rectification

After rectification

We emphasize that:

- No judgment is made regarding the legality or regularity in relation to deforestation alerts presented on the MapBiomas Alerta platform. Any and all detected and confirmed loss of native vegetation constitutes an alert.
- There may be differences in total alerts and deforested area for the years reported in previous RADs. This occurs because there are remnants of alerts where images were not available and could only be validated after the closure of previous reports, or by the addition of new sources of alerts.
- Furthermore, each year, we use the most recent versions available of public databases of territorial, land boundaries, etc. We have redone the spatial cross-references of the entire alert base since 2019, with the most recent databases.

Figure 4 Example of rectification of the spatial limits of the alert after publication for alert Code 564078, detected in 2022.

2.3 | Limitations of the Method

Like every method, MapBiomas Alerta has some limitations that must be considered when applying its data:

A. Processing time – the import of alerts from their sources (detection systems) occurs monthly, with the exception of DETER alerts, which occur every 15 days. As part of the alert processing is done individually and visually by trained analysts, validation and processing time depends on the biome and time of year. As a result, the time elapsed from the date of detection by the source system until publication on the platform in MapBiomas Alerta can range from 30 to 90 days. The emphasis of MapBiomas Alerta is to increase certainty about reported deforestation events and to provide detailed reports ready for use in remote monitoring. Rapid field surveillance operations, which target flagrant detection, can be planned directly with pre-existing detection systems.

B. Alert Omissions – deforestation is validated and refined based on the existence of an alert previously captured by a third-party deforestation detection system. The possible omissions of these systems in detecting deforestation also affect the alerts evaluated by MapBiomas Alerta.

At the beginning of MapBiomas Alerta, most Brazilian biomes did not have a specific monthly monitoring system, and the main source of alerts used was GLAD, a global system that uses images from Landsat satellites to automatically flag areas where forest cover suffered a decline. disturb. The system covers the entire tropical region. However, alerts detect changes more reliably in areas with at least 60% forest cover, making them more suitable for use in dense tropical forests. Because of this, GLAD had omissions as it was not adjusted to the specific characteristics of each Brazilian biome.

To avoid these omissions in the detection of deforestation, MapBiomas supported the development of Deforestation Alert Systems (SADs), adapted for each Brazilian biome, by several universities, research institutions and civil society organizations:

- SAD Caatinga, which began operating in 2020, developed by the MapBiomas team in Caatinga (UEFS and Geodatin);
- SAD Mata Atlântica, developed by SOS Mata Atlântica and ArcPlan , was implemented in 2021 for four river basins (Tietê, Jequitinhonha, Iguaçu and Miranda/Aquidauana), where 2,126 alerts were identified in addition to GLAD alerts and has been operating for the entire biome since January 2022;
- SAD Pantanal, developed by SOS Pantanal and ArcPlan to monitor deforestation alerts in forest and savanna formations , implemented at the end of 2021 (where 103 alerts were identified), operating monthly since January 2022;
- SAD Pampa, developed by GeoKarten and UFRGS, in operation since 2022, focusing on forest suppression. Since then, GLAD alerts have been used in a complementary way;
- SAD Cerrado, developed by IPAM in 2022, when there was still a partial addition of alerts in the testing phase. It has been operational since January 2023. In the period from January to June 2023, all alerts generated were validated, regardless of size, while for the period from July to December 2023, only alerts above 10 ha were considered.

In a complementary fashion, the annual deforestation identified by PRODES, from 2020 onwards, in the Amazon and Cerrado, and in 2023 in Pampa and Pantanal, were used to identify omissions from the monthly monitoring systems of these biomes. With the same objective of reducing omissions, the annual

1 | More information at: https://www.globalforestwatch.org/blog/data-and-research/glad-deforestation-alerts/

deforestation identified by the Atlas of Forest Remnants of SOS Mata Atlântica/INPE were also included, rejecting all those overlapping with already validated alerts.

It is also worth noting that deforestation monitoring systems have minimum detection areas and, therefore, may omit some small deforestation events. For example, alerts smaller than 3 hectares are not detected in the Amazon (DETER Amazônia) and those smaller than 1 hectare are not detected in the Cerrado (DETER Cerrado). The use of multiple sources for the same region aims to reduce these omissions.

C. **Underestimated Deforestation Speed –** when validating and refining an alert, a pair of good quality Planet satellite images are searched at the time before and after deforestation. The "previous" image is the most recently available one for the period up to 12 months before detection (with some exceptions that may occur due to image availability), and the "later" image is the one closest to the end of deforestation . The presence of clouds in satellite images can increase the period between images selected to represent before and after deforestation by days, weeks and even months. This does not change the statement that deforestation occurred in the period between the two images, but it does affect the calculation of the average speed at which deforestation actually occurred.

D. **Automatic Polygon Delimitation –** the polygons that delimit the refined alerts are established by a process of automatic classification of the area of change between the two images, in other words, the place where the native vegetation was suppressed. When delimiting the deforestation polygon, areas with signs of previous alteration or with small groups of trees that may have remained amid deforestation are removed. In 2020, a procedure was developed to minimize the small islands within the polygons generated in the refinement stage, as well as to remove excess vertices (points that form the polygons).

E. **Limitations for Native Non-Woody Vegetation –** the detection of the suppression of non-forest vegetation, such as grassland vegetation, for example, has limitations in the systems that originate the alerts, whose methods focus on identifying where there has been suppression of flowering vegetation. With the exception of SAD Cerrado, which has calibrated detection for both forest, savanna and grassland formations . However, when there is also suppression of non-forest vegetation in the alert area or in an area adjacent to other biomes, the use of high-resolution images allows their recording during the alert refinement phase. Because of this, most of the deforestation of non-woody vegetation that has been detected since 2019 has occurred occasionally, whenever observed in the vicinity of woody vegetation alerts. Therefore, current detection systems still underestimate the suppression of native non-forest vegetation.

2.4 | Differences in relation to Official Annual Data

The comparison of deforestation data from MapBiomas Alerta with official deforestation data (PRODES) must be done with caution, as these two systems present some important differences (Table 2):

Board 2 DIFFERENCES BETWEEN DATA FROM THE OFFICIAL ANNUAL DEFORESTATION SYSTEMS AND MAPBIOMAS ALERTA IN 2023

Theme	PRODES Amazon	PRODES Caatinga, Cerrado, Mata Atlântica, Pantanal and Pampa	ATLAS Atlantis Forest	MapBiomas Alert
Minimum Mapped Area	6.25 ha	1 ha	3 ha	0.3 ha
Area Calculation	publishes rate that estimates deforestation also in areas not observed	data represents the sum of the observed areas	data represents the sum of the observed areas	data represents the sum of the observed areas
Analysis Period	August 2019 to July 2022	August 2019 to July 2022	October 2018 to September 2023	deforestation detected between January and December 2019, 2020, 2021, 2022 and 2023.
Image Capture Window	July to September 2019, 2020, 2021 and 2022	June to September 2020, 2021 and 2022	July to November 2019, 2020, 2021, 2022 and 2023	July 2018 to December 2023
Territorial Scope	Brazilian Amazon	biome limits on a 1:250,000 scale (for the Cerrado, subtracting the overlapping area with the Brazilian Amazon)	Map of the Atlantic Forest Law application area refined by SOS Mata Atlântica at scale 1:1,000,000	IBGE biome limits on scale 1:250,000
Tipo de Vegetação Mapeada	primary or existing forest vegetation in 1988 (excludes cerrado areas and non-forest areas in 1988)	forest, savanna and countryside vegetation existing in 2000	primary or existing forest vegetation in 1985	primary vegetation and may include secondary vegetation

RESULTS

3.1 | Consolidated alerts from detection systems

In 2023, 296,099 original deforestation alert polygons were imported from 10 different sources (Appendix 2). After integrating these alerts, the alerts were consolidated (a process in which overlaps with previously detected areas and grouping between systems detecting the same area were eliminated). The number of consolidated alerts therefore means the number of alerts that were effectively used in the validation and refinement process. For the year 2023, the number of consolidated alerts was 235,292 alerts. Most of these alerts occurred in the Cerrado (39.1%), the Amazon (26.3%) and the Caatinga (17.9%) (Table 2).

There was a 21% reduction in the number of alerts consolidated and evaluated between 2022 and 2023. However, there was an increase in the number of alerts in the Cerrado (31%) and Caatinga (122%) biomes (Table 3). Some methodological factors contributed to this result:

- SAD Caatinga, SAD Pantanal, SAD Mata Atlântica were consolidated as primary sources and comparable with the previous year.
- GLAD will no longer be a source of alerts in 2022 in the Atlantic Forest biome, remaining only in Pampa as a complement to SAD Pampa alerts.
- In the Cerrado, SAD Cerrado entered as a complement to DETER Cerrado.
- In the Amazon, the same systems remained as a source of alerts.

Table 2 NUMBER OF DEFORESTATION ALERTS CONSOLIDATED BY SYSTEM AND BIOME IN BRAZIL IN 2023*

Detection System	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Total
SAD (Amazônia)	37,255		882			5	38,142
SIRADX	7,721		203				7,924
DETERB-AMAZONIA	16,853		1,619			2	18,474
DETER-CERRADO	1	3	13,068				13,072
SAD-CAATINGA		41,463	154	27			41,644
SAD-CERRADO	8	15	75,885	2			75,910
SAD-MATA-ATLANTICA		609	300	28,718	278		29,905
SAD-PAMPA					2,818		2,818
GLAD					320		320
SAD-PANTANAL			two			7,081	7,083
Total	**61,838**	**42,090**	**92,113**	**28,747**	**3,416**	**7,088**	**235,292**
Percentage	**26.3%**	**17.9%**	**39.1%**	**12.2%**	**1.5%**	**3.0%**	**100%**

* In this table, the numbers indicate the cross-referencing of alerts with the limits of biomes defined by IBGE on a scale of 1:250,000 published in 2019. That is why there are alerts from DETER-CERRADO in the Amazon and Caatinga, since this new version of the Biome Map of the IBGE changed the limits of the 1:5,000,000 scale map published in 2004.

Table 3 NUMBER OF PRE-VALIDATION AND REFINEMENT DEFORESTATION ALERTS CONSOLIDATED BY BIOME IN BRAZIL IN 2019, 2020, 2021, 2022 AND 2023*

Biome	2019	2020	2021	2022	2023	Variation 2022-2023
Amazon	84,883	116,168	90,046	140,235	57,031	-59%
Caatinga	1,463	10,257	17,678	18,944	42,090	122%
Cerrado	11,985	13,426	18,935	70,290	92,089	31%
Atlantic Forest	12,932	12,377	22,871	46,893	28,747	-39%
Pampa	610	665	832	3,912	3,415	-13%
Pantanal	1930	41,547	28,539	10,157	7,088	-30%
Brazil	113,803	194,440	178,901	290,431	230,460	-21%

Box 1 COMPARISON WITH ANNUAL DEFORESTATION DATA FROM PRODES

To assess the degree to which PRODES, even though it is annual, can help reduce possible omissions from monthly systems, we tested the use of PRODES in the Amazon and Cerrado as a complementary source of alerts.

In the Amazon, when considering PRODES data, we for the period from August 2019 to July 2020 we identified a total of 14,607 polygons that had not appeared in the DETER deforestation alerts from 2019 and 2020. After validation and refinement analysis, they were identified 2,228 polygons (32,921 hectares), which is equivalent to approximately 3.7% increase in the deforested area in the biome. For the period from August 2020 to July 2021, after validation and refinement analysis, 11,658 polygons (131,277 hectares) were identified, which is equivalent to approximately 11.8% increase in the deforested area in the biome.

In the Cerrado, when considering data from PRODES Cerrado, we identified in the period from August 2019 to July 2020, after validation and refinement, the addition of 22,628 polygons (213,201 hectares), which represented a growth of 33.4 % in the area deforested in the biome in 2020, and mainly an increase in polygons indicating small deforestation.
In the Cerrado biomes in 2021, Amazon, Pampa and Pantanal in 2022, PRODES polygons are in the validation process and some alerts have already been included.

After confirming the importance of PRODES as a complementary source, imports were made for the other biomes and years, which must be validated and refined in parallel with the most recent monthly deforestation.

Board 3 NUMBER OF PRODES POLYGONS VALIDATED IN BRAZILIAN BIOMES CURRENTLY ON MAPBIOMAS ALERTA.

Source	2019	2020	2021	2022	2023	Total
PRODES-AMAZÔNIA		2,228	11,658	397		**14,283**
PRODES-CERRADO		22,628	199			**22,827**
PRODES-PAMPA				4		**4**
PRODES-PANTANAL	1			1		**2**
Total	1	24,856	11,857	402		37,116

3.2 | Alerts Validated, Refined and Published by MapBiomas Alert

The alerts originated by deforestation detection systems were consolidated considering the overlaps of different systems (e.g., SAD and DETER in the Amazon) and the aggregation of alerts with overlapping of their spatial contours. Then, the alerts were validated with high-resolution images and false positives (e.g., reforestation harvest areas) were excluded. More details are available in chapter 2 on the method.

The process resulted in the validation and refinement of **83,353 alerts in 2023** , which totaled **1,829,597 deforested hectares**, distributed across the six Brazilian biomes (Figure 5). This represented an **11.6% reduction in the total deforested area** and an 8.7% increase in the total number of alerts compared to 2022 (Table 4). In 2023, a greater concentration of deforested area will be observed in the MATOPIBA region in the Cerrado, mainly in the states of Maranhão, Tocantins and Bahia, on the other hand, there has been a reduction in deforestation in the regions of the deforestation arc and AMACRO in the Amazon (Figure 6).

Table 4 DEFORESTATION ALERTS VALIDATED BY MAPBIOMAS ALERTA IN BRAZIL IN 2019, 2020, 2021, 2022 AND 2023

Alert Validation	2019	2020	2021	2022	2023	Variation between 2022-2023
Number of Alerts	56,511	98,987	81,641	76,670	83,353	8.7%
Total deforested area (ha)	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597	-11.6%

Note. There may be differences in the total number of alerts and deforested area for the years reported in previous RADs . This occurs because there are remnants of alerts where images were not available and could only be validated after the closure of previous reports, or by the addition of new sources of alerts. Another factor is the inclusion of alerts in deforested areas identified by PRODES in the Amazon, Cerrado, Pampa and Pantanal that are made in the following years.

Of the total alerts analyzed in Brazil, 54.0% were validated, refined and published; 18.3% of the alerts were duplicated (when, during the validation process, the delimitation of another nearby alert already included that deforestation); and 27.1% were false positives, meaning that they did not correspond to real deforestation. Among the main reasons for false positives are confusion with burned areas (mainly in the Pantanal and Cerrado), flooded areas (especially in the Pantanal), forestry (mainly in the Pampa and Atlantic Forest) and the effect of seasonality on native vegetation (mainly Caatinga, Pantanal and Cerrado) and areas undergoing a recent regeneration process (considered already altered, identified in the Amazon and Cerrado, for example) (Table 5).

Table 5 QUANTITY AND PERCENTAGE OF ALERTS VALIDATED AND REASONS FOR NOT VALIDATING ALERTS IN BIOMES AND IN BRAZIL IN 2023.

Reasons	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Brazil
Validated, Refined and Published	**33,310**	**18,842**	**67,895**	**3,718**	**318**	**314**	**124,397**
Not Validated	**23,721**	**23,248**	**24,194**	**25,029**	**3,097**	**6,774**	**106,063**
Duplication	18,134	9,071	12,467	1,435	385	701	42,193
False positive	4,735	14,005	11,406	23,584	2,712	6,073	62,515
Not observed	801	48	228	4			1,081
Others	51	124	93	6			274
Total	**57,031**	**42,090**	**92,089**	**28,747**	**3,415**	**7,088**	**230,460**

Row Labels	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Brazil
Validated, Refined and Published	**58.4%**	**44.8%**	**73.7%**	**12.9%**	**9.3%**	**4.4%**	**54.0%**
Not Validated	**41.6%**	**55.2%**	**26.3%**	**87.1%**	**90.7%**	**95.6%**	**46.0%**
Duplication	31.8%	21.6%	13.5%	5.0%	11.3%	9.9%	18.3%
False positive	8.3%	33.3%	12.4%	82.0%	79.4%	85.7%	27.1%
Not observed	1.4%	0.1%	0.2%	0.0%	0.0%	0.0%	0.5%
Others	0.1%	0.3%	0.1%	0.0%	0.0%	0.0%	0.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Box 2 ALERTS CANCELED AFTER PUBLICATION

In certain situations, deforestation alerts published on the MapBiomas Alerta platform may be rectified, or even cancelled. Whenever there is a formal note or a reasoned request indicating possible errors associated with alerts, whether by environmental agencies or platform users, the MapBiomas Alerta technical team carries out a new technical and thorough analysis of these alerts. We emphasize that cancellation only occurs if it is proven that the vegetation removed is not native vegetation. MapBiomas does not make any assessment of the legality, regularity or responsibility of deforestation. Over the five years of monitoring, 880 alerts were canceled after publication, representing 0.2% of published alerts. Furthermore, each year, the number of alerts canceled after publication has been reduced (Table 6).

Table 6 NUMBER OF ALERTS CANCELED AFTER PUBLICATION PER BIOME PER YEAR*

Biomes	2019	2020	2021	2022	2023	Total
Amazon	420	108	28	23	3	**582**
Caatinga	7	7	2	2	2	**20**
Cerrado	51	4	9	13	5	**82**
Atlantic Forest	13	29	54	83	11	**190**
Pampa	2					**2**
Pantanal	2			two		**4**
Brazil	**495**	**148**	**93**	**123**	**21**	**880**

*All cases of doubts about specific alerts and possible re-analyses are handled via email suporte.alerta@mapbiomas.org

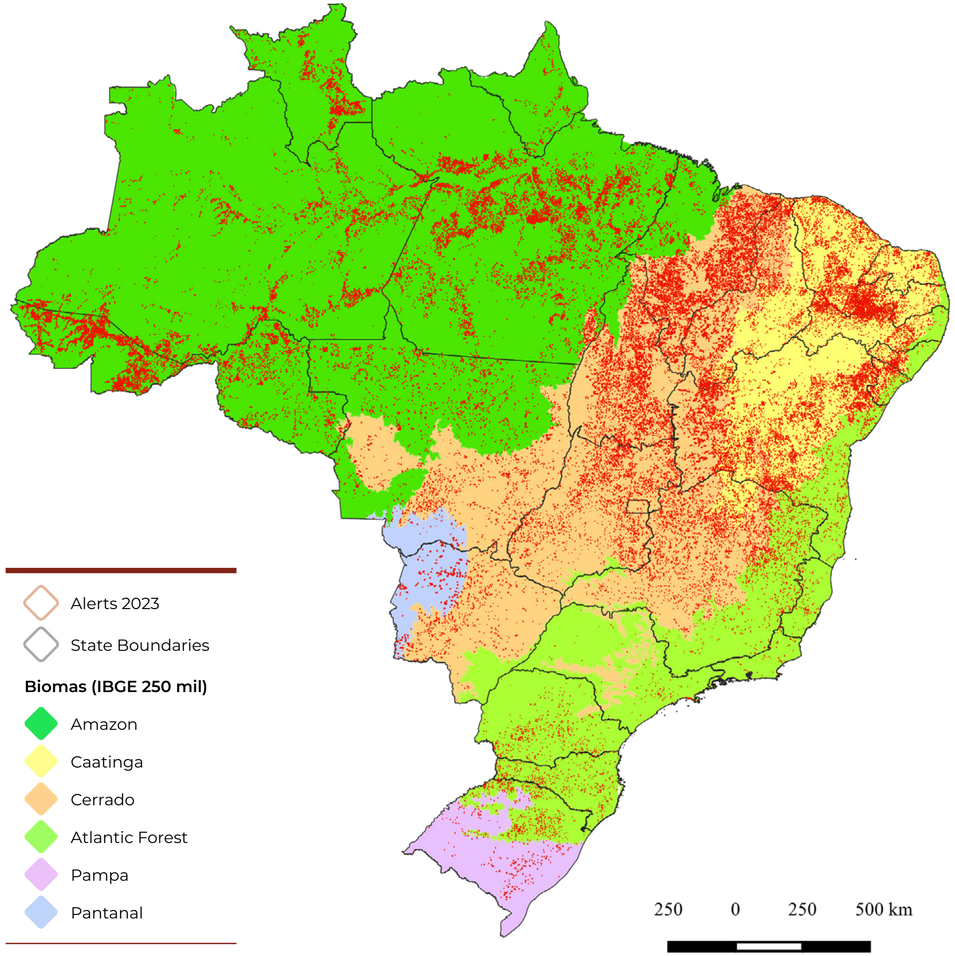


Figure 5 Map of deforestation alerts in Brazil in 2023 .

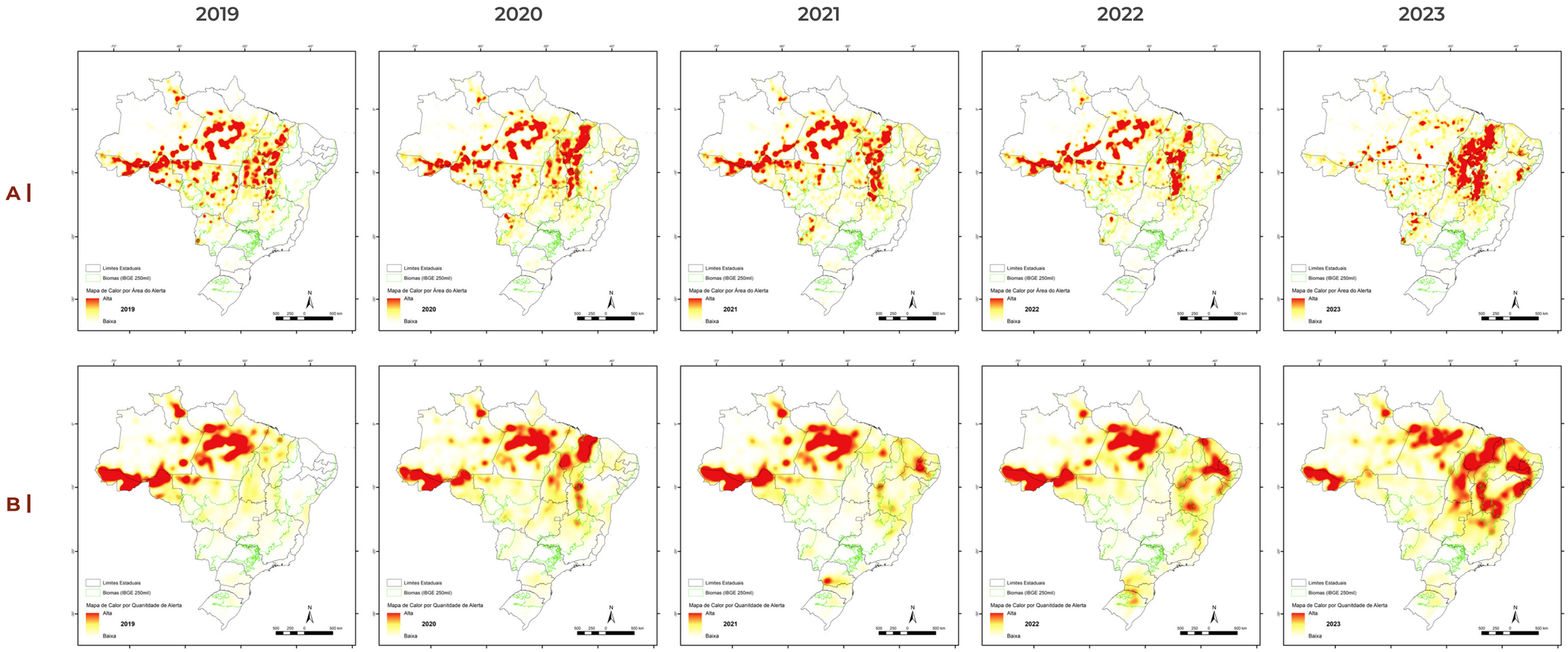


Figure 6 Density of deforested area in Brazil in 2019, 2020, 2021, 2022 and 2023. A) Heat map by deforested area; B) Heat map by deforestation event.

SADs have proven to be relevant complementary sources for monitoring deforestation in biomes, especially in biomes with no official systems, such as the Caatinga, Atlantic Forest, Pampa and Pantanal, and for smaller deforested areas, such as the Amazon and the Cerrado (Table 7 and Figure 7).

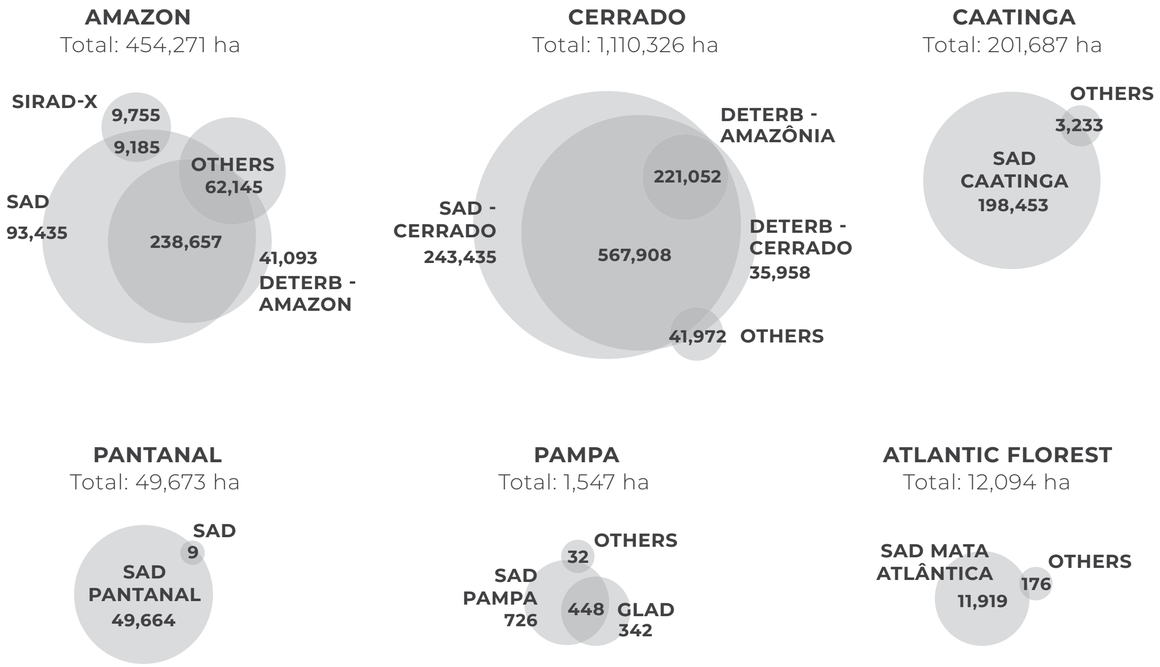


Figure 7 Area (ha) of alerts validated and published by detection source by biome in 2023.

Table 7 NUMBER OF VALIDATED ALERTS AND DEFORESTED AREA BY BIOME AND BY SOURCE/DETECTION SYSTEM IN 2023

BIOME	Source	Amount	% of Quantity	Area (ha)	% of Area
Amazon		33,311		454,271	
	SAD	19,118	57.4%	93,435	20.6%
	DETERB-AMAZÔNIA + SAD	6,614	19.9%	238,657	52.5%
	DETERB-AMAZÔNIA	2,825	8.5%	41,093	9.0%
	SIRADX	2,647	7.9%	9,755	2.1%
	SAD + SIRADX	1,071	3.2%	9,185	2.0%
	Other multiple sources	1,036	3.1%	62,145	13.7%
Caatinga		18,840		201,687	
	SAD-CAATINGA	18,692	99.2%	198,453	98.4%
	Other sources	148	0.8%	3,233	1.6%
Cerrado		26,861		1,110,326	
	SAD-CERRADO	17,567	65.4%	243,435	21.9%
	DETER-CERRADO, SAD-CERRADO	6,336	23.6%	567,908	51.1%
	DETERB-AMAZÔNIA, DETER-CERRADO, SAD-CERRADO	1,326	4.9%	221,052	19.9%
	DETER-CERRADO	649	2.4%	35,958	3.2%
	Other sources	983	3.7%	41,972	3.8%
Atlantic Forest		3,709		12,094	
	SAD-MATA-ATLANTICA	3,698	99.7%	11,919	98.5%
	Other sources	11	0.3%	176	1.5%
Pampa		318		1,547	
	SAD-PAMPA	222	69.8%	726	46.9%
	GLAD	44	13.8%	342	22.1%
	GLAD,SAD -PAMPA	41	12.9%	448	29.0%
	SAD-MATA-ATLÂNTICA, SAD-PAMPA	11	3.5%	32	2.0%
Pantanal		314		49,673	
	SAD-PANTANAL	313	99.7%	49,663	100.0%
	SAD	1	0.3%	9	0.0%
TOTAL		83,353		1,829.59	

3.3 | Profile of Validated and Refined Alerts

3.3.1 | Deforestation by Biome

Brazil has lost around 8,558,237 ha of native vegetation in the last 5 years. Considering 2023, more than 85% of the deforested area occurred in the Amazon and Cerrado biomes. Although the Cerrado has a share of only 32.2% in the total number of alerts, its total deforested area represents more than half of the country's total deforested area (60.7%) (Table 8).

In 2023, the Cerrado surpassed the Amazon for the first time and presented the largest deforested area among the biomes, totaling 1,110,326 ha.

The Amazon came in second place, with 24.8% of the deforested area in Brazil (454,271 ha), followed by the Caatinga in third place, with 11% of the area (201,687 ha). In the Pantanal, 2.7% of the country's total deforestation was observed, totaling 49,673 ha. In the Atlantic Forest, even with most of its forest area already deforested, with less than 29% of the biome remaining with forest cover , 12,094 ha were deforested, which represents 0.7% of the total deforested area in the country. Pampa accounts for the smallest area of deforestation (0.1% of the total), and it should be noted that the current detection system still omits the suppression of grassland vegetation, typical of the biome.

There was an increase in the deforested area in the Cerrado (67.7%), Pantanal (59.2%) and Caatinga (43.4%) biomes in 2023 compared to 2022. On the other hand, **in the Amazon biomes (-62.2%), Atlantic Forest (-59.6%) and Pampa (-50.4%) there was a reduction in the deforested area** in 2023 compared to 2022. **In the country, in 2023 there was a reduction in the deforested area of 11.6% in relation to previous year (Table 8 and Figure 8).**

It is worth noting that, in the Cerrado, in addition to the detection systems already used in previous years, the SAD Cerrado alert detection system (IPAM) was also operationally incorporated. Therefore, part of the increase in deforestation seen in 2023 may be related to improvements in deforestation detection, due to the inclusion of this new system. In the other biomes, the increase is only related to the occurrence of more deforestation events since the alert detection method remained stable from one year to the next.

Table 8 DEFORESTED AREA AND NUMBER OF ALERTS VALIDATED BY BIOME IN BRAZIL FROM 2019 TO 2023*

Number of alerts

BIOME	2019	2020	2021	2022	2023	Total	Biome participation in 2023	Variation 2022-2023	Variation 2022-2023
Amazon	46,984	61,218	58,120	47,837	33,311	247,470	40.0%	-14,526	-30.4%
Caatinga	531	5,644	10,621	13,989	18,840	49,625	22.6%	4,851	34.7%
Cerrado**	7,347	28,751	7,330	6,297	26,861	76,586	32.2%	20,564	326.6%
Atlantic Forest	1,380	3,061	5,118	7,855	3,709	21,123	4.4%	-4,146	-52.8%
Pampa	66	105	160	424	318	1,073	0.4%	-106	-25.0%
Pantanal	203	208	292	268	314	1,285	0.4%	46	17.2%
Brazil	56,511	98,987	81,641	76,670	83,353	397,162	100.0%	6,683	8.7%

Area in hectares (ha)

BIOME	2019	2020	2021	2022	2023	Total	Biome participation in 2023	Variation 2022-2023	Variation 2022-2023
Amazon	772,905	883,776	1,112,325	1,202,628	454,271	4,425,905	24.8%	-748,357	-62.2%
Caatinga	13,922	67,141	115,068	140,635	201,687	538,453	11.0%	61,051	43.4%
Cerrado**	406,039	637,632	509,172	662,186	1,110,326	3,325,354	60.7%	448,139	67.7%
Atlantic Forest	10,462	23,950	30,091	29,916	12,094	106,513	0.7%	-17,821	-59.6%
Pampa	626	1,271	2,426	3,121	1,547	8,991	0.1%	-1,574	-50.4%
Pantanal	16,284	25,961	29,896	31,208	49,673	153,021	2.7%	18,465	59.2%
Brazil	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597	8,558,237	100.0%	-240,097	-11.6%

* There may be differences in the total number of alerts and deforested area for the years reported in previous RADs . In the case of the Cerrado, the main factor for the increase in alerts in 2020 is the inclusion of alerts in deforested areas identified by PRODES Cerrado, which was made in 2022.
** In 2023, all deforestation alerts from the SAD Cerrado were incorporated operationally, between January and July 2023, and from July to December 2023, only alerts with areas larger than 10 hectares were incorporated.

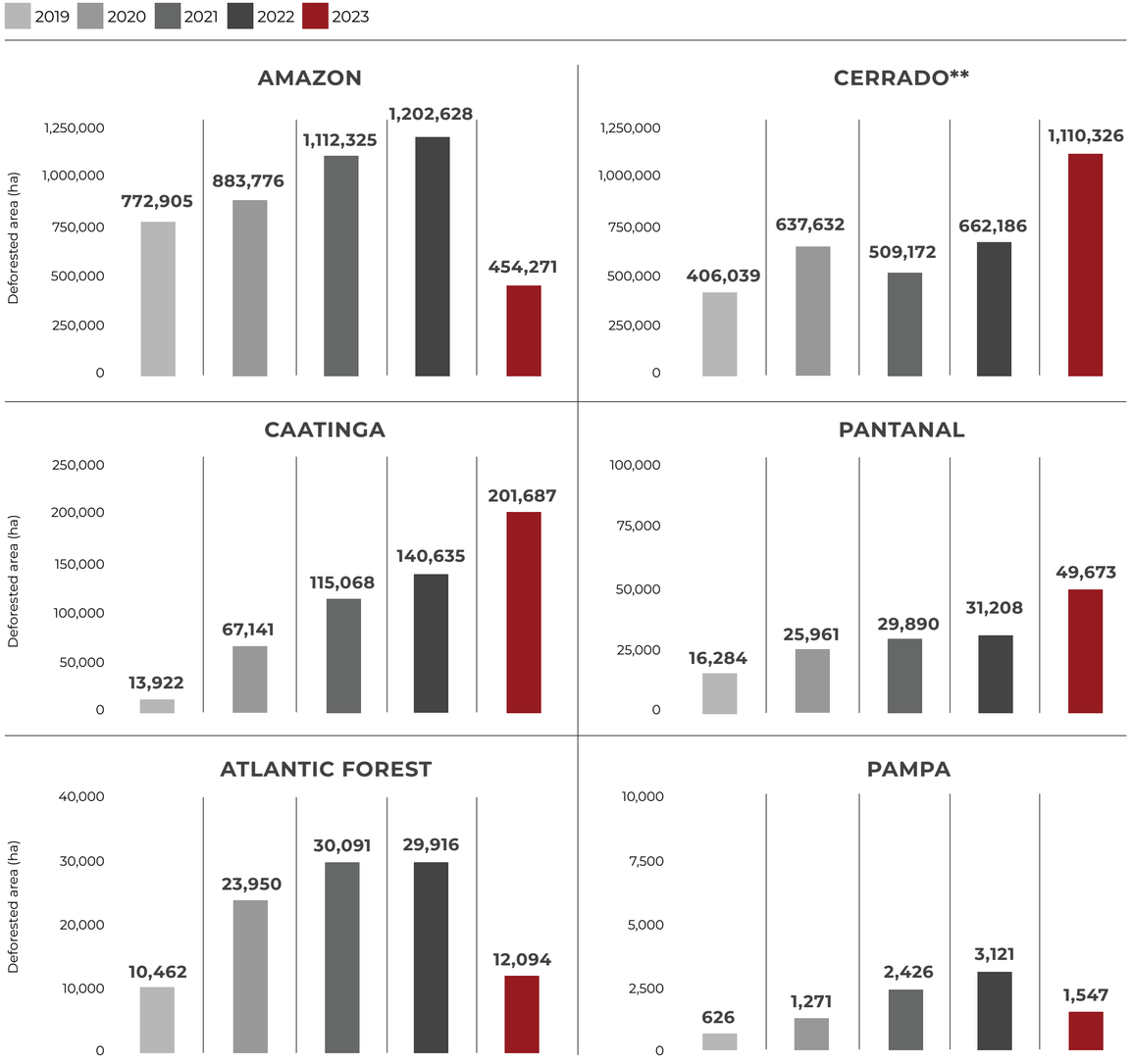


Figure 8 Deforested area by biome (ha) per year from 2019 to 2023

Box 3 DEFORESTATION IN THE LEGAL AMAZON

The limits of the Amazon biome in Brazil and the Legal Amazon are different and, therefore, have different results. While in the Amazon biome, there were a total of 33,311 deforestation alerts validated for the year 2023, in the Legal Amazon this number was 44,774 alerts. **In the last 5 years, the Legal Amazon territory lost 5,895,301 ha of native vegetation** (Table 9, Figure 9).

Table 9 NUMBER OF ALERTS AND DEFORESTED AREA PER YEAR IN THE LEGAL AMAZON*

Legal Amazon	Number of Alerts	Deforested Area (ha)
2019	51,154	989,358
2020	73,668	1,188,522
2021	61,257	1,315,797
2022	50,123	1,428,606
2023	44,774	973,018
Total	**280,976**	**5,895,301**

*The Legal Amazon is an administrative political limit that corresponds to 58.9% of the Brazilian territory and comprises the states of Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins and part of the state of Maranhão (Source: MMA, 1996 via TerraBrasilis).

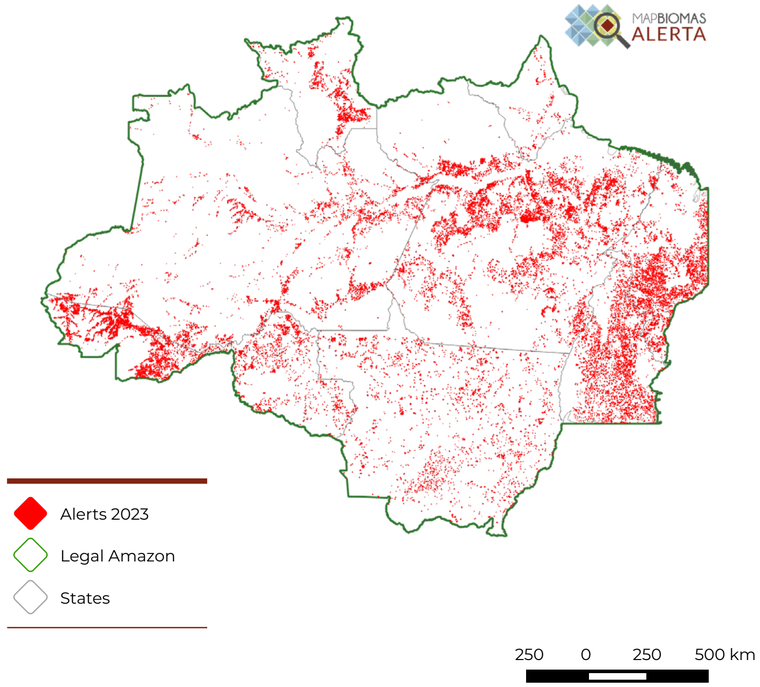


Figure 9 Deforestation alerts in 2023 in the Legal Amazon

Box 4 DEFORESTATION IN THE COASTAL SYSTEM

The Coastal-Marine System (defined in the IBGE Biome Map), despite being predominantly composed of its maritime part, has a mainland portion that occupies 1.7% of the national territory and overlaps with other biomes. An **increase in deforestation in the coastal system of 96.4% was obseved** in 2023, when compared to 2022, mainly concentrated in areas overlapping the Caatinga and Cerrado biomes, on the north coast (Table 10 and Figure 10). On the other hand, there was a reduction in deforestation in the coastal area of the Atlantic Forest.

Table 10 DEFORESTED AREA (HA) IN THE COASTAL SYSTEM* BY PORTION OVERLAPPING EACH OF THE BIOMES FROM 2019 TO 2023

Coastal System	2019	2020	2021	2022	2023	Total	Variation 2022-2023
Amazon	119	257	172	163	196	908	20.8%
Caatinga	194	98	864	640	998	2,794	55.9%
Cerrado	47	3,062	604	493	1,650	5,857	234.8%
Atlantic Forest	496	683	705	227	182	2,294	-19.9%
Pampa	8	12	54	23	10	108	-56.2%
Total	**865**	**4,112**	**2,400**	**1,546**	**3,037**	**11,960**	**96.4%**

* Biomes and coastal-marine system in Brazil: compatible with the 1:250,000 scale / IBGE, Coordination of Natural Resources and Environmental Studies. - Rio de Janeiro: IBGE, 2019. 168 p. - (Methodological reports, ISSN 0101- 2843; v. 45). Available at: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101676.pdf

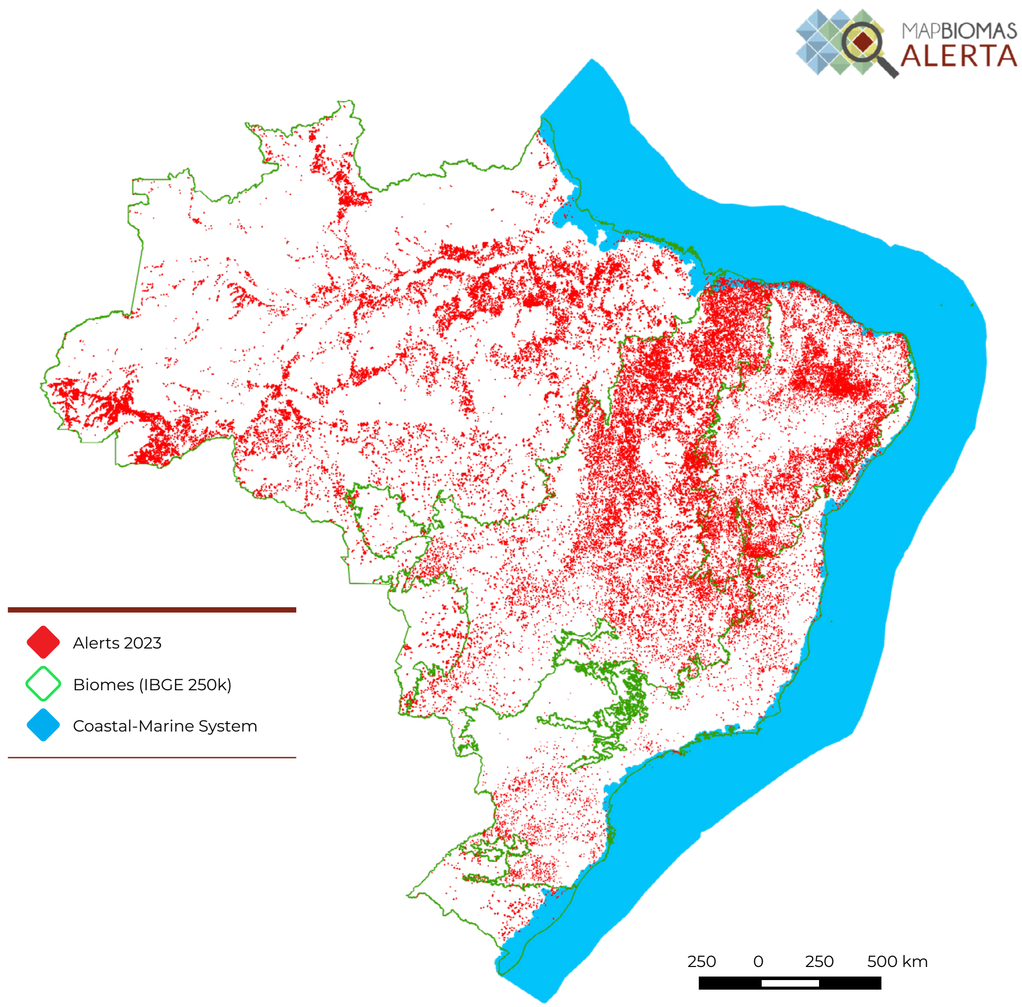


Figure 10 Deforestation alerts in 2023 and the coastal-marine system in Brazil

3.3.2 | Alert Size

The average size of deforestation in 2023 was 21.9 ha, which represents a reduction of 18.7% compared to the 27 ha, on average, seen in 2022 (Table 11).

The Pantanal, which already had the largest average area of alerts in all previous years, showed an increase of 35.9%, resulting in 158.2 ha of average area of deforestation events in 2023. The Cerrado had the second largest average area of deforestation alerts (41.3 ha), followed by the Amazon (13.6 ha) and the Caatinga (10.7 ha)

The Atlantic Forest and Pampa had the smallest average areas due to deforestation (3.3 and 4.9 ha, respectively), which can be explained by the greater fragmentation of the landscape and the land structure, with smaller rural properties in these biomes when compared to the others.

Table 11 AVERAGE SIZE OF DEFORESTATION ALERTS BY BIOME AND IN BRAZIL FROM 2019 TO 2023

BIOME	2019	2020	2021	2022	2023	Total	Average in the period from 2019 to 2023	Variation 2022-2023	Variation 2022-20232
Amazon	16.5	14.4	19.1	25.1	13.6	**17.9**	17.76	- 12	-45.8%
Caatinga	26.2	11.9	10.8	10.1	10.7	**10.9**	13.94	0.7	6.5%
Cerrado*	55.3	22.2	69.5	105.2	41.3	**43.4**	58.68	- 63.8	-60.7%
Atlantic Forest	7.6	7.8	5.9	3.8	3.3	**5.0**	5.67	- 0.5	-14.4%
Pampa	9.5	12.1	15.2	7.4	4.9	**8.4**	9.79	- 2.5	-33.9%
Pantanal	80.2	124.8	102.4	116.4	158.2	**119.1**	116.41	41.7	35.9%
Total	**21.6**	**16.6**	**22.0**	**27.0**	**21.9**	**21.5**	**21.83**	**- 5.0**	**-18.7%**

*change in the pattern explained by the incorporation of SAD Cerrado

3.3.2.1 | Largest deforestation by biome

The largest deforestation detected in Brazil, in 2023, was 6,691.29 ha (alert code 918727), in the municipality of Alto Parnaíba, in Maranhão (Figure 11). Once again, the greatest deforestation in Brazil was in the Cerrado, but with a reduction of 45.8% in relation to the highest alert in 2022. There was a reduction in the maximum size in all biomes, with the exception of the Caatinga, where there was an increase of 331 .2%, with an alert (code 912386) with 4,730 hectares (Tables 12 and 13).

Table 12 MAXIMUM SIZE OF DEFORESTATION ALERTS BY BIOME AND IN BRAZIL FROM 2019 TO 2023

BIOME	2019	2020	2021	2022	2023	Maximum in the period from 2019 to 2023	Variation 2022-2023	Variation 2022-20232
Amazon	4,478.0	6,476.5	3,585.8	3,580.4	2,683.4	6,476.50	- 897	-25.1%
Caatinga	1,050.9	1,049.2	1,268.3	1,096.8	4,730.0	4,729.99	3,633.1	331.2%
Cerrado	2,384.6	7,506.9	4,977.6	12,342.7	6,691.3	12,342.73	- 5,651.4	-45.8%
Atlantic Forest	125.5	274.1	456.0	294.9	217.9	455.99	- 77.0	-26.1%
Pampa	117.2	127.6	466.5	80.5	39.0	466.53	- 41.4	-51.5%
Pantanal	2,268.6	4,132.1	968.5	2,804.9	2,603.4	4,132.10	- 201.6	-7.2%
Brazil	**4,478.0**	**7,506.9**	**4,977.6**	**12,342.7**	**6,691.3**	**12,342.73**	**- 5,651.4**	**-45.8%**

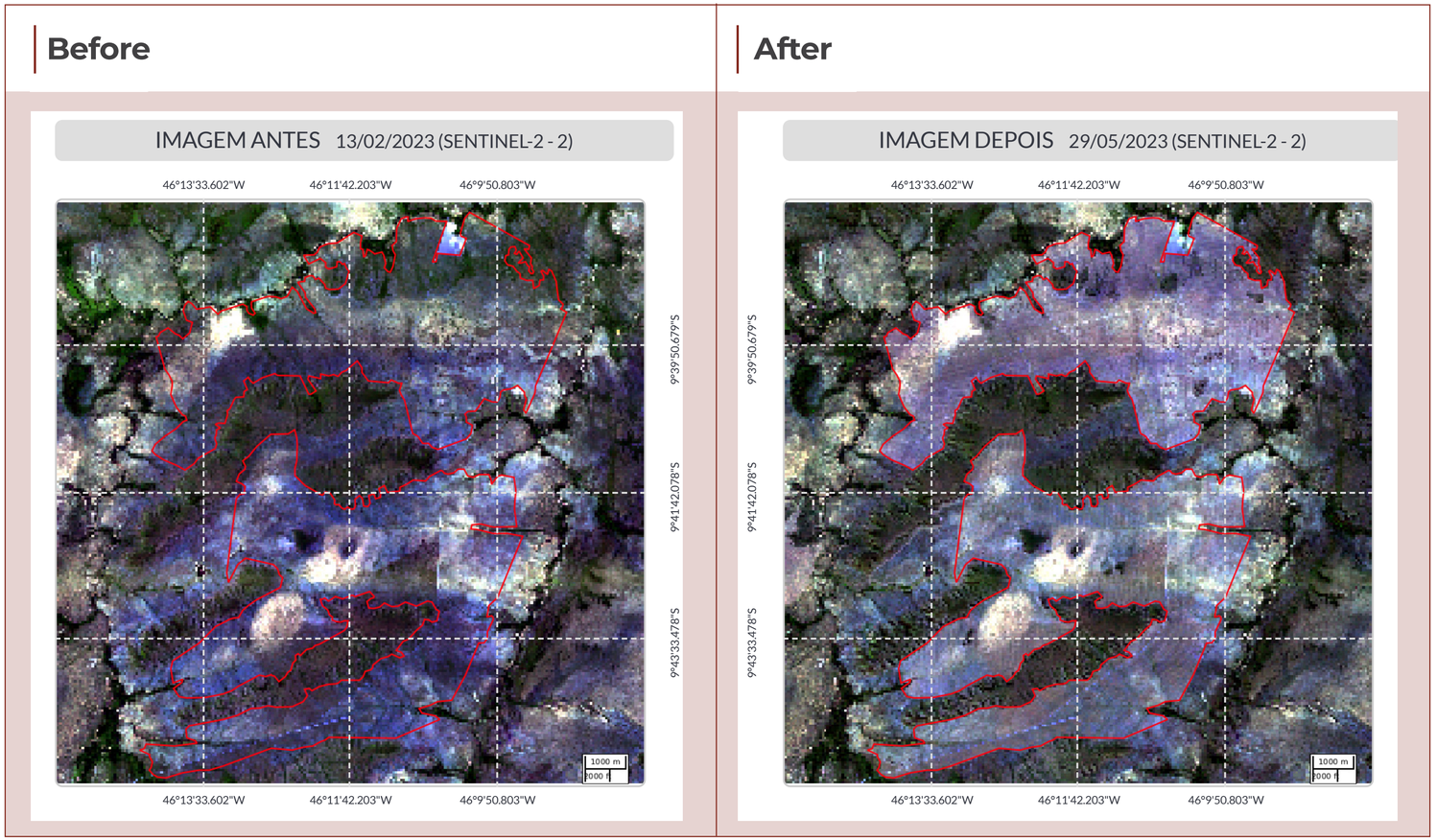


Figure 11 Highest deforestation detected in 2023 in Brazil (alert code 918727), with 6,691.3 ha, in the Cerrado biome, municipality of Alto Parnaíba, in the state of Maranhão

The largest deforestation detected in the **Amazon biome**, in 2023, was 2683.4 ha (alert code 887194) and occurred in the municipality of Altamira, in the state of Pará. According to Semas-PA (communication via email, on the 29th of April 2024), there is no licensing in progress that concerns this area and the aforementioned deforestation is embargoed by the state and available for consultation on the LDI website[2].

In addition to Table 13 and location of alerts in biomes (Figure 12), details about each of the largest deforestation events by biome and their respective information sent by the responsible state agencies are in Appendix 5 of this report.

Table 13 HIGHEST DEFORESTATION BY BIOME AND IN 2023*

Biome	Area in hectares	Alert Code	Source	Municipality	UF	Detection date	Link do laudo
Cerrado	6,691.3	918727	SAD Cerrado	Alto Parnaíba	MA	04/01/2023	https://plataforma.alerta.mapbiomas.org/alerta/918727
Caatinga	4,730.0	912386	SAD Caatinga	Barra	BA	04/01/2023	https://plataforma.alerta.mapbiomas.org/alerta/912386
Amazon	2,683.4	887194	Deterb Amazonia and SAD	Altamira	PA	04/01/2023	https://plataforma.alerta.mapbiomas.org/alerta/887194
Pantanal	2,603.4	934272	SAD Pantanal	Corumbá	MS	05/31/2023	https://plataforma.alerta.mapbiomas.org/alerta/934272
Atlantic Forest	217.9	1060704	SAD Atlantic Forest	Tremedal	BA	09/30/2023	https://plataforma.alerta.mapbiomas.org/alerta/1060704
Pampa	39.0	1204419	GLAD	Herval	RS	12/31/2023	https://plataforma.alerta.mapbiomas.org/alerta/1204419

*More details in Appendix 5 about each of the alerts in this table and the position of the responsible state bodies.

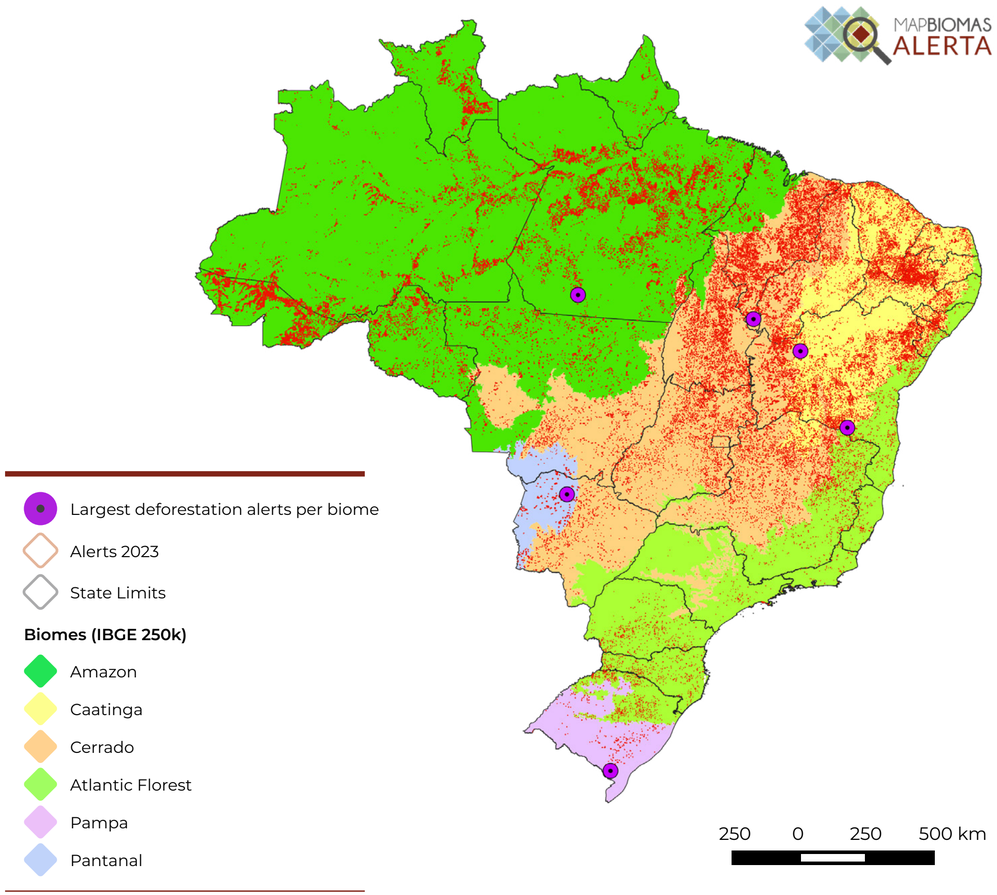


Figure 12 Location of the largest deforestation detected in Brazil in 2023, in each of the biomes.

2 | Visit: https://monitoramento.semas.pa.gov.br/ldi/

3.3.2.2 | Alerts by size class

In 2023, deforested areas of less than 25 ha represent 86% of total alerts, but only 23.9% of the deforested area. Deforestation of more than 100 ha represents 4% of alerts, but accounts for 54.2% of the total deforestation in the country. There was a reduction in the number of alerts with an area larger than 100 ha of 17.1% (Figure 13 and Table 14).

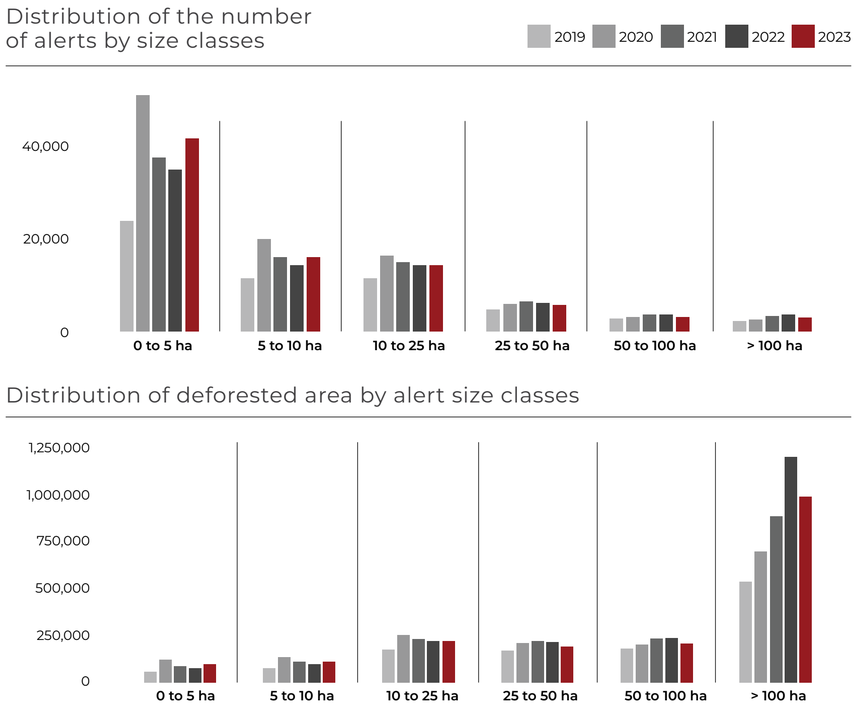


Figure 13 Distribution of the number of alerts and deforested area by size class (ha) of alerts in Brazil from 2019 to 2023*.

Table 14 DISTRIBUTION OF THE AMOUNT OF DEFORESTATION AND DEFORESTED AREA BY SIZE CLASS (HA) IN BRAZIL FROM 2019 TO 2023.

	Number of alerts					%				
Classes	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**	**2022**	**2023**
0 to 5 ha	23,801	51,176	37,450	34,968	41,664	42%	52%	46%	46%	50%
5 to 10 ha	11,584	19,793	16,045	14,247	15,914	20%	20%	20%	19%	19%
10 to 25 ha	11,393	16,550	14,997	14,112	14,198	20%	17%	18%	18%	17%
25 to 50 ha	4,937	6,115	6,574	6,196	5,580	9%	6%	8%	8%	7%
50 to 100 ha	2,661	2,919	3,409	3,497	2,972	5%	3%	4%	5%	4%
> 100 ha	2,135	2,434	3,166	3,650	3,025	4%	2%	4%	5%	4%
Total	**56,511**	**98,987**	**81,641**	**76,670**	**83,353**	**100%**	**100%**	**100%**	**100%**	**100%**

	Area (ha)					%				
Classes	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**	**2022**	**2023**
0 to 5 ha	58,622	123,559	91,898	80,779	102,001	4.8%	7.5%	5.1%	3.9%	5.6%
5 to 10 ha	82,850	140,434	114,550	102,143	112,969	6.8%	8.6%	6.4%	4.9%	6.2%
10 to 25 ha	179,615	257,387	236,012	222,531	221,230	14.7%	15.7%	13.1%	10.8%	12.1%
25 to 50 ha	171,961	211,825	229,674	216,684	194,358	14.1%	12.9%	12.8%	10.5%	10.6%
50 to 100 ha	185,025	202,233	235,872	243,454	207,013	15.2%	12.3%	13.1%	11.8%	11.3%
> 100 ha	542,162	704,291	890,972	1,204,104	992,025	44.4%	43.0%	49.5%	58.2%	54.2%
Total	**1,220,236**	**1,639,730**	**1,798,978**	**2,069,695**	**1,829,597**	**100%**	**100%**	**100%**	**100%**	**100%**

When analyzing the size classes of deforested areas by biome in 2023, contrasting patterns are observed. In the Atlantic Forest, 40% of the deforested area occurred on less than 5 ha, equivalent to 84.5% of validated alerts. In the Pantanal, almost 90% of the deforested area in the biome occurred in alerts with more than 100 ha, equivalent to 40% of the total validated alerts.

Furthermore, in the Cerrado and the Amazon more than half of the alerts are larger than 50 hectares, 76.2% and 52.3% respectively (Table 15).

Table 15 DISTRIBUTION OF THE AMOUNT OF DEFORESTATION AND DEFORESTED AREA BY SIZE CLASS (HA) BY BIOME IN 2023*.

	Amount						%					
Biome	**0 to 5**	**5 to 10**	**10 to 25**	**25 to 50**	**50 to 100**	**> 100**	**0 to 5**	**5 to 10**	**10 to 25**	**25 to 50**	**50 to 100**	**> 100**
Amazon	19,367	6,121	4,677	1,630	854	662	58.1%	18.4%	14.0%	4.9%	2.6%	2.0%
Caatinga	10,155	4,335	2,971	903	313	163	53.9%	23.0%	15.8%	4.8%	1.7%	0.9%
Cerrado*	8,728	5,037	6,307	2,966	1,752	2,071	32.5%	18.8%	23.5%	11.0%	6.5%	7.7%
Atlantic Forest	3,133	358	173	33	10	2	84.5%	9.7%	4.7%	0.9%	0.3%	0.1%
Pampa	235	42	34	7			73.9%	13.2%	10.7%	2.2%	0.0%	0.0%
Pantanal	46	21	36	41	43	127	14.6%	6.7%	11.5%	13.1%	13.7%	40.4%

	Area (ha)					%	%					
Biome	**0 to 5**	**5 to 10**	**10 to 25**	**25 to 50**	**50 to 100**	**> 100**	**0 to 5**	**5 to 10**	**10 to 25**	**25 to 50**	**50 to 100**	**> 100**
Amazon	45,063	43,270	71,928	56,402	58,555	179,052	9.9%	9.5%	15.8%	12.4%	12.9%	39.4%
Caatinga	27,656	30,283	45,484	31,217	21,209	45,838	13.7%	15.0%	22.6%	15.5%	10.5%	22.7%
Cerrado*	23,820	36,452	100,013	103,980	123,524	722,536	2.1%	3.3%	9.0%	9.4%	11.1%	65.1%
Atlantic Forest	4,841	2,531	2,668	1,069	639	348	40.0%	20.9%	22.1%	8.8%	5.3%	2.9%
Pampa	511	293	525	218			33.0%	18.9%	34.0%	14.1%	0.0%	0.0%
Pantanal	110	141	612	1,473	3,085	44,251	0.2%	0.3%	1.2%	3.0%	6.2%	89.1%

* For the Cerrado, PRODES Cerrado 2020 was included, with validation of all polygons. Furthermore, PRODES Cerrado 2021 was included, which is in the validation process. For the year 2023, the SAD Cerrado was included, for which all alerts from January to June 2023 were validated, and from July to December 2023 only alerts larger than 10 ha were validated.

3.3.3 | Speed of Deforestation

The deforestation speed of an alert is calculated by dividing the deforested area and the number of days that have passed between the dates of the images before and after deforestation. The real speed is always underestimated as it is not always possible to obtain a good image of the precise day of the beginning or end of deforestation, especially in periods and places with high cloud cover. However, it is a good indication of the speed at which events occur.

In 2023, the average area deforested per day in Brazil was 5,012.6 hectares – or 208.9 hectares per hour (Table 14). In the Cerrado alone, 3,042 hectares of native vegetation were lost per day. **In the Amazon, 1,244.6 hectares were lost per day, or 51.9 hectares per hour, which is equivalent to around 8 trees per second.**

There was a reduction of around 11% in the average area deforested per day in the country compared to 2022 (which had been 5,636.3 ha per day).

The average deforestation speed per alert remained relatively stable in 2023, when compared to the previous year (0.20 ha/alert/day in 2022 and 0.23 ha/alert/day in 2023). An average of 228 new deforestation events were detected and validated per day in 2023 (in 2022 there were 208).

The highest average speed of deforestation occurred for the third consecutive year in the Pantanal, with 2.1 ha/day per deforestation event, followed by the Cerrado, with 0.43 ha/day (Table 16).

Table 16 DEFORESTATION SPEED INDICATORS BY BIOME AND IN BRAZIL IN 2023

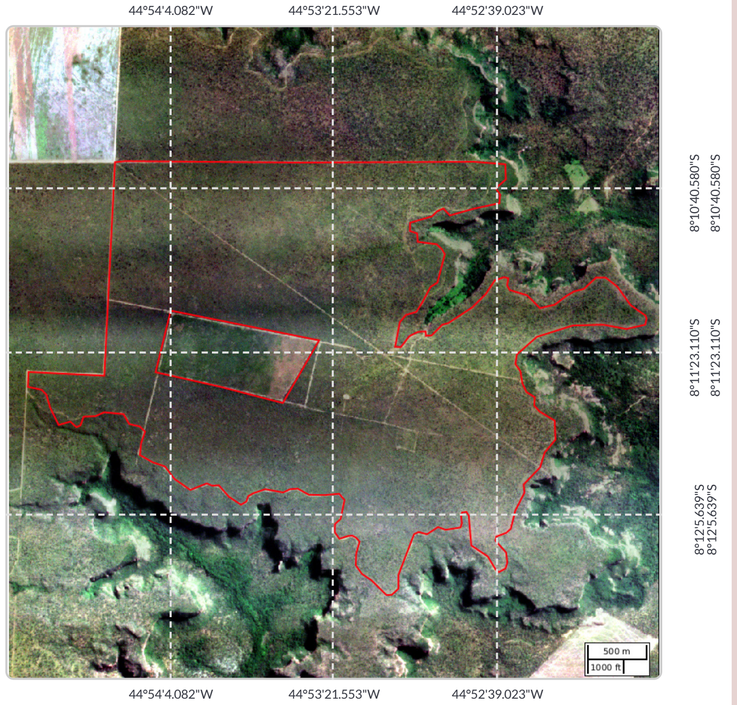
BIOME	Average Speed per Alert (ha/alert/day)	Maximum Speed (ha/alert/day)	Average number of events per day	Area deforested per day (ha)	Area deforested per hour (ha)
Amazon	0.14	30.2	91.3	1,244.6	51.9
Caatinga	0.10	65.5	51.6	552.6	23.0
Cerrado	0.43	118.0	73.6	3,042.0	126.7
Atlantic Forest	0.05	2.9	10.2	33.1	1.4
Pampa	0.06	0.5	0.9	4.2	0.2
Pantanal	2.10	29.3	0.9	136.1	5.7
Grand total	0.23	118.0	228.4	5,012.6	208.9

The states with the largest areas deforested per day, in 2023, were Maranhão, Bahia and Tocantins. Adding the three states, an area equivalent to 2,334.5 hectares of native vegetation was lost per day (Table 17).

Table 17 RANKING OF STATES BY DEFORESTATION SPEED (HA/H)

STATE	Average Speed per Alert (ha/alert/day)	Maximum Speed (ha/alert/day)	Average number of events per day	Area deforested per day (ha)	Area deforested per hour (ha)
Maranhão	0.37	63.73	21.7	907.5	37.8
Bahia	0.29	101.61	26.5	796.2	33.2
Tocantins	0.51	46.91	13.6	630.8	26.3
Pará	0.13	43.10	38.5	506.2	21.1
Mato Grosso	0.51	33.89	9.6	442.1	18.4
Piauí	0.35	118.03	12.4	372.6	15.5
Amazon	0.15	10.08	16.8	240.4	10.0
Mato Grosso do Sul	0.95	23.85	3.1	226.6	9.4
Minas Gerais	0.17	13.79	13.9	204.2	8.5
Goiás	0.20	11.79	9.6	190.5	7.9
Rondônia	0.19	4.39	5.7	114.4	4.8
Ceará	0.07	3.09	9.8	89.0	3.7
Acre	0.06	1.71	18.0	78.7	3.3
Roraima	0.13	6.90	4.8	59.7	2.5
Pernambuco	0.08	2.76	5.7	44.5	1.9
Paraíba	0.06	2.39	6.0	36.3	1.5
Rio Grande do Norte	0.14	3.04	1.8	25.0	1.0
Alagoas	0.08	2.81	1.4	14.7	0.61
Sergipe	0.07	0.97	1.6	13.9	0.58
Rio Grande do Sul	0.04	0.52	2.7	6.4	0.27
Amapá	0.03	0.27	1.2	3.8	0.16
Paraná	0.05	0.42	1.5	3.2	0.13
Santa Catarina	0.04	0.56	1.3	2.0	0.08
Federal District	0.22	3.20	0.1	1.7	0.07
Espírito Santo	0.04	0.24	0.4	1.0	0.04
São Paulo	0.03	1.09	0.4	0.8	0.03
Rio de Janeiro	0.06	0.30	0.2	0.4	0.02

Before



After

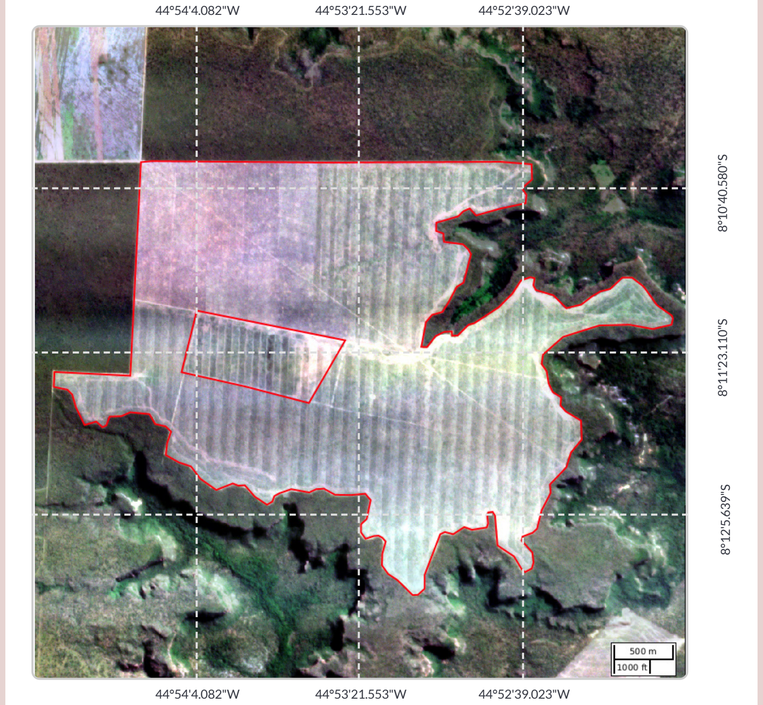


Figure 14 Alert with the maximum average speed (Code 931176) in Brazil in 2023, of 118 ha/day in the municipality of Baixa Grande do Ribeiro-PI, in the Cerrado biome, totaling 944.25 ha deforested between 05/23/2023 and 05/31/2023

The alert with the highest average daily speed, of 944 hectares in 8 days, or 118 ha/day, is located in the municipality of Baixa Grande do Ribeiro (PI), in the Cerrado biome (Figure 14 and Table 18).

Table 18 ALERTS WITH THE MAXIMUM AVERAGE SPEED (HA/DAY) PER BIOME IN 2023*

BIOME	Alert Code	Average Speed (ha/day)	County
Amazon	887194	30.15	Altamira - PA
Caatinga	939002	65.50	Alvorada do Gurguéia - PI
Cerrado	931176	118.03	Baixa Grande do Ribeiro - PI
Atlantic Forest	938300	2.88	Encruzilhada - BA
Pampa	890965	0.52	Caçapava do Sul - RS
Pantanal	960635	29.32	Porto Esperidião - MT

* The calculation of the speed of deforestation is an estimate, as it depends on the availability of quality images before and after the deforestation event. Therefore, there may be other faster events that resulted in speeds lower than those presented.

3.3.4 | Deforestation by State

For the fifth consecutive year, all states and the Federal District had deforestation alerts detected. The mark of 1,000 deforestation events detected in 2023 was surpassed in 16 states. In 2022, this occurred in 14 states (Table 19 and Figure 15).

The MATOPIBA states (Maranhão, Tocantins, Piauí and Bahia) gained positions in the ranking, surpassing the deforested area in Amazon states (e.g., Pará, Amazonas and Mato Grosso). Maranhão moved from fifth place to occupy first place for the first time, with a 95.1% increase in the deforested area compared to 2022, totaling a loss of 331,225 ha of native vegetation. The states of Tocantins and Goiás also showed relevant increases in the deforested area, of 177.9% and 125.3%, respectively. Together, five states (Maranhão, Bahia, Tocantins, Pará and Mato Grosso) comprise 65.5% of all deforestation in the country in 2023 (Table 19). This increase results both from the growth in deforestation, as well as from improvements in detection systems.

In the northeast, Paraíba (106.5%) and Rio Grande do Norte (161%) showed significant increases in the area of suppressed native vegetation.

The states that showed the biggest reductions in the deforested area compared to 2022 (around 68 to 70% reduction) were: Paraná, Rondônia, Acre, Rio de Janeiro, Santa Catarina and Amazonas.

Despite the reduction in deforestation in 2023 in the state, Pará had the largest deforested area over the last 5 years, while Rio de Janeiro had the smallest (Figure 16).

Table 19 AREA AND NUMBER OF DEFORESTATION ALERTS BY BRAZILIAN STATE IN 2019, 2020, 2021, 2022 AND 2023

Number of alerts:

State	2019	2020	2021	2022	2023	Rank 2023	Participation 2023	Variation 2022-2023
Pará	18,438	25,497	23,432	20,107	14,065	1	16.9%	-30.0%
Bahia	1,220	4,738	4,855	5,985	9,668	2	11.6%	61.5%
Maranhão	2,486	13,236	3,163	2,260	7,933	3	9.5%	251.0%
Acre	9,228	11,507	11,969	10,073	6,573	4	7.9%	-34.7%
Amazon	6,985	10,237	9,308	7,547	6,129	5	7.4%	-18.8%
Minas Gerais	854	3,520	2,275	2,869	5,072	6	6.1%	76.8%
Tocantins	1,916	4,814	849	725	4,969	7	6.0%	585.4%
Piauí	594	3,119	2,100	3,086	4,519	8	5.4%	46.4%
Ceará	29	788	2,595	3,472	3,592	9	4.3%	3.5%
Goiás	1,097	3,075	574	504	3,521	10	4.2%	598.6%
Mato Grosso	4,674	6,227	4,599	3,858	3,493	11	4.2%	-9.5%
Paraíba	3	369	982	894	2,194	12	2.6%	145.4%
Rondônia	5,216	5,464	5,925	4,570	2,071	13	2.5%	-54.7%
Pernambuco	15	344	1,569	2,543	2,069	14	2.5%	-18.6%
Roraima	2,121	2,524	2,310	1,377	1,745	15	2.1%	26.7%
Mato Grosso do Sul	404	800	774	462	1,142	16	1.4%	147.2%
Rio Grande do Sul	221	363	586	1,958	999	17	1.2%	-49.0%
Rio Grande do Norte	4	258	793	273	658	18	0.8%	141.0%
Sergipe	15	63	127	420	592	19	0.7%	41.0%
Paraná	257	770	1,879	1,485	532	20	0.6%	-64.2%
Alagoas	6	71	61	306	526	21	0.6%	71.9%
Santa Catarina	130	354	382	958	466	22	0.6%	-51.4%
Amapá	504	656	298	139	441	23	0.5%	217.3%
São Paulo	53	88	179	348	156	24	0.2%	-55.2%
Espírito Santo	16	36	30	305	137	25	0.2%	-55.1%
Rio de Janeiro	21	42	25	143	65	26	0.1%	-54.5%
Federal District	4	27	2	3	26	27	0.0%	766.7%
Grand total	56,511	98,987	81,641	76,670	83,353			

Area data (hectares):

State	2019	2020	2021	2022	2023	Rank 2022	Rank 2023	Participation 2023	Variation 2022-2023
Maranhão	81,224	232,584	178,984	169,802	331,225	5	1 ▲	18.1%	95.1%
Bahia	64,561	113,073	152,644	227,991	290,606	4	2 ▲	15.9%	27.5%
Tocantins	104,169	109,824	63,386	82,853	230,253	9	3 ▲	12.6%	177.9%
Pará	300,256	385,963	469,423	465,074	184,763	1	4 ▼	10.1%	-60.3%
Mato Grosso	201,086	200,126	204,990	237,619	161,381	3	5 ▼	8.8%	-32.1%
Piauí	42,458	77,035	68,887	148,282	135,985	6	6 ●	7.4%	-8.3%
Amazon	126,245	133,747	214,304	275,319	87,762	2	7 ▼	4.8%	-68.1%
Mato Grosso do Sul	28,784	52,036	56,260	49,073	82,695	11	8 ▲	4.5%	68.5%
Minas Gerais	26,353	46,449	47,497	50,346	74,517	10	9 ▲	4.1%	48.0%
Goiás	33,678	54,456	32,098	30,869	69,541	12	10 ▲	3.8%	125.3%
Rondônia	122,725	119,796	146,476	139,824	41,747	7	11 ▼	2.3%	-70.1%
Ceará	849	8,860	20,474	23,205	32,486	14	12 ▲	1.8%	40.0%
Acre	57,238	58,058	75,748	92,677	28,707	8	13 ▼	1.6%	-69.0%
Roraima	24,189	23,153	23,669	23,624	21,792	13	14 ▼	1.2%	-7.8%
Pernambuco	132	3,766	14,442	21,886	16,236	15	15 ●	0.9%	-25.8%
Paraíba	11	2,751	6,834	6,421	13,258	16	16 ●	0.7%	106.5%
Rio Grande do Norte	71	3,927	6,597	3,500	9,135	20	17 ▲	0.5%	161.0%
Alagoas	60	952	918	3,149	5,361	21	18 ▲	0.3%	70.2%
Sergipe	258	846	1,495	3,658	5,076	19	19 ●	0.3%	38.8%
Rio Grande do Sul	1,125	2,159	3,748	5,231	2,343	17	20 ▼	0.1%	-55.2%
Amapá	1,461	1,628	784	1,095	1,392	23	21 ▲	0.1%	27.1%
Paraná	2,140	5,559	6,987	4,035	1,180	18	22 ▼	0.1%	-70.7%
Santa Catarina	487	1,761	1,471	2,320	734	22	23 ▼	0.0%	-68.4%
Federal District	95	153	125	90	638	27	24 ▲	0.0%	612.5%
Espírito Santo	86	217	114	503	349	25	25 ●	0.0%	-30.6%
São Paulo	370	530	462	754	281	24	26 ▼	0.0%	-62.7%
Rio de Janeiro	125	321	161	495	155	26	27 ▲	0.0%	-68.6%
Grand total	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597				

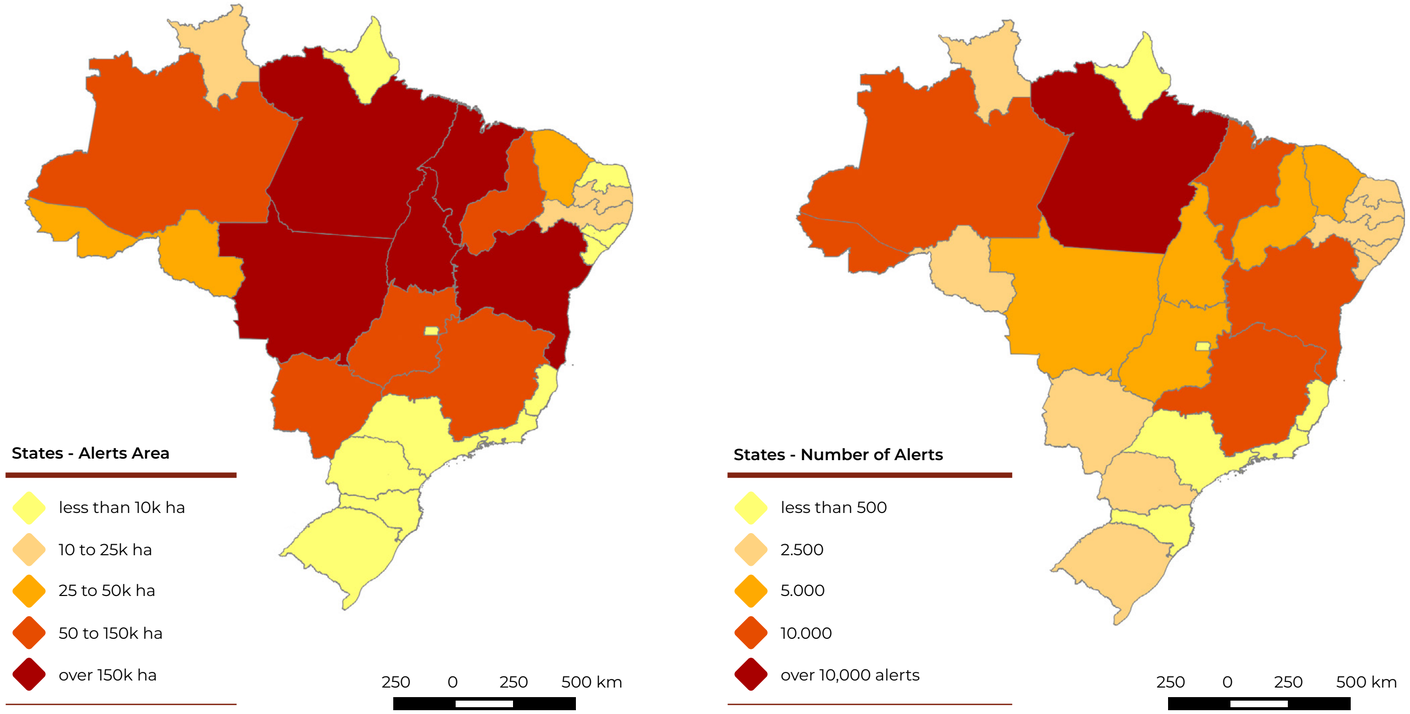


Figure 15 Intensity of deforested area in Brazilian states in 2023

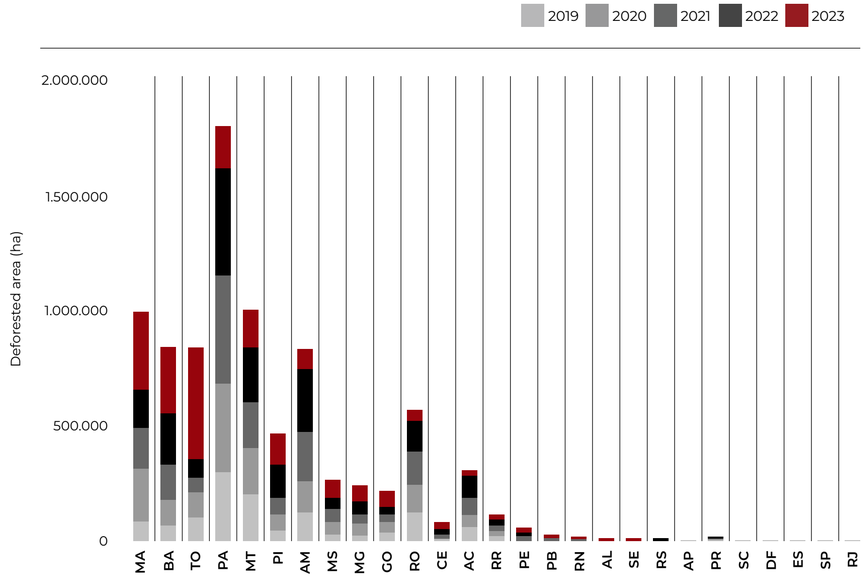


Figure 16 Deforested area (hectares) per year in each Brazilian state from 2019 to 2023, states ordered according to the 2023 ranking

Table 20 AREA IN HECTARES AND PERCENTAGE OF DEFORESTATION BY BRAZILIAN STATE BY BIOME IN 2023

Area (ha) deforested by biome in each state:

State	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal
Acre	28,707					
Alagoas		5,172		188		
Amapá	1,392					
Amazon	87,762					
Bahia		93,437	194,272	2,896		
Ceará		32,486				
Federal District			638			
Espírito Santo				349		
Goiás			69,541			
Maranhão	10,341		320,884			
Mato Grosso	97,409		57,593			6,380
Mato Grosso do Sul			39,388	14		43,293
Minas Gerais		7,654	62,142	4,721		
Pará	166,577		18,186			
Paraíba		13,248		10		
Paraná				1,180		
Pernambuco		15,997		239		
Piauí		20,060	115,924			
Rio de Janeiro				155		
Rio Grande do Norte		9,114		21		
Rio Grande do Sul				796	1,547	
Rondônia	39,658		2,089			
Roraima	21,792					
Santa Catarina				734		
São Paulo			48	233		
Sergipe		4,519		557		
Tocantins	633		229,620			
Grand total	454,271	201,687	1,110,326	12,094	1,547	49,673

Percentage of deforestation in the state in each biome in 2023:

State	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal
Acre	100.0%					
Alagoas		96.5%		3.5%		
Amapá	100.0%					
Amazon	100.0%					
Bahia		32.2%	66.9%	1.0%		
Ceará		100.0%				
Federal District			100.0%			
Espírito Santo				100.0%		
Goiás			100.0%			
Maranhão	3.1%		96.9%			
Mato Grosso	60.4%		35.7%			4.0%
Mato Grosso do Sul			47.6%			52.4%
Minas Gerais		10.3%	83.4%	6.3%		
Pará	90.2%		9.8%			
Paraíba		99.9%		0.1%		
Paraná				100.0%		
Pernambuco		98.5%	0.0%	1.5%		
Piauí		14.8%	85.2%			
Rio de Janeiro				100.0%		
Rio Grande do Norte		99.8%		0.2%		
Rio Grande do Sul				34.0%	66.0%	
Rondônia	95.0%		5.0%			
Roraima	100.0%					
Santa Catarina				100.0%		
São Paulo			17.0%	83.0%		
Sergipe		89.0%		11.0%		
Tocantins	0.3%		99.7%			
Grand total	24.8%	11.0%	60.7%	0.7%	0.1%	2.7%

Box 5 MATOPIBA AND AMACRO

Two regions characterized by the targeted expansion of agricultural activities have become regions of significant deforestation pressure: Amacro and Matopiba.

The Amacro region is where the border of the three Amazon states (Amazonas, Acre and Rondônia) is located, and is considered the new deforestation frontier in the Amazon. Matopiba is the region made up of the state of Tocantins, and part of the states of Maranhão, Piauí and Bahia, where the expansion of agriculture has been intensifying over the last two decades, mainly in the Cerrado biome.

In 2023, around 47% of all native vegetation loss in the country occurred in the Matopiba region and totaled 858,952 ha. This represents an increase of 59% compared to 2022, which had already recorded significant increases compared to 2021. This increase is due both to the increase in deforestation in the region, as well as to the improvement and integration of new detection systems. It is in the Matopiba region that 74% of Cerrado deforestation will be concentrated in 2023.

The Amacro region recorded a 73.6% drop in deforestation, when compared to 2022. There were 5,587 alerts totaling 102,956 ha in 2023 (Tables 21 and 22).

Table 21 NUMBER OF ALERTS AND DEFORESTED AREA IN THE MATOPIBA REGION FROM 2019 TO 2023

MATOPIBA	Number of Alerts	Deforested Area (ha)
2019	4,570	273,004
2020	21,007	476,367
2021	5,663	396,636
2022	4,984	540,438
2023	17,204	858,952
Total	**53,428**	**2,545,396**

Table 22 NUMBER OF ALERTS AND DEFORESTED AREA IN THE AMACRO REGION FROM 2019 TO 2023

AMACRO	Number of Alerts	Deforested Area (ha)
2019	11,676	226,881
2020	14,096	231,681
2021	14,513	330,660
2022	12,651	390,187
2023	5,587	102,956
Total	**58,523**	**1,282,365**

3.3.5 | Deforestation by Municipality

Of the 5,572 Brazilian municipalities, 3,511 (63%) had at least one deforestation event detected and validated in 2023 (Table 23). Considering the last five years together, 81% of Brazilian municipalities had at least one deforestation event detected and validated. The remainder (19%) had no deforestation detected over the last five years.

Among the 3,511 municipalities with alerts in 2023, 50 alone accounted for 36% of the total deforested area in Brazil, of which 13 are in the state of Maranhão and ten in Bahia (Table 24 and Figures 17 and 18).

At the top of the ranking, the ten municipalities that deforested the most in 2023 together accounted for 14.7% of the total deforestation validated in the country. All ten lost an area greater than 20,000 ha of native vegetation in 2023, four of which are in Bahia and two in Maranhão.

Of the 50 municipalities that lost the most native vegetation in 2023, 13 are present on the List of priority municipalities in the Amazon for actions to prevent, control and reduce deforestation and forest degradation, according to Ordinance GM/MMA nº 834, of November 9, 2023[4]. All 13 showed a drop in the deforested area compared to 2022.

The municipalities that showed the biggest increases in deforestation compared to 2022 were Barão de Grajaú (MA) with an increase of 1,266%, Ponte Alta do Tocantins (TO) with 947%, Rio Sono (TO) with 864%, and Natividade (TO) with 789%.

The municipality of Lábrea, in Amazonas, which led the ranking the previous year, dropped to 22nd position, with an 84% reduction in the deforested area. And the municipality of São Desidério in Bahia now leads the ranking of municipalities that deforested the most in 2023, with 40,052 hectares deforested and an increase of 9% compared to 2022.

Table 23 NUMBER OF BRAZILIAN MUNICIPALITIES WITH DEFORESTATION DETECTED BETWEEN 2019 AND 2023

Year	Number of municipalities with deforestation dedected	Proportion of municipalities with deforestation dedected
2019	1,755	31%
2020	2,852	51%
2021	2,989	54%
2022	3,591	64%
2023	3,511	63%
2019-2023	4,522	81%
Brazil	5,572	

3 | Ordinance - https://www.in.gov.br/en/web/dou/-/portaria-gm/mma-n-834-de-9-de-novembro-de-2023-522161549

Table 24 LIST OF THE 50 MUNICIPALITIES THAT DEFORESTED THE MOST FROM 2019 TO 2023 IN BRAZIL, AREA DEFORESTED PER MUNICIPALITY (HA), VARIATION FROM 2022 TO 2023 AND AVERAGE AREA DEFORESTED PER DAY PER MUNICIPALITY.

Rank	UF	County	2019	2020	2021	2022	2023	Variation 2022-2023	Average Deforestation per day (ha/day)
1	BA	São Desidério	2,312.4	12,470	17,428	36,594.8	40,052.3	9%	110
2	MA	Balsas	8,010.6	22,744	17,637	28,156.9	37,363.1	33%	102
3	BA	Jaborandi	7,799.0	7,626	13,467	20,927.5	31,626.0	51%	87
4	MA	Alto Parnaíba	1,773.5	3,332	4,639	7,407.6	29,236.8	295%	80
5	MS	Corumba	6,570.4	13,985	10,832	15,756.6	23,425.6	49%	64
6	PI	Baixa Grande do Ribeiro	8,150.4	8,955	4,190	11,774.4	21,768.8	85%	60
7	TO	Rio Sono	2,455.1	3,009	1,271	2,258.4	21,767.7	864%	60
8	BA	Cocos	3,800.7	1,531	9,156	3,614.1	21,290.1	489%	58
9	PA	Altamira*	54,250.6	60,676	71,261	61,486.3	20,920.1	-66%	57
10	BA	Barreiras	5,390.6	5,001	5,319	13,623.5	20,881.6	53%	57
11	AM	Apuí*	21,865.0	22,228	39,956	61,072.6	18,304.4	-70%	50
12	BA	Correntina	3,714.1	3,870	8,882	19,087.0	17,401.5	-9%	48
13	BA	Formosa do Rio Preto	20,636.1	14,603	15,177	36,267.2	15,632.7	-57%	43
14	BA	Saint Rita de Cassia	3,684.3	6,344	7,180	7,974.6	15,117.7	90%	41
15	TO	Paranã	5,368.4	5,816	5,012	3,988.4	14,746.3	270%	40
16	RO	Porto Velho*	35,267.0	44,378	53,805	48,331.9	14,739.2	-70%	40
17	MA	Mirador	1,786.1	11,469	4,205	2,536.2	13,912.4	449%	38
18	MA	Caxias	1,359.5	7,597	9,356	7,276.0	13,887.8	91%	38
19	PI	Uruçuí	9,875.9	8,902	9,587	23,791.8	12,004.9	-50%	33
20	PA	São Félix do Xingu*	40,193.4	47,005	58,303	47,742.8	11,768.4	-75%	32
21	MA	Grajaú	2,356.6	6,810	6,615	5,243.8	11,628.7	122%	32
22	AM	Lábrea*	32,545.7	37,750	54,233	62,712.9	10,797.1	-83%	30
23	MS	Porto Murtinho	5,486.6	4,071	6,641	6,982.4	10,506.8	50%	29
24	MA	Riachão	3,311.8	5,962	2,386	4,090.0	10,254.3	151%	28

* municípios presentes na lista de municípios prioritários da Amazônia conforme Portaria GM/MMA nº 834, de 9 de novembro de 2023.

CONTINUE

Rank	UF	County	2019	2020	2021	2022	2023	Variation 2022-2023	Average Deforestation per day (ha/day)
25	MA	Barão do Grajaú	64.2	483	36	711.4	9,720.1	1266%	27
26	TO	Pium	3,477.1	1,860	430	4,772.3	9,635.0	102%	26
27	MA	Parnarama	1,970.6	6,918	5,799	4,293.7	9,479.3	121%	26
28	MT	Colniza *	18,542.8	19,877	24,723	35,708.1	9,453.2	-74%	26
29	BA	Riachão das Neves	1,694.5	4,455	4,877	9,105.2	8,891.3	-two%	24
30	AM	Novo Aripuanã	18,168.4	10,841	17,467	29,538.1	8,836.2	-70%	24
31	BA	Cotegipe	1,023.6	3,953	1,635	2,994.0	8,505.8	184%	23
32	MA	Carolina	1,387.1	4,467	3,717	6,731.7	8,166.7	21%	22
33	AM	Canutama*	5,654.5	5,544	11,993	19,612.5	7,996.4	-59%	22
34	MA	Codó	1,846.4	4,967	6,327	3,879.0	7,982.1	106%	22
35	TO	Ponte Alta do Tocantins	1,413.7	2,289	1,430	746.0	7,807.9	947%	21
36	MT	Aripuanã*	15,048.9	13,019	15,102	10,698.0	7,793.4	-27%	21
37	PA	Portel*	11,692.0	19,247	24,805	30,309.2	7,681.6	-75%	21
38	PA	Santa Maria das Barreiras	887.0	896	2,120	1,945.1	7,443.7	283%	20
39	PI	Santa Filomena	1,475.6	1,526	2,542	16,434.2	7,404.2	-55%	20
40	MA	Loreto	1,052.5	3,331	3,636	3,065.0	7,342.6	140%	20
41	MS	Aquidauana	2,283.5	4,761	11,643	5,354.8	6,997.9	31%	19
42	TO	Natividade	1,934.3	756	661	778.9	6,927.4	789%	19
43	AM	Manicoré*	6,441.5	7,521	14,154	22,074.4	6,915.5	-69%	19
44	PI	Ribeiro Gonçalves	557.3	982	899	5,308.4	6,575.6	24%	18
45	PA	Moju*	1,801.3	3,431	6,409	11,545.2	6,505.7	-44%	18
46	AC	Feijó*	8,824.7	8,776	13,514	17,294.6	6,473.8	-63%	18
47	MA	Fernando Falcao	1,145.4	2,081	1,681	1,528.6	6,469.7	323%	18
48	MA	São Raimundo das Mangabeiras	1,007.1	2,650	1,653	2,268.2	6,426.9	183%	18
49	MT	Juara*	5,828.1	5,725	6,048	10,324.2	6,215.7	-40%	17
50	BA	Barra	33.5	1,186	1,744	5,148.5	5,860.4	14%	16

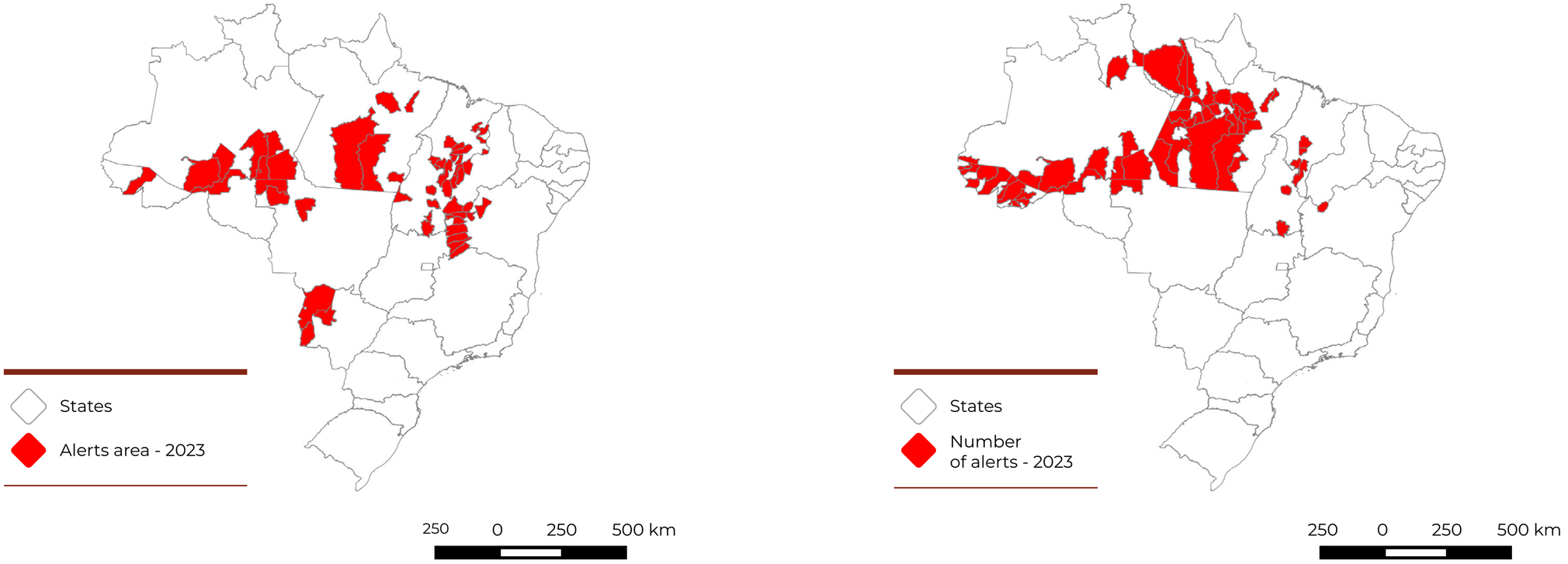


Figure 17 Location of the 50 Brazilian municipalities with the largest deforested area in 2023

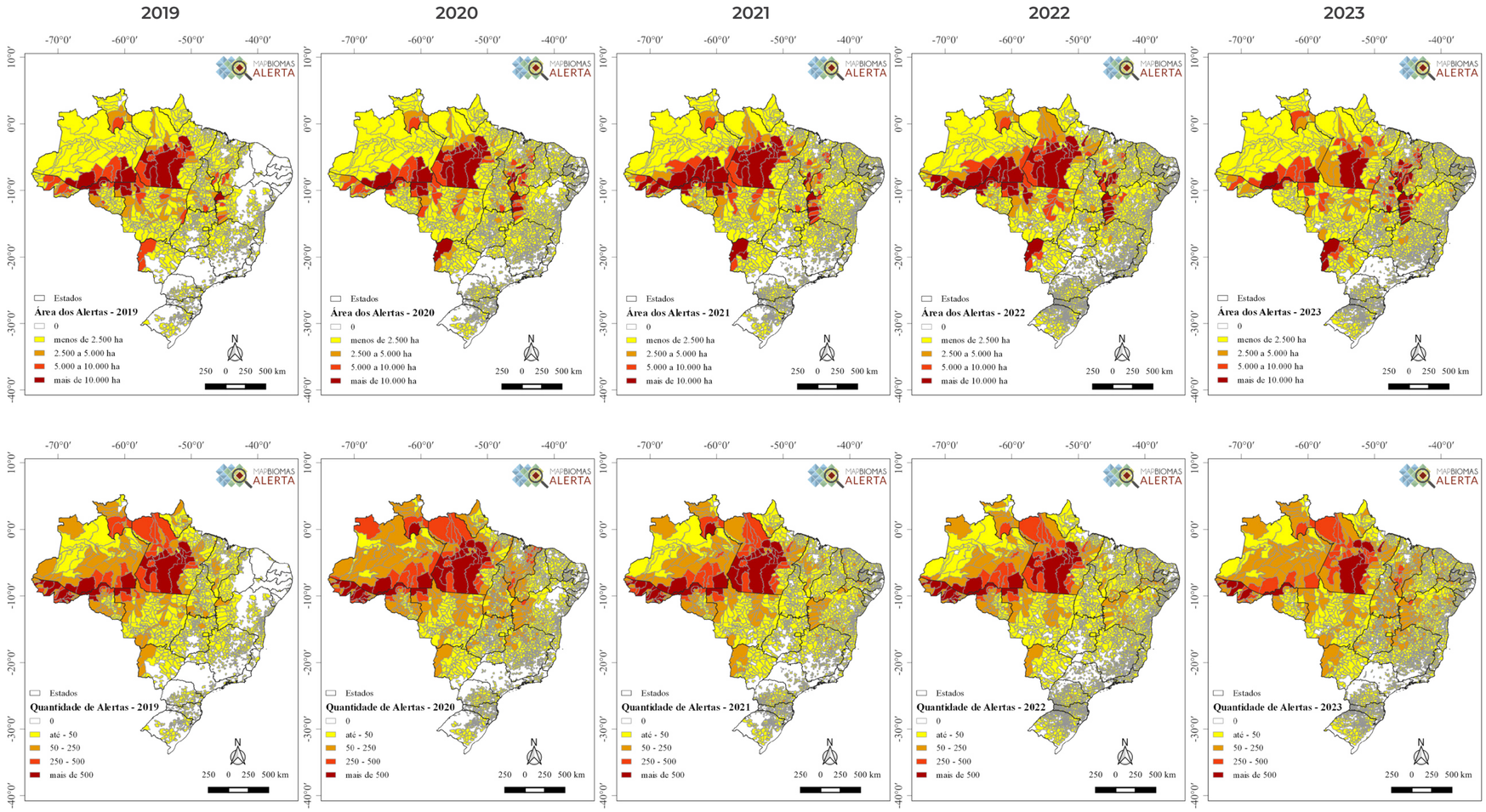


Figure 18 Classification of municipalities by classes of number of alerts and deforested area from 2019 to 2023

3.3.6 | Deforestation by Hydrographic Macroregions

By overlaying deforestation alerts with the Regions and Hydrographic Basins base of the National Water Resources Policy, it is possible to check how much was deforested in each macrobasin in the country (Figure 19).

When comparing the year 2023 with the year 2022, there is a 61.4% reduction in deforestation in the Amazon macrobasin. On the other hand, there was an increase, in proportional terms, in the Paraná and Western Northeast Atlantic macrobasins (79.1% and 78.8% respectively) (Table 25).

Table 25 DEFORESTED AREA (HA) IN EACH MACROBASIN PER YEAR

Macrobasins	2019	2020	2021	2022	2023	Total	Variation 2022-2023
AMAZON	709,465	762,236	968,873	1,053,202	406,536	3,900,312	-61.4%
TOCANTINS-ARAGUAIA	234,009	300,911	247,190	274,388	407,436	1,463,934	48.5%
WESTERN NORTH-EAST ATLANTIC	55,911	141,890	118,870	96,754	173,040	586,464	78.8%
PARNAÍBA	61,896	144,562	114,272	207,288	257,842	785,860	24.4%
NORTHEAST ATLANTIC	1,010	16,104	34,773	33,108	56,259	141,253	69.9%
SÃO FRANCISCO	78,554	126,573	168,525	250,115	308,008	931,775	23.1%
EAST ATLANTIC	8,256	30,729	39,996	46,938	70,245	196,164	49.7%
SOUTHEAST ATLANTIC	1,524	3,939	3,122	5,417	2,196	16,197	-59.5%
SOUTH ATLANTIC	1,113	2,558	3,657	4,272	2016	13,617	-52.8%
URUGUAY	558	1,293	1,205	3,064	997	7,117	-67.5%
PARANÁ	18,556	27,437	22,666	19,503	34,940	123,103	79.1%
PARAGUAY	38,567	59,985	57,788	57,137	89,853	303,329	57.3%

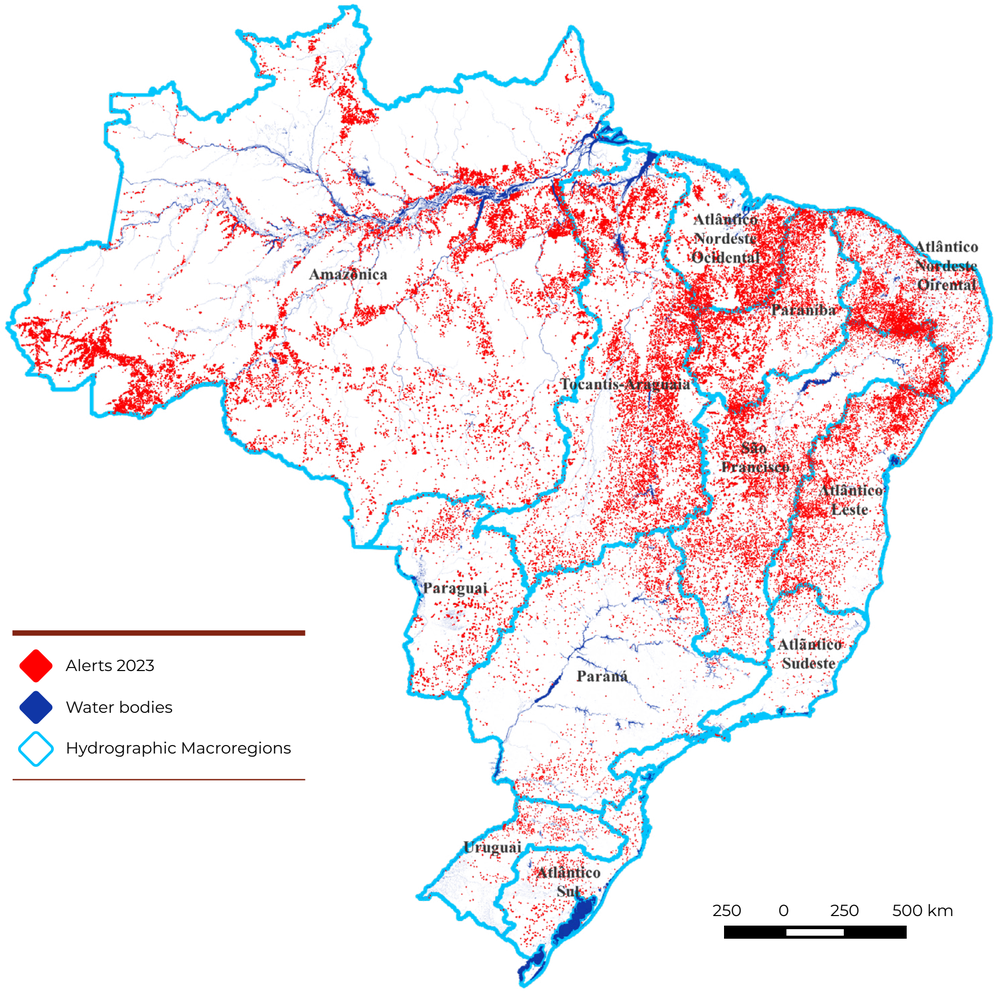


Figure 19 Deforested areas in Brazil in 2023 with the boundaries of hydrographic macro-regions.

3.3.7 | Distribution of deforestation throughout the year

The calculation of the area deforested each day in Brazil is done on an estimated basis. To this end, the total area of each alert is divided by the number of days between the dates of the pair of satellite images selected to represent the moment before and after deforestation.

It is important to highlight that due to this method, the alert area assigned to the days of the second half of 2023 presents values slightly lower than the real ones, as deforestation at the beginning of 2024 (not considered in this report) and which may have an image of the moment prior to deforestation selected in the last months of 2023, have not yet been computed (Figure 20). This fraction of unaccounted area will be distributed and added on the days corresponding to 2023 only in the next annual report.

Based on this procedure, the day with the largest deforested area in 2023 was February 15, with 4,864.6 ha deforested, which is equivalent to 563 m 2 per second or 3.4 hectares per minute (Table 26). In a single day, an area equivalent to 5,884 football fields was deforested in Brazil.

Table 26 DAYS WITH THE MOST DEFORESTATION CALCULATED FOR EACH BIOME AND FOR BRAZIL

BIOME	Day with the most deforestation	Deforested Area (ha)
Amazon	August 6	1,800.9
Caatinga	June 7	521.7
Cerrado	25th March	3,190.0
Atlantic Forest	February 27th	49.7
Pampa	March 20	7.5
Pantanal	July 28th	189.2
BRAZIL	**February 15th**	**4,864.6**

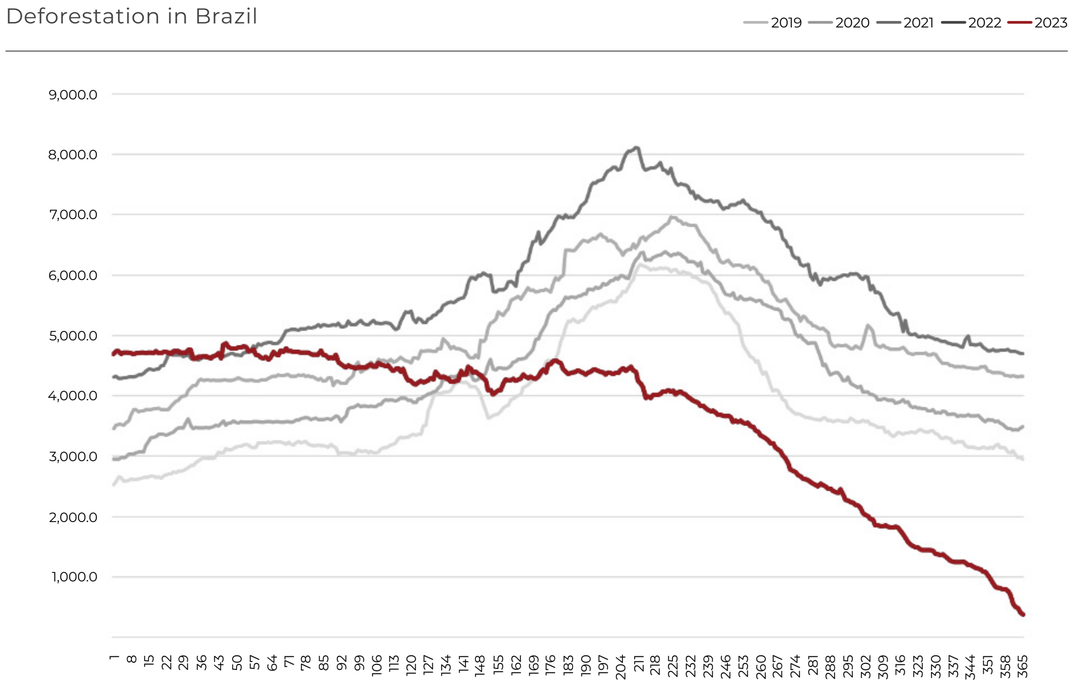


Figure 20 Comparative distribution of estimates of area (hectares) deforested per day in Brazil over the last five years.

The temporal dynamics of deforestation in biomes presents differences in behavior. **In the Caatinga and Cerrado, a change in the pattern is observed for the year 2023, with an advance in the concentration of deforestation events to the first half of the year.** In the Amazon, the greatest activity continues to occur in the second half of the year, especially in the months of July and August (Figure 21).

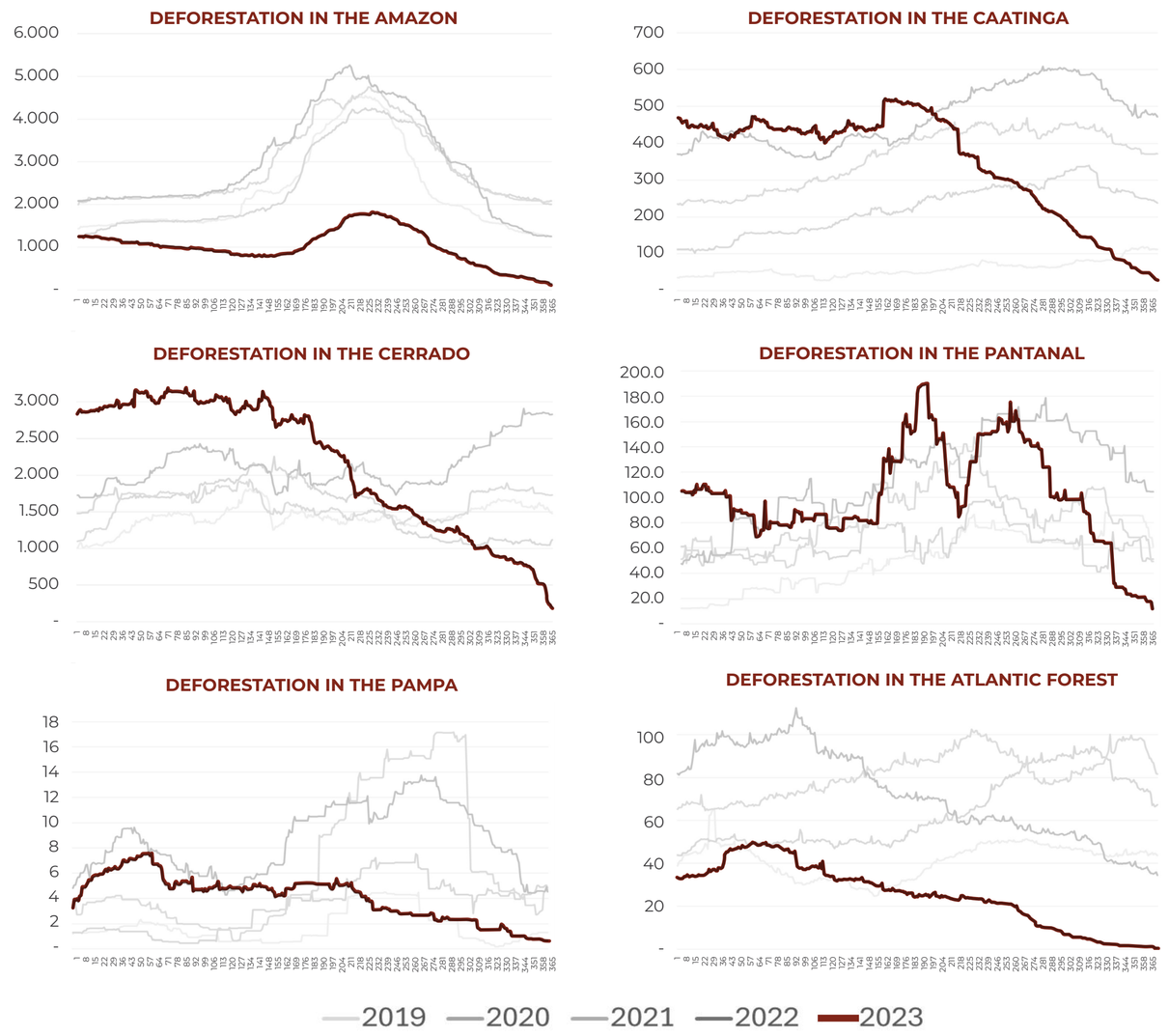


Figure 21 Comparative distribution of estimates of area (hectares) deforested per day in Brazilian biomes over the last five years.

3.3.8 | Type of Native Vegetation Deforested

Deforestation (or the suppression of native vegetation) can occur in different types of native vegetation. By crossing the deforested area with the MapBiomas land use and coverage map (Collection 8), it is observed that in 2023, for the first time, there was a predominance of deforestation in savanna formations (54.8%). In previous years, the predominance occurred in forest formations. This is partly due to the shifting of deforestation activities to the savanna regions of Brazil, and partly to the improvement of detection and integration systems for new sources for these same regions, such as the SAD Cerrado. It is worth noting, however, that the detection of deforestation in native non-forest vegetation is still poor and, therefore, deforestation in these classes is still underestimated. For the alerts validated in 2023 in the Amazon, Atlantic Forest and Pampa biomes, there was a predominance of deforestation in forest formations, while in the Cerrado and Caatinga biomes, the predominance was of suppression of non-forest formations (Figure 22 and Table 27).

In the Pantanal, 38% of deforestation occurred in forest formation areas , 35 % in savanna formations and 27% of deforestation occurred in grassland formations or other types.
It is possible to note that the percentage of conversion in grassland formations in both Pantanal and Pampa (21.9%) is a smaller proportion than the area of occurrence of this type of vegetation in the biomes (68.9% in Pampa and 50.8% % in the Pantanal). This is a result of the difficulties in detecting and validating conversion in these environments. Therefore, deforestation in this type of vegetation is still underestimated.

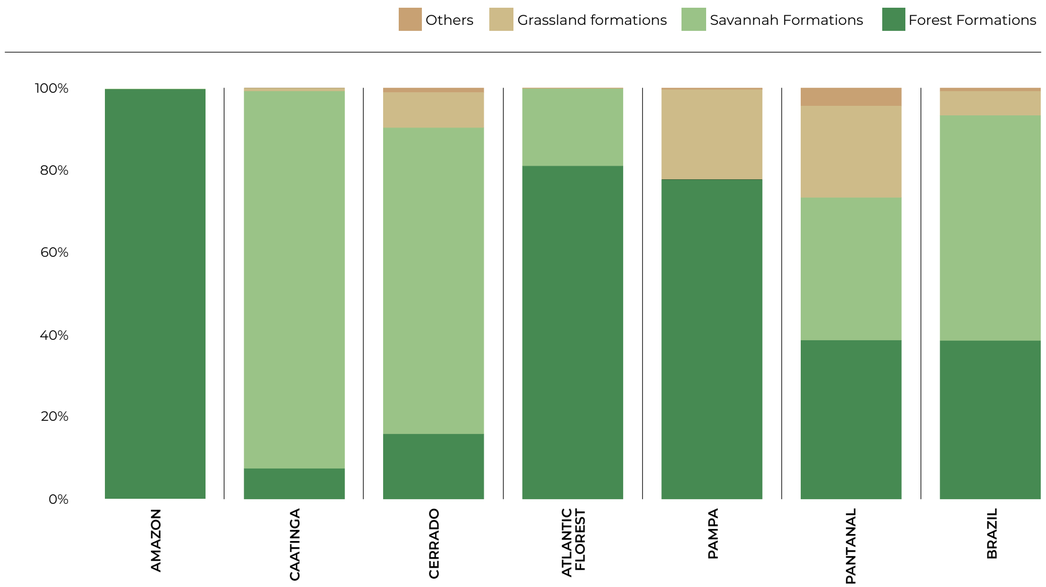


Figure 22 Proportion of deforested area in 2023 by type of native vegetation in biomes and in Brazil in 2022

Table 27 PERCENTAGE OF COVERAGE OF EACH CLASS OF NATIVE VEGETATION BY BIOME IN 2022 AND PERCENTAGE OF DEFORESTATION IN EACH CLASS IN 2023 BY BIOME

	Percentage of native vegetation in the Biome (MapBiomas 2022)						
	Amazon	**Caatinga**	**Cerrado**	**Atlantic Forest**	**Pampa**	**Pantanal**	**Brazil**
Forest Formations	95.0%	6.4%	26.4%	85.0%	25.1%	19.4%	70.6%
Savanna Formations	0.5%	87.9%	58.8%	4.1%	0.0%	19.6%	20.0%
Field Formations	2.4%	5.6%	8.3%	5.5%	68.9%	50.8%	6.2%
Others	2.1%	0.1%	6.5%	5.5%	5.9%	10.2%	3.2%

	Percentage of native vegetation converted in 2023						
	Amazon	**Caatinga**	**Cerrado**	**Atlantic Forest**	**Pampa**	**Pantanal**	**Brazil**
Forest Formations	99.7%	7.4%	15.8%	81.0%	77.7%	38.6%	38.5%
Savanna Formations	0.2%	91.8%	74.5%	18.8%	0.0%	34.7%	54.8%
Field Formations	0.1%	0.8%	8.6%	0.1%	21.9%	22.3%	5.9%
Others	0.0%	0.0%	1.1%	0.1%	0.4%	4.4%	0.8%

In 2023, for the first time, there was a predominance of deforestation in savanna formations (54.8%).

Box 6 DEFORESTATION AFTER DECEMBER 31, 2020 AND BY TYPE OF VEGETATION - WHAT THE IMPACT OF NEW EUROPEAN UNION REGULATIONS COULD BE

The European Union's new commodity import regulation (European Union Deforestation-Free Regulation) is in force and the requirements imposed on production chains will be imposed beginning December 30, 2024. Considering that one of the prohibitions is the purchase of products from forest areas deforested after December 31, 2020, we analyzed deforestation alerts whose previous images are from January 1, 2021. The high-resolution image proves that these areas were native vegetation up to the deadline established in the rule. Using this criterion, MapBiomas Alerta identified 208,522 alerts, with a total area of 4,885,688 hectares of native vegetation conversion. The biomes with the largest areas are the Amazon, with 2,269,225 ha and Cerrado, with 2,033,071 ha deforested after December 31, 2020 (Table 28).

It is important to note that 57.3% of this deforested area is forest formations and is completely included in the FAO definition of forest. The mapping of savanna formations occupies 38.5% of the area and is partially included in the FAO definition. Field formations and other native formations are not currently included and occupy 4.2%. The restriction could affect around 230 thousand rural properties (approximately 3.1% of the 7.5 million properties registered in the CAR) (Table 29).

Table 28 NUMBER OF ALERTS AND DEFORESTED AREA (HA) AFTER DECEMBER 31, 2020 BY BIOME (IMAGES FROM BEFORE DEFORESTATION AS OF JANUARY 1, 2021).

BIOME	Number of Alerts	Area (ha)
Amazon	116,647	2,269,225
Caatinga	38,362	408,779
Cerrado	36,691	2,033,071
Atlantic Forest	15,104	60,221
Pampa	885	6,963
Pantanal	833	107,429
Total	**208,522**	**4,885,688**

Table 29 PERCENTAGE OF EACH TYPE OF NATIVE VEGETATION DEFORESTED AFTER DECEMBER 31, 2020

	Percentage of native vegetation deforested after December 31, 2020						
	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Brazil
Forest Formations	99.8%	5.7%	15.8%	82.8%	63.0%	37.4%	57.3%
Savanna Formations	0.1%	92.9%	75.9%	16.9%	0.0%	33.3%	38.5%
Field Formations	0.1%	1.3%	7.4%	0.1%	36.6%	22.6%	3.7%
Others	0.0%	0.0%	0.9%	0.2%	0.4%	6.7%	0.5%

3.3.9 | Deforestation drivers

During the process of validating and refining the alerts, an analysis is carried out of the deforestation drivers, that is, the possible activities causing deforestation (e.g., agriculture, mining, mining, urban expansion, reservoirs or dams, extreme weather events, among others). In 2023, new drivers such as reservoirs or dams, renewable energy, roads and aquaculture were added (Figure 23).

Deforestation due to agricultural pressure accounts for more than 97% of all loss of native vegetation in Brazil in the last five years (Table 30).

A difference occurs in some areas of Pará, where there were concentrations of alerts in which mining was deforestation drivers. In areas close to capitals and large urban centers such as the metropolitan region of São Paulo, the pressure is associated with urban expansion. In the Caatinga, it was possible to observe alerts (69 alerts, totaling 4,302 ha deforested) where the installation of solar and wind energy generation projects was the main driver (Figure 23).

The **extreme climate events** deforestation driver encompasses loss of native vegetation due to events such as landslides, floods and strong winds. Some examples can be observed in the Atlantic Forest of the Serra do Mar region, between São Paulo and Rio de Janeiro.

Table 30 DEFORESTED AREA (HA) AND PROPORTION (%) BY DEFORESTATION DRIVER FROM 2019 TO 2023 IN BRAZIL

Deforestation drivers	2019	2020	2021	2022	2023	Total
Agriculture	1,202,695	1,615,881	1,740,416	1,980,546	1,784,010	8,323,547
Urban Expansion	1,053	2,505	6,004	3,397	5,601	18,560
Renewable energy		476	498	3,928	4,535	9,437
Mining	8,992	9,029	9,389	6,166	3,599	37,175
Reservoirs or Dams*					1,953	1,953
Mining	1,479	1,447	1,667	1,189	1,948	7,731
Roads*					1,107	1,107
Extreme climate events		25	475	653	277	1,430
Aquaculture*					201	201
Others	6,020	10,372	40,535	73,820	26,370	157,117
Total	**1,220,239**	**1,639,735**	**1,798,984**	**2,069,698**	**1,829,602**	**8,558,258**

Deforestation drivers	2019	2020	2021	2022	2023	Total
Agriculture	98.6%	98.5%	96.7%	95.7%	97.5%	97.3%
Urban Expansion	0.09%	0.15%	0.33%	0.16%	0.31%	0.2%
Renewable energy		0.03%	0.03%	0.19%	0.25%	0.1%
Mining	0.74%	0.55%	0.52%	0.30%	0.20%	0.4%
Reservoirs or Dams*					0.11%	0.0%
Mining	0.12%	0.09%	0.09%	0.06%	0.11%	0.1%
Roads*					0.06%	0.0%
Extreme climate events		0.00%	0.03%	0.03%	0.02%	0.0%
Aquaculture*					0.01%	0.0%
Others	0.5%	0.6%	2.3%	3.6%	1.4%	1.8%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

* New deforestation driver categories for deforestation starting in 2023

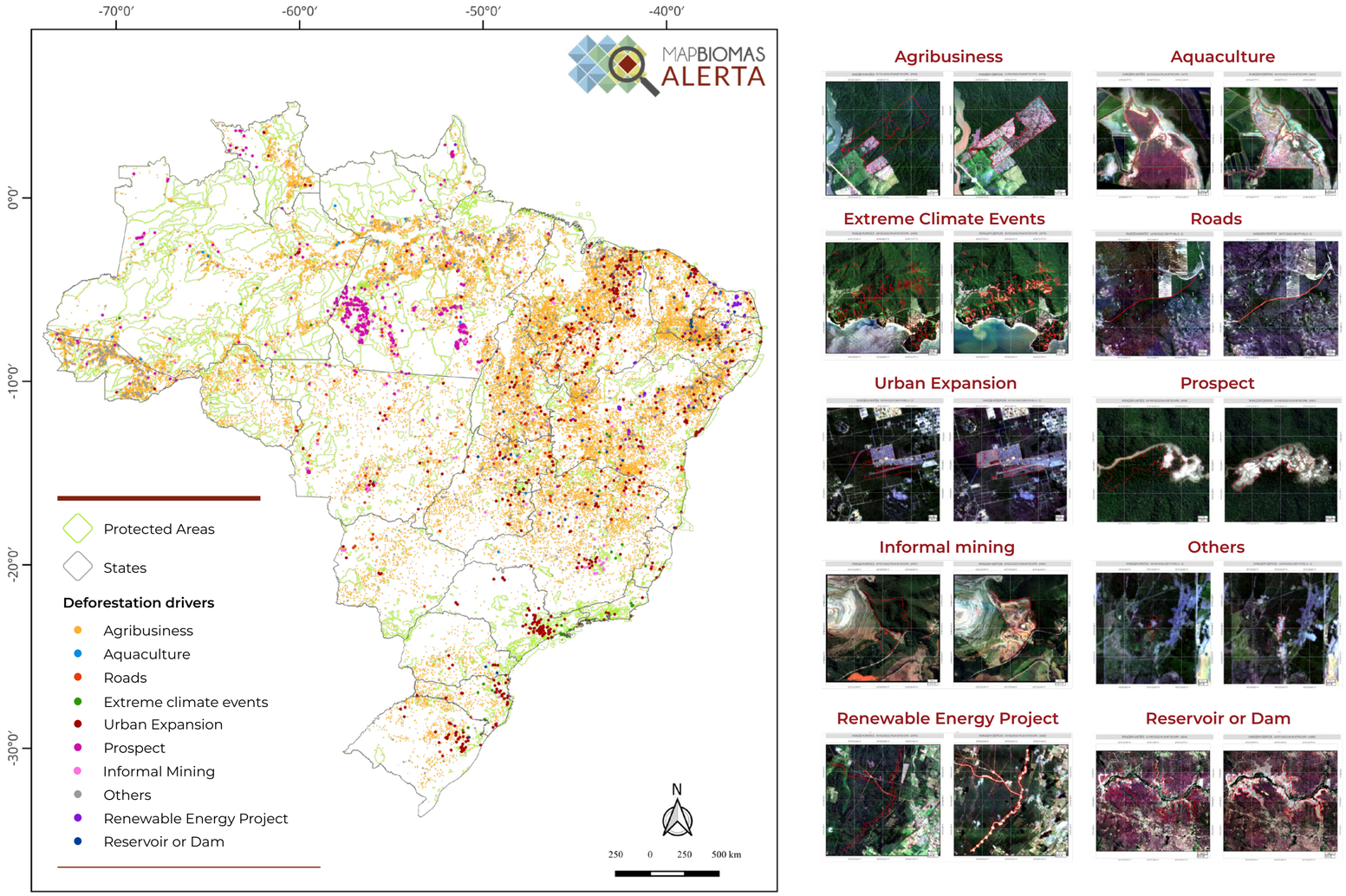


Figure 23 Distribution of deforestation drivers causing deforestation in Brazil in 2023 and characteristics of deforestation alerts according to the different deforestation drivers

3.4 | Territorial planning and deforestation

In this section we analyze the alerts according to the different types of territorial area in which they occur, such as Conservation Units, Indigenous Lands, Rural Settlements, Quilombo Remnant Communities, properties registered in the Rural Environmental Registry (CAR), among other land types.

3.4.1 | Deforestation in Conservation Units

In 2023, of the total of 2,739 federal, state and municipal land Conservation Units (UCs) registered in the National Registry of Conservation Units (CNUC, MMA/ ICMBio , 03/2024), 325 UCs (12%) had at least one event of deforestation (considering areas above 0.3 ha), which represents a slight increase when compared to the number observed in 2022 (319 UCs). Considering the last five years, 517 UCs (19%) had areas of at least 0.3 ha deforested (Table 31).

In total, 96,761 hectares of native vegetation were lost within UCs in 2023, which represents a reduction of 53.5% compared to 2022. This calculation considers all categories and levels of UC administration (Table 32 and Figure 24).

Most deforestation in UCs occurred in State Conservation Units for Sustainable Use. In the last five years, 58.6% of all native vegetation loss in UCs occurred within this category. Deforestation in Strictly Protected UCs represents approximately 15% of the total observed in UCs in the same period (federal and state). In this category, the greatest reduction in deforestation was observed: from 38,735 ha, in 2022, to 10,732 ha (reduction of 72.3%), in 2023 (Table 32).

Table 31 NUMBER OF CONSERVATION UNITS WITH DETECTED DEFORESTATION FROM 2019 TO 2023 IN BRAZIL**

Biome	2019	2020	2021	2022	2023	Total
Total UCs with deforestation detected*	240	322	303	319	325	517
Number of Mainland UCs in the CNUC	2,739					
% of total UCs with deforestation	9%	12%	11%	12%	12%	19%

*considering only mainland UCs
** Quantities for the years 2019 to 2022 may be different in relation to previous annual reports, since the entire alert base is spatially crossed with the updated UC base each year.

Table 32 DEFORESTED AREA (HECTARES) AND PROPORTION OF DEFORESTED AREA BY TYPE OF CONSERVATION UNIT AND BY ADMINISTRATIVE LEVEL BETWEEN 2019 AND 2023

Level and Category of UCs	2019	2020	2021	2022	2023	Total
Federal - Strictly Protected	**6,520**	**6,532**	**6,792**	**9,318**	**1974**	**31,136**
Ecological Station	2,824	1,294	3,068	4,452	584	12,221
Natural Monument				40	4	45
National Park	2,042	2,763	2,619	2,748	1,173	11,346
Biological Reserve	1,646	2,475	1,098	2,050	203	7,472
Wildlife Refuge	7	0	7	27	10	52
Federal - Sustainable Use	**38,257**	**41,420**	**56,929**	**48,234**	**22,160**	**207,000**
Environmental Protection Area	8,483	11,273	17,164	17,804	14,609	69,333
Area of Relevant Ecological Interest	42	72		68	4	186
National Forest	19,613	19,004	28,793	18,024	3,349	88,783
Sustainable Development Reserve		5			9	13
Private Natural Heritage Reserve	63	133	270	194	77	737
RESEX	10,056	10,934	10,703	12,143	4,112	47,948
State - Strictly Protected	**13,147**	**20,210**	**26,513**	**29,417**	**8,758**	**98,044**
Ecological Station	11,950	18,432	21,172	21,642	4,928	78,123
Natural Monument	32	102	1		182	317
Park	1,165	1,642	5,134	7,646	3,189	18,776
Wildlife Refuge		7	206	104	434	751
Biological Reserve		27	1	25	24	78
State - Sustainable Use	**88,737**	**98,345**	**111,179**	**120,593**	**62,365**	**481,220**
Environmental Protection Area	74,417	82,321	94,613	103,411	56,384	411,146
Area of Relevant Ecological Interest	3	4	11	20	1	39
Forest	2,600	4,441	2,275	6,832	1,281	17,428
Sustainable Development Reserve	382	550	708	424	1,280	3,343
Extractive Reserve	11,335	11,029	13,572	9,905	3,416	49,257
Private Natural Heritage Reserve		0		2	4	7
Municipal - Strictly Protected				**18**	**3**	**21**
Ecological Station				1		1
Natural Monument				0	3	3
Wildlife Refuge				17		17
Municipal - Sustainable Use	**337**	**860**	**419**	**578**	**1,501**	**3,695**
Environmental Protection Area	318	842	414	576	1,494	3,645
Area of Relevant Ecological Interest	18	17	5	0		39
Sustainable Development Reserve	1	1		1	5	9
Extractive Reserve					2	2
Total	**146,998**	**167,366**	**201,832**	**208,159**	**96,761**	**821,116**

CONTINUE

Percentage of deforestation in each category/level of UCs:						
Level and Category of UCs	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Federal - Strictly Protected	**4.4%**	**3.9%**	**3.4%**	**4.5%**	**2.0%**	**3.8%**
Ecological Station	1.9%	0.8%	1.5%	2.1%	0.6%	1.5%
Natural Monument				0.0%	0.0%	0.0%
National Park	1.4%	1.7%	1.3%	1.3%	1.2%	1.4%
Biological Reserve	1.1%	1.5%	0.5%	1.0%	0.2%	0.9%
Wildlife Refuge	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Federal - Sustainable Use	**26.0%**	**24.7%**	**28.2%**	**23.2%**	**22.9%**	**25.2%**
Environmental Protection Area	5.8%	6.7%	8.5%	8.6%	15.1%	8.4%
Area of Relevant Ecological Interest	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
National Forest	13.3%	11.4%	14.3%	8.7%	3.5%	10.8%
Sustainable Development Reserve		5			9	13
Private Natural Heritage Reserve	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
RESEX	6.8%	6.5%	5.3%	5.8%	4.2%	5.8%
State - Strictly Protected	**8.9%**	**12.1%**	**13.1%**	**14.1%**	**9.1%**	**11.9%**
Ecological Station	8.1%	11.0%	10.5%	10.4%	5.1%	9.5%
Natural Monument	0.0%	0.1%	0.0%		0.2%	0.0%
Park	0.8%	1.0%	2.5%	3.7%	3.3%	2.3%
Wildlife Refuge		0.0%	0.1%	0.1%	0.4%	0.1%
Biological Reserve		0.0%	0.0%	0.0%	0.0%	0.0%
State - Sustainable Use	**60.4%**	**58.8%**	**55.1%**	**57.9%**	**64.5%**	**58.6%**
Environmental Protection Area	50.6%	49.2%	46.9%	49.7%	58.3%	50.1%
Area of Relevant Ecological Interest	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forest	1.8%	2.7%	1.1%	3.3%	1.3%	2.1%
Sustainable Development Reserve	0.3%	0.3%	0.4%	0.2%	1.3%	0.4%
Extractive Reserve	7.7%	6.6%	6.7%	4.8%	3.5%	6.0%
Private Natural Heritage Reserve		0.0%		0.0%	0.0%	0.0%
Municipal - Strictly Protected				**0.0%**	**0.0%**	**0.0%**
Ecological Station				0.0%		0.0%
Natural Monument				0.0%	0.0%	0.0%
Wildlife Refuge				0.0%		0.0%
Municipal - Sustainable Use	**0.2%**	**0.5%**	**0.2%**	**0.3%**	**1.6%**	**0.5%**
Environmental Protection Area	0.2%	0.5%	0.2%	0.3%	1.5%	0.4%
Area of Relevant Ecological Interest	0.0%	0.0%	0.0%	0.0%		0.0%
Sustainable Development Reserve	0.0%	0.0%		0.0%	0.0%	0.0%
Extractive Reserve					0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

In 2023, of the total 52,814 ha deforested in UCs in the Cerrado, 92.5% occurred in federal, state and municipal Environmental Protection Areas (APAs) (Table 33). The greatest loss of native vegetation in UCs occurred in State APAs in the Cerrado biome, totaling 41,934 ha deforested. The Amazon had 34,195 ha of deforested area within UCs, which corresponds to less than 2% of the total deforested area in the country.

Table 33 AREA (HA) AND PROPORTION OF DEFORESTATION WITH TOTAL OR PARTIAL OVERLAP BY TYPE OF CONSERVATION UNIT IN EACH BIOME IN 2023

Level and Category of UCs	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Total
Federal - Strictly Protected	**1,374**	**64**	**534**	**3**			**1974**
Ecological Station	476	3	105				584
Natural Monument		2		2			4
National Park	694	59	419	1			1,173
Biological Reserve	203						203
Wildlife Refuge			10				10
Federal - Sustainable Use	**9,302**	**6,848**	**5,951**	**37**	**22**		**22,160**
Environmental Protection Area	2,219	6,835	5,533	1	22		14,610
Area of Relevant Ecological Interest	4						4
National Forest	3,100		249				3,349
Sustainable Development Reserve			9				9
Private Natural Heritage Reserve		12	29	36			77
RESEX	3,980		131	1			4,112
State - Strictly Protected	**6,281**	**32**	**2,383**	**61**	**1**		**8,758**
Ecological Station	4,928						4,928
Natural Monument		5	177				182
Park	1,330	14	1,785	59	1		3,189

CONTINUE

Wildlife Refuge		13	421				434
Biological Reserve	22			2			24
State - Sustainable Use	**17,164**	**2,265**	**42,573**	**355**	**6**	**1**	**62,365**
Environmental Protection Area	11,826	2,265	41,934	352	6		56,384
Area of Relevant Ecological Interest	1						1
Forest	1,281						1,281
Sustainable Development Reserve	641		639				1,280
Extractive Reserve	3,416						3,416
Private Natural Heritage Reserve				3		1	4
Municipal - Strictly Protected			**3**				**3**
Natural Monument			3				3
Municipal - Sustainable Use	**74**	**2**	**1,370**	**55**			**1,501**
Environmental Protection Area	72	2	1,370	50			1,494
Sustainable Development Reserve				5			5
Extractive Reserve	2						2
Total	**34,195**	**9,210**	**52,814**	**512**	**28**	**1**	**96,761**

Level and Category of UCs	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Total
Federal - Strictly Protected	**4.0%**	**0.7%**	**1.0%**	**0.5%**			**2.0%**
Ecological Station	1.4%	0.0%	0.2%				0.6%
Natural Monument		0.0%		0.4%			0.0%
National Park	2.0%	0.6%	0.8%	0.1%			1.2%
Biological Reserve	0.6%						0.2%
Wildlife Refuge			0.0%				0.0%
Federal - Sustainable Use	**27.2%**	**74.3%**	**11.3%**	**7.3%**	**77.5%**		**22.9%**
Environmental Protection Area	6.5%	74.2%	10.5%	0.1%	77.5%		15.1%
Area of Relevant Ecological Interest	0.0%						0.0%
National Forest	9.1%		0.5%				3.5%
Sustainable Development Reserve			0.0%				0.0%
Private Natural Heritage Reserve		0.1%	0.1%	7.0%			0.1%
RESEX	3,980		0.2%	0.2%			4.2%
State - Strictly Protected	**18.4%**	**0.3%**	**4.5%**	**11.9%**	**2.2%**		**9.1%**
Ecological Station	14.4%						5.1%
Natural Monument		0.1%	0.3%				0.2%
Park	3.9%	0.2%	3.4%	11.5%	2.2%		3.3%
Wildlife Refuge		0.1%	0.8%				0.4%
Biological Reserve	0.1%			0.4%			0.0%

CONTINUE

State - Sustainable Use	**50.2%**	**24.6%**	**80.6%**	**69.4%**	**20.3%**	**100.0%**	**64.5%**
Environmental Protection Area	34.6%	24.6%	79.4%	68.9%	20.3%		58.3%
Area of Relevant Ecological Interest	0.0%						0.0%
Forest	3.7%						1.3%
Sustainable Development Reserve	1.9%		1.2%				1.3%
Extractive Reserve	10.0%						3.5%
Private Natural Heritage Reserve				0.6%		100.0%	0.0%
Municipal - Strictly Protected			**0.0%**				**0.0%**
Natural Monument			0.0%				0.0%
Municipal - Sustainable Use	**0.2%**	**0.0%**	**2.6%**	**10.8%**			**1.6%**
Environmental Protection Area	0.2%	0.0%	2.6%	9.8%			1.5%
Sustainable Development Reserve				1.0%			0.0%
Extractive Reserve	0.0%						0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Altogether, approximately 5.3% of the deforested area in 2023 occurred within a Conservation Unit in Brazil. **When the Environmental Protection Area (APA) category is excluded, which allows rural production activities on private properties, the area deforested in 2023 in UCs falls to 1.3% of total deforestation in Brazil** (Table 34).

Table 34 PROPORTION OF DEFORESTED AREA IN CONSERVATION UNITS IN EACH BIOME AND IN BRAZIL IN RELATION TO THE TOTAL DEFORESTED IN 2023 AND PROPORTION OF DEFORESTED AREA WITHOUT CONSIDERING ENVIRONMENTAL PROTECTION AREAS (APAS)

Level	Conservation Unit Category	Amazon	Caatinga	Cerrado	Atlantic Forest	Pampa	Pantanal	Brazil
Federal	Strictly Protected	0.3%						0.1%
Federal	Sustainable Use (without APA)	1.6%			0.3%			0.4%
Federal	Environmental Protection Area	0.5%	3.4%	0.5%		1.4%		0.8%
State	Strictly Protected	1.4%		0.2%	0.5%			0.5%
State	Sustainable Use (without APA)	1.2%		0.1%				0.3%
State	Environmental Protection Area	2.6%	1.1%	3.8%	2.9%	0.4%		3.1%
Municipal	Strictly Protected							
Municipal	Sustainable Use (without APA)							
Municipal	Environmental Protection Area			0.1%	0.4%			0.1%
Total	**Total**	**7.5%**	**4.6%**	**4.8%**	**4.2%**	**1.8%**		**5.3%**
Total	**Total without APA**	**4.4%**	**0.1%**	**0.4%**	**0.9%**			**1.3%**

Of the total of 325 UCs with deforestation in 2023, 17 had more than 1,000 hectares deforested, 12 of which were APAs (in 2022, there were 25). The UC with the largest deforested area was the Rio Preto APA (BA), in the Cerrado, with 14,066 ha deforested (Figure 24). In 2022, this APA was in second place in the ranking with 33,348 ha, therefore there was a 57.8% reduction in the deforested area (Table 35 and Figure 25).

Table 35 LIST OF THE 50 CONSERVATION UNITS WITH THE LARGEST DEFORESTED AREA IN BRAZIL IN 2023

Rank	Name and Code of the Conservation Unit in SNUC	Number of Alerts in 2023	Area (ha) deforested in 2023
1	APA DO RIO PRETO (0000.29.1016)	223	14,066
2	APA ILHA DO BANANAL/CANTÃO (0000.17.1501)	223	11,638
3	APA TRIUNFO DO XINGU (0000.15.1039)	200	9,391
4	APA SERRA DA IBIAPABA (0000.00.0029)	413	4,691
5	APA DA CHAPADA DO ARARIPE (0000.00.0008)	656	4,636
6	ESTAÇÃO ECOLÓGICA SOLDADO DA BORRACHA (0000.11.4448)	84	4,129
7	APA BACIA OF RIO DE JANEIRO (0000.29.0305)	52	4,006
8	APA DE UPAON-AÇU / MIRITIBA / ALTO PREGUIÇAS (0000.21.1888)	289	3,361
9	APA DO TAPAJÓS (0000.00.0268)	213	2,219
10	APA DOS MORROS GARAPENSES (0000.21.1892)	105	2,059
11	APA COCHÁ E GIBÃO (0000.31.0894)	38	2,046
12	RESERVA EXTRATIVISTA JACI-PARANÁ (0000.11.0776)	49	2,042
13	RESERVA EXTRATIVISTA CHICO MENDES (0000.00.0222)	662	1,805
14	PARQUE ESTADUAL DO MIRADOR(0000.21.1963)	10	1,684
15	APA DAS NASCENTES DO RIO VERMELHO(0000.00.0028)	48	1,348
16	PARQUE ESTADUAL DE GUAJARÁ-MIRIM STATE(0000.11.0765)	65	1,269
17	APA BACIA DO RIO PANDEIROS (0000.31.0355)	36	1,103
18	APA DAS CABECEIRAS DO RIO CUIABÁ (0000.51.0453)	17	973
19	FLORESTA NACIONAL DO JAMANXIM (0000.00.0266)	27	955
20	APA LAGO DE SOBRADINHO (0000.29.1015)	43	868
21	APA POUSO ALTO (0000.52.0900)	69	846
22	APA DO PLANALTO CENTRAL (0000.00.0023)	36	769
23	APA DO LAGO DE TUCURUI (0000.15.1029)	92	764
24	RDS VEREDAS DO ACARI (0000.31.0416)	3	639

CONTINUE

25	APA SERRA DO LAJEADO (0000.17.1498)	36	602
26	RESERVA EXTRATIVISTA DO RIO PRETO-JACUNDÁ (0000.11.0777)	23	586
27	RESERVA EXTRATIVISTA VERDE PARA SEMPRE (0000.00.0260)	240	570
28	APA LAGO DE PALMAS (0000.17.1497)	15	562
29	APA DA BAIXADA MARANHENSE (0000.21.1887)	39	555
30	APA DA BACIA DO RIO IGUATEMI NO MUNICÍPIO DE AMAMBAI (0060.50.4333)	5	518
31	FLORESTA ESTADUAL DO PARU (0000.15.1038)	27	470
32	APA CAVERNAS DO PERUAÇU (0000.00.0002)	5	454
33	FLORESTA NACIONAL DE TEF (0000.00.0112)	83	442
34	ESTAÇÃO ECOLÓGICA DA TERRA DO MEIO (0000.00.0047)	28	431
35	REFÚGIO DE VIDA SILVESTRE CORIXÃO DA MATA AZUL (0000.51.0475)	1	421
36	ESTAÇÃO ECOLÓGICA SAMUEL (0000.11.0764)	51	407
37	APA JALAPÃO (0000.17.1499)	6	362
38	APA DELTA DO PARNAÍBA (0000.00.0019)	54	334
39	FLORESTA NACIONAL SARACA-TAQUERA (0000.00.0109)	32	333
40	RESERVA FLORESTAL DO ALTO JURUÁ (0000.00.1517)	136	332
41	APA DOS MANANCIAIS SUPERFICIAIS DAS NASCENTES DO RIO APA (2100.50.4439)	8	324
42	APA DA SERRA DA CAIÇARA (0000.27.4375)	22	295
43	FLORESTA ESTADUAL DO AMAPÁ (0000.16.0885)	87	293
44	APA CAVERNA DO MORIAGA DE PRESIDENTE FIGUEIREDO (0000.13.0993)	65	279
45	PARQUE NACIONAL DAS NASCENTES DO RIO PARNAÍBA PARK (0000.00.0156)	18	268
46	ESTAÇÃO ECOLÓGICA DO RIO ROOSEVELT (0000.51.1899)	13	250
47	FLORESTA NACIONAL DE CRISTÓPOLIS (0000.00.0090)	4	249
48	RESERVA EXTRATIVISTA DO RIO CAJARI(0000.00.1518)	81	229
49	RESERVA EXTRATIVISTA GUARIBA-ROOSEVELT (0000.51.0463)	14	228
50	RDS AMANÃ (0000.13.0981)	63	222

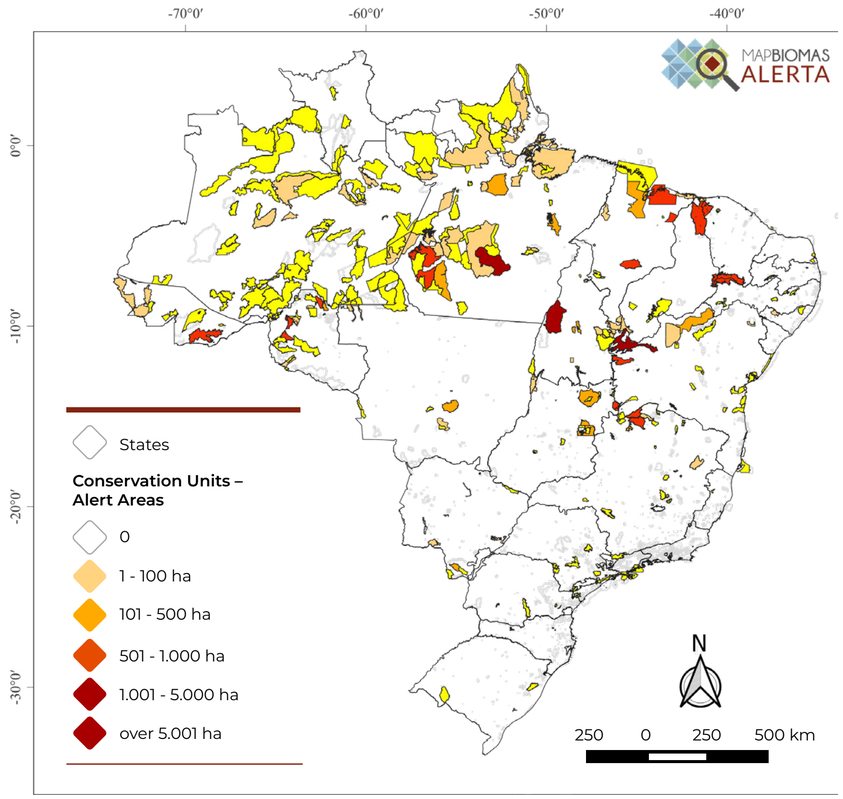
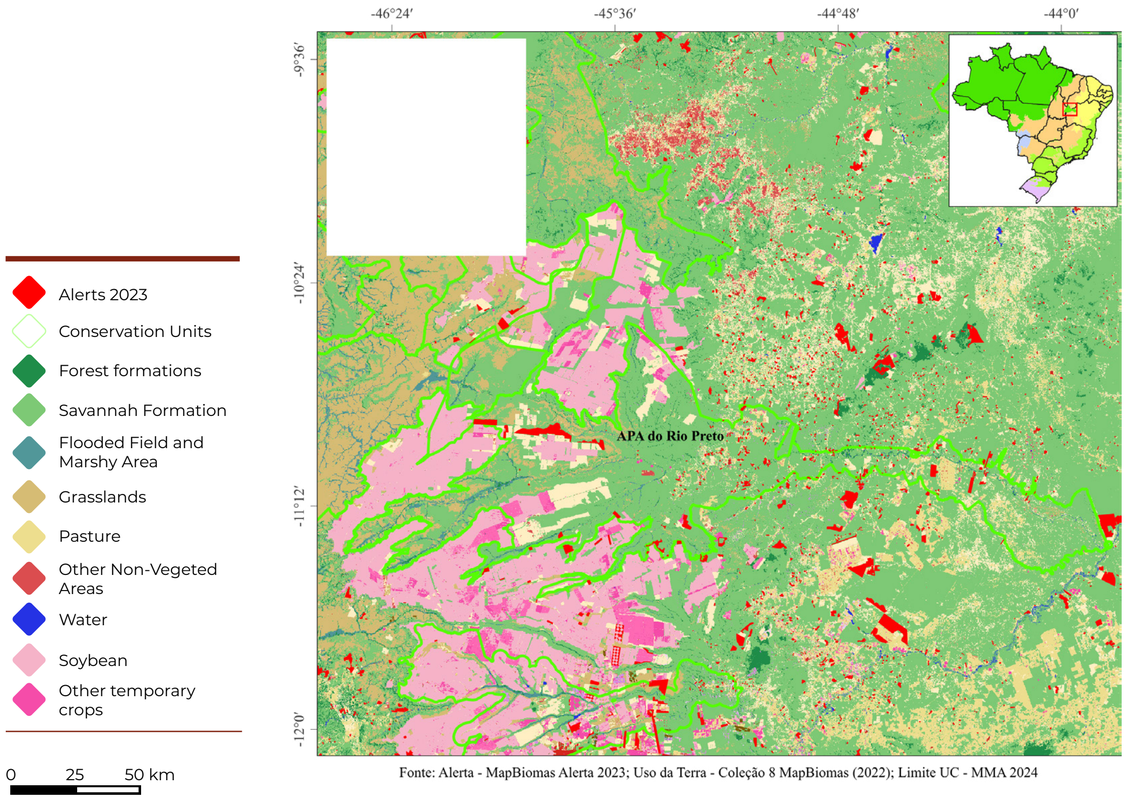


Figure 24 Conservation Units with deforestation in Brazil in 2023



Fonte: Alerta - MapBiomas Alerta 2023; Uso da Terra - Coleção 8 MapBiomas (2022); Limite UC - MMA 2024

Figure 25 Deforestation alerts in the Rio Preto APA (BA), Conservation Unit with the largest deforested area detected in 2023

3.4.2 | Deforestation in Indigenous Lands

Of the total of 627 Indigenous Lands (TIs) in Brazil (considering their various phases of recognition and demarcation, including those with a prohibition ordinance), 253 (40%) had at least one deforestation event in 2023 (with a sum greater than 0. 3 ha) (Figure 26). The number of TIs where some level of deforestation was observed in the last five years reached 376 (60%) (Table 36).

In 2023, 20,822 ha of native vegetation loss were observed within TIs (1.1% of all deforestation in Brazil). This represents a reduction of more than 27% in deforestation in TIs compared to 2022 (Tables 36 and 37)**.**

Table 36 DISTRIBUTION OF DEFORESTATION ON INDIGENOUS LANDS IN BRAZIL FROM 2019 TO 2023**

Deforestation in TIs compared to the total Tis	2019	2020	2021	2022	2023	Total
Total TIs with deforestation detected	217	292	244	225	253	376
Number of Tis in Brazil	627					
% of TIs with deforestation	35%	47%	39%	36%	40%	60%

Deforestation in TIs compared to the total in Brazil	2019	2020	2021	2022	2023	Total
Deforested area in TIs (ha)	35,912	33,806	32,543	28,502	20,822	151,585
Total deforested area in Brazil (ha)	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597	8,558,237
% of deforested areas in TIs in Brazil	2.9%	2.1%	1.8%	1.4%	1.1%	1.8%

** the quantities for the years 2019 to 2022 may be different in relation to previous annual reports, since the entire alert base is spatially crossed again with the updated IT base

Table 37 DEFORESTED AREA (HA) AND NUMBER OF DEFORESTATION ALERTS OVERLAPPING WITH INDIGENOUS LANDS BY BIOME FROM 2019 TO 2023

Area (ha):

Biome	2019	2020	2021	2022	2023	Total
Amazon	32,693	29,466	28,786	25,758	13,552	130,256
Caatinga	12	10	116	112	177	427
Cerrado	2,850	3,671	3,438	2,450	7,048	19,457
Atlantic Forest	190	599	203	180	45	1,216
Pampa						
Pantanal	168	60		2		230
Total	**35,912**	**33,806**	**32,543**	**28,502**	**20,822**	**151,585**

Biome	2019	2020	2021	2022	2023	Total
Amazon	3,216	5,230	3,576	3,248	3,228	18,498
Caatinga	2	5	23	41	57	128
Cerrado	26	312	101	111	261	811
Atlantic Forest	14	38	46	42	17	157
Pampa	3	2		3		8
Pantanal	3,261	5,587	3,746	3,445	3,563	19,602
Total	**6,522**	**11,174**	**7,492**	**6,890**	**7,126**	**39,204**

The largest deforested area in the TI in 2023 occurred in the Porquinhos dos Canela-Apãnjekra TI, in the state of Maranhão, with a loss of 2,750 ha of native vegetation (Figure 27). This area is around 74% smaller than the area observed in the TI that occupied first place in this ranking in 2022 (TI Apyterewa in Pará with 10,565 ha deforested) (Table 38).

4 | This number excludes only the Indigenous Lands that are in the "under study" categories in the FUNAI database. It includes approved, forwarded RI, declared, delimited and regularized.

Table 38 LIST OF THE 50 INDIGENOUS LANDS WITH THE LARGEST DEFORESTED AREA IN 2023 IN BRAZIL

Rank	Name of the Indigenous Land	Number of Alerts in 2023	Area (ha) deforested in 2023
1	Porquinhos dos Canelas - Apãnjekra (36602)	32	2,750
2	Kanela Memortumré (20702)	17	2006
3	Apyterewa (3002)	265	1,458
4	Kapôt Nhinore (64501)	7	1,228
5	Cachoeira Seca (7601)	199	1,084
6	Kayapó (23001)	619	948
7	Bacurizinho (4902)	23	836
8	Igarapé Lage (16101)	51	734
9	Yanomami (50901)	153	628
10	Trincheira Bacaja (46201)	149	613
11	Uru-Eu- Wau - Wau (48201)	12	579
12	Sararé (42101)	24	403
13	Andirá-Marau (2001)	158	388
14	7 de Setembro (43001)	57	387
15	Tratarim Marmelos (Gleba B) (62901)	8	365
16	Munduruku (29801)	69	315
17	Parque Xingu (33801)	208	281
18	Sepoti (42301)	12	277
19	Waimiri-Atroari (49501)	78	263
20	Parabubure (32701)	77	260
21	Wedezé (73601)	3	224
22	Karipuna (21601)	10	208
23	Krikati (23501)	17	177
24	Utiariti (48501)	4	170

CONTINUE

25	Paresi (33401)	5	142
26	Apurinã Km 124 BR-317 (2901)	13	123
27	Vale do Javari (48701)	36	99
28	Sarauá (58901)	22	98
29	Kaxarari (22001)	19	98
30	Aripuanã (4201)	7	96
31	Alto Rio Negro (1101)	47	88
32	Pacaás Novas (31601)	21	86
33	Xikrin do Rio Catete (50501)	10	83
34	Roosevelt (40701)	8	75
35	Deni (10901)	14	74
36	Mamoadate (26201)	20	69
37	Kaxuyana-Tunayana (68101)	32	68
38	Uirapuru (47901)	1	68
39	Bakairi (5201)	3	61
40	Uaçá (47601)	20	58
41	Nhamundá/ Mapuera (30501)	26	57
42	Cana Brava/ Guajajara (8701)	12	57
43	Trombetas/ Mapuera (46401)	21	54
44	Évare I (12101)	24	52
45	Cuiu-Cuiu (10701)	8	52
46	Katukina / Kaxinawá (21901)	14	46
47	Médio Rio Negro I (28501)	27	46
48	Menkragnoti (28701)	37	46
49	Manoki (17302)	2	45
50	Porquinhos (36601)	2	42

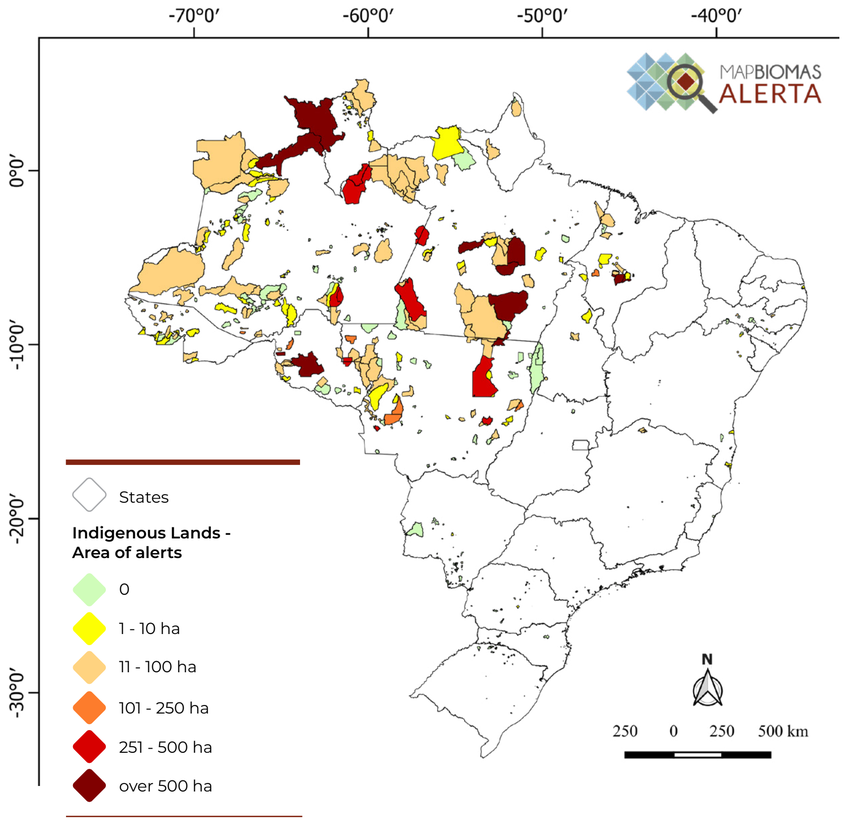
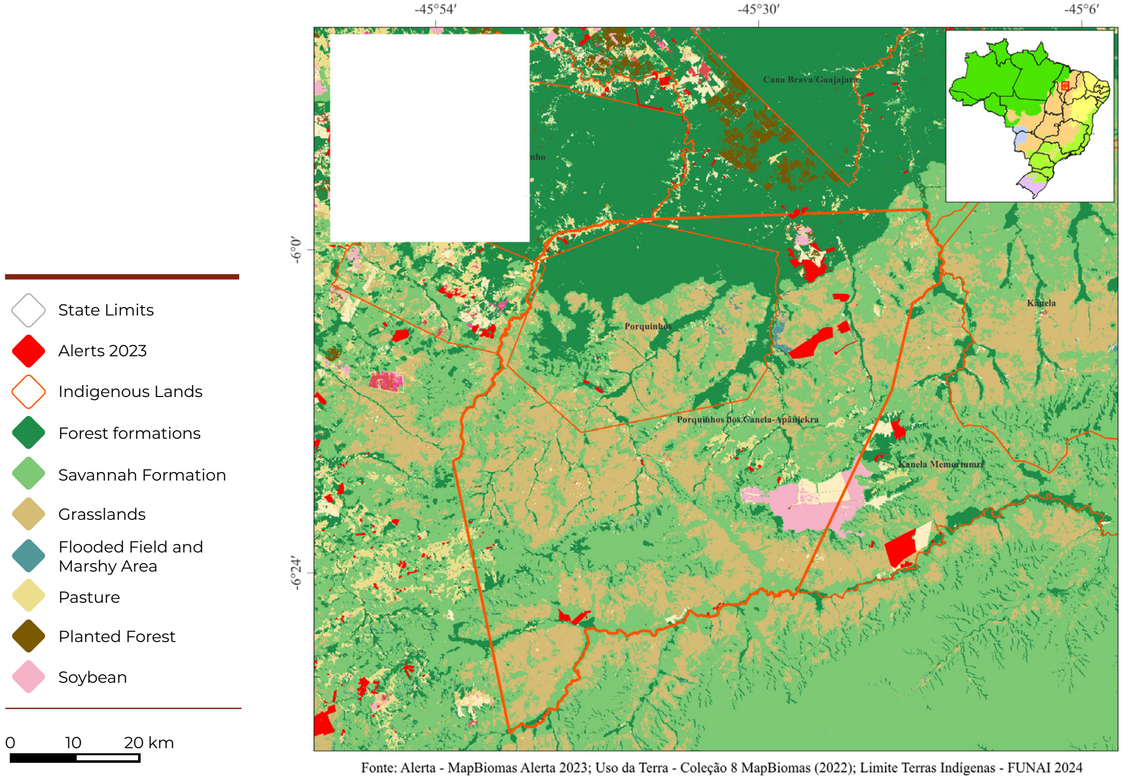


Figure 26 Indigenous Lands with deforestation in Brazil in 2023



Fonte: Alerta - MapBiomas Alerta 2023; Uso da Terra - Coleção 8 MapBiomas (2022); Limite Terras Indígenas - FUNAI 2024

Figura 27 Deforestation alerts in the Porquinhos dos Canela TI_Apãnjekra (MA), the Indigenous Land with the largest deforested area detected in 2023.

3.4.3 | Deforestation in Rural Settlements

Of the 7,182 rural settlements registered in the INCRA database (INCRA 10/2023, accessed on 03/2024), 1,804 (25%) had at least one deforestation alert in 2023, with an area greater than 0.3 ha (Table 39 and Figure 28). This version of the INCRA database includes federal and recognized settlements[5].

Deforestation that overlapped with areas of rural settlements totals 118,060 ha, which represents 6.5% of the total deforested area in Brazil in 2023. However, this area is 57% smaller than the deforested area in settlements observed in 2022 (274,739 ha) (Table 39). The Amazon biome had the largest deforested area in rural settlements, totaling 86,527 ha, and this represents a 66.6% reduction compared to 2022 (295,402 ha) (Table 40).

Table 39 ALERTS WITH TOTAL OR PARTIAL OVERLAP WITH RURAL SETTLEMENTS IN BRAZIL FROM 2019 TO 2023*

Deforestation in Settlements compared to the total of Settlements	2019	2020	2021	2022	2023	Total
Total Settlements with deforestation detected	1,238	1,866	1,535	1,484	1,804	2,867
Number of Settlements in Brazil	7,182					
% of Settlements with deforestation	17%	26%	21%	21%	25%	40%

Deforestation in Settlements compared to the total in Brazil	2019	2020	2021	2022	2023	Total
Deforested area in Settlements (ha)	177,679	224,747	254,307	274,739	118,060	1,049,532
Total deforested area in Brazil (ha)	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597	8,558,237
% of deforested areas in Settlements in Brazil	14.6%	13.7%	14.1%	13.3%	6.5%	12.3%

* the quantities for the years 2019 to 2022 may be different in relation to previous annual reports, since the entire alert base is spatially cross-referenced again with the updated settlement base

5 | Terminology used in the INCRA base.

Table 40 DEFORESTED AREA (HA) AND NUMBER OF ALERTS IN RURAL SETTLEMENTS IN BRAZIL BY BIOME FROM 2019 TO 2023

Area (ha)

Biome	2019	2020	2021	2022	2023	Total
Amazon	165,114	196,382	236,824	259,204	86,527	944,050
Caatinga	883	2,994	3,496	3,632	6,341	17,347
Cerrado	11,270	24,806	12,627	10,954	24,879	84,536
Atlantic Forest	277	401	1,180	660	165	2,684
Pampa	3	5	14	63	13	98
Pantanal	132	160	167	226	134	818
Total	**177,679**	**224,747**	**254,307**	**274,740**	**118,060**	**1,049,533**

Number of alerts:

Biome	2019	2020	2021	2022	2023	Total
Amazon	14,191	17,635	17,469	14,457	8,687	72,439
Caatinga	65	481	584	591	992	2,713
Cerrado	665	2,947	704	471	2,134	6,921
Atlantic Forest	34	81	190	171	71	547
Pampa	1	2	4	12	3	22
Pantanal	11	13	18	32	21	95
Total	**14,967**	**21,159**	**18,969**	**15,734**	**11,908**	**82,737**

The three rural settlements with the largest deforested areas are in the states of Pará (Table 41 and Figure 28). With 3,003 ha of loss of native vegetation, the PDS LIBERDADE I settlement was the settlement with the most deforestation (in 2022, it occupied second place in the ranking with 14,450 ha of deforestation). The first place in the ranking for the year 2022, the PA Rio Juma rural settlement (AM), with 32,373 ha of native vegetation suppression, is not included in the base version of INCRA used for this analysis, as well as other state or unrecognized settlements.

Table 41 LIST OF THE 50 RURAL SETTLEMENTS WITH THE LARGEST DEFORESTED AREA IN 2023 IN BRAZIL

Rank	Settlements	State	Number of Alerts in 2023	Area (ha) deforested in 2023
1	PDS FREEDOM I	PA	65	3,003
2	PDS RENASCER II	PA	16	2,044
3	PDS HOPE	PA	10	1979
4	PA ACARI	AM	56	1,797
5	PA CORTA CORDAE	PA	46	1,744
6	PDS ADEMIR FREDERICCE	PA	46	1,647
7	PAD ANAUÁ	RR	177	1,645
8	PIC - BARRA DO CORDA	MA	57	1,566
9	PAF JEQUITIBÁ	RO	76	1,410
10	PA CIDAPAR 1a PARTE	PA	142	1,376
11	PAE SÃO BENEDITO	AM	25	1,260
12	PAE ANTIMARY	AM	105	1,209
13	PA JACARÉ	PA	47	1,136
14	PAC BOM SOSSEGO	PA	65	1,117
15	PA LAND FOR PEACE	PA	55	1,116
16	PDS REALITY	AM	31	1,113
17	PA MOJU IE II	PA	108	1,081
18	PAE SANTA MARIA AUXILIADO-RA	AM	61	1,071
19	PA RIO CURURUI	PA	93	985
20	PDS ITATÁ	PA	197	979
21	PAE ARIPUANÃ-GUARIBA	AM	12	950
22	PDS SERRA AZUL	PA	110	898
23	PA SURUBIM	PA	94	840
24	PA TABOCÃO	MA	9	836
25	PDS LARANJAL	PA	25	833
26	PA ANGICAL I	BA	65	820
27	PAC OURO BRANCO II	PA	4	768
28	PA JATAPU	RR	96	670
29	PDS SANTA CLARA	PA	16	652
30	PA RENASCER	PA	15	648
31	PA SANTA RITA	MT	32	646
32	PA MACIFE	MT	22	630
33	PA BEIRA RIO	BA	16	603
34	PA TUERE	PA	73	599
35	PA PARAÍSO	PA	54	575
36	PA PILÃO POENTE II	PA	100	541
37	PA ALTO PARÁ		16	535
38	PDS JAMIL JEREISSATI	AC	132	520
39	PA ITAPUAMA	PA	80	518
40	PDS TERRA NOSSA	PA	55	499
41	PA OZIEL ALVES PEREIRA	GO	33	483
42	PDS PARAÍSO	PA	55	455
43	PIC MONTE ALEGRE	PA	48	450
44	PA CARNAÚBA	MT	5	446
45	PA PENHA	TO	26	441
46	PA JAHU	PA	11	435
47	PRIMOROSA PA	MT	16	429
48	PA SAN FRANCISCO	AM	27	426
49	PA PAREDÃO	RR	46	425
50	PA CAUTARINHO	RO	8	422

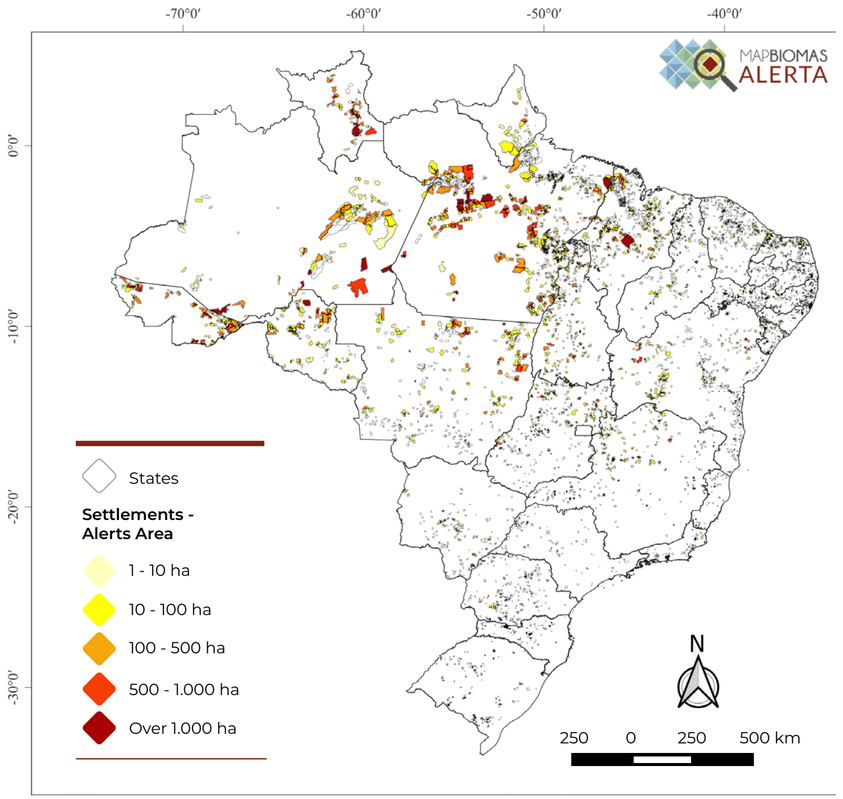
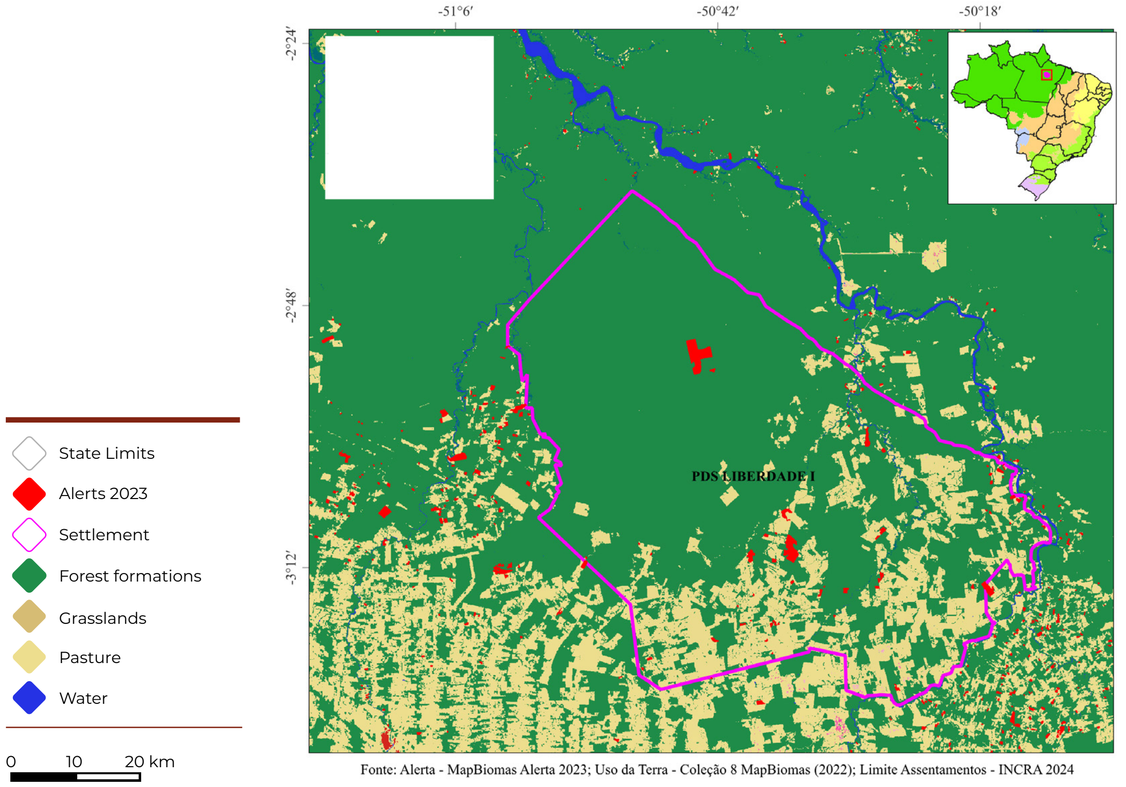


Figure 28 Rural settlements with deforestation in 2023 in Brazil



Fonte: Alerta - MapBiomas Alerta 2023; Uso da Terra - Coleção 8 MapBiomas (2022); Limite Assentamentos - INCRA 2024

Figure 29 Deforestation alerts in PDS Liberdade I (PA), rural settlement with the largest deforested area detected in 2023.

3.4.4 | Deforestation in Quilombo Remnant Communities

Of the total of 495 Quilombo Remnant Communities (CRQ) present in the database (INCRA 12/2023), 99 of them (i.e., 20%) had at least one deforestation alert detected and validated in 2023, considering areas larger than 0.3 ha. In the last five years, deforestation that overlaps the CRQs represented 0.14% of the total area (Table 42).

Table 42 ALERTS WITH TOTAL OR PARTIAL OVERLAP WITH QUILOMBO REMNANT COMMUNITIES IN BRAZIL FROM 2019 TO 2023

Deforestation in CRQs compared to the total of CRQs	2019	2020	2021	2022	2023	Total
Total CRQs with deforestation detected	51	81	67	79	99	174
Number of CRQs in Brazil	495					
% of CRQs with deforestation	10%	16%	14%	16%	20%	35%

Deforestation in Settlements compared to the total in Brazil	2019	2020	2021	2022	2023	Total
Deforested area in CRQs (ha)	1,438	2,874	2,274	1,336	4,063	11,985
Total deforested area in Brazil (ha)	1,220,236	1,639,730	1,798,978	2,069,695	1,829,597	8,558,237
% of deforested areas in CRQs in Brazil	0.12%	0.18%	0.13%	0.06%	0.22%	0.14%

** the quantities for the years 2019 to 2022 may be different in relation to previous annual reports, since the entire alert base is spatially cross-referenced again with the updated CRQs base

Table 43 LIST OF THE 20 REMNANT QUILOMBO COMMUNITIES WITH THE LARGEST DEFORESTED AREAS IN 2023 IN BRAZIL

Rank	CRQ name	State	Number of Alerts in 2023	Area (ha) deforested in 2023
1	**Barra do Aroeira**	TO	**35**	**1,597**
2	**Família Magalhãesy**	GO	**3**	**365**
3	**Kalunga**	GO	**12**	**230**
4	**Riacho da Sacutiaba e Sacutiaba**	BA	**8**	**156**
5	**Alto Trombetas II**	PA	**13**	**108**
6	**Erepecuru**	PA	**24**	**90**
7	**Queimadas**	CE	**3**	**85**
8	**Cipó**	MA	**3**	**84**
9	**Cabeceiras - TQ Cabeceiras formed by the communities of São José, Silêncio, Mata, Cuecê , Apui and Castanhaduba**	PA	**21**	**83**
10	**Igarapé Preto, Baixinha, Panpelônia , Teófilo**	PA	**20**	**75**
11	**Santana e São Patrício**	MA	**1**	**73**
12	**Pacoval do Alenquer**	PA	**17**	**71**
13	**Barra do Parateca**	BA	**2**	**66**
14	**Bacuri dos Pires**	MA	**2**	**58**
15	**Altamira**	MA	**1**	**57**
16	**Gurutuba**	MG	**4**	**56**
17	**Serra dos Chagas**	CE	**10**	**53**
18	**Machado**	MG	**2**	**43**
19	**Jamari dos Pretos**	MA	**6**	**34**
20	**Balique (TQ BAILIQUE composed of the communities Bailique Beira, Bailique Centro, Poção and São Bernardo)**	PA	**8**	**30**

Quilombo Barra do Aroeira had the largest deforested area, with 1,597 hectares deforested (Figure 30 and Table 43).

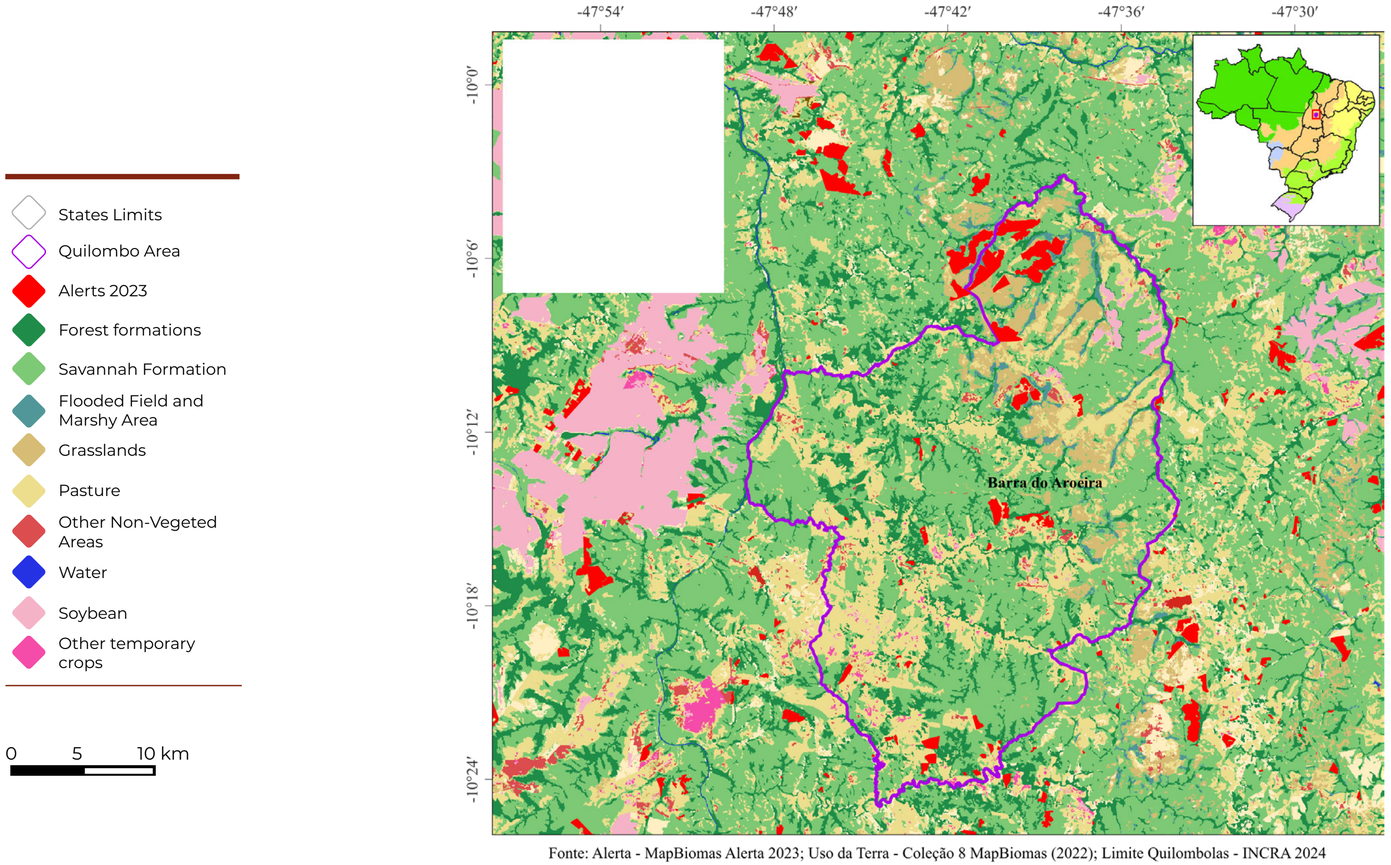


Figure 30 Deforestation alerts in the Quilombo Remnant Community of Barra do Aroeira (TO), where the largest deforestation was recorded for this land category in 2023

3.4.5 | Deforestation at archaeological sites

For the first time in the report, cross-linking alerts from 2019 to 2023 with the 27,485 archaeological sites registered in the IPHAN database indicates that deforestation overlapped with 93 archaeological sites over the five years. In 2023, ten of the 22 deforestation events at archaeological sites (45.5%) occurred in the Caatinga biome, followed by the Cerrado with seven (31.8%), the Atlantic Forest with four (18.1%) and the Amazon with an alert at an archaeological site. In the Pantanal and Pampa biomes, no alerts were identified in archaeological sites registered with IPHAN (Table 44 and Figure 31).

Table 44 NUMBER OF DEFORESTATION ALERTS AT ARCHAEOLOGICAL SITES BY BIOMES AND PER YEAR

BIOME	2019	2020	2021	2022	2023	Total
Amazon	4	7	2	1	1	**15**
Caatinga			7	8	10	**25**
Cerrado	2	7	3	3	7	**22**
Atlantic Forest	17	4	2	4	4	**31**
Total	**23**	**18**	**14**	**16**	**22**	**93**

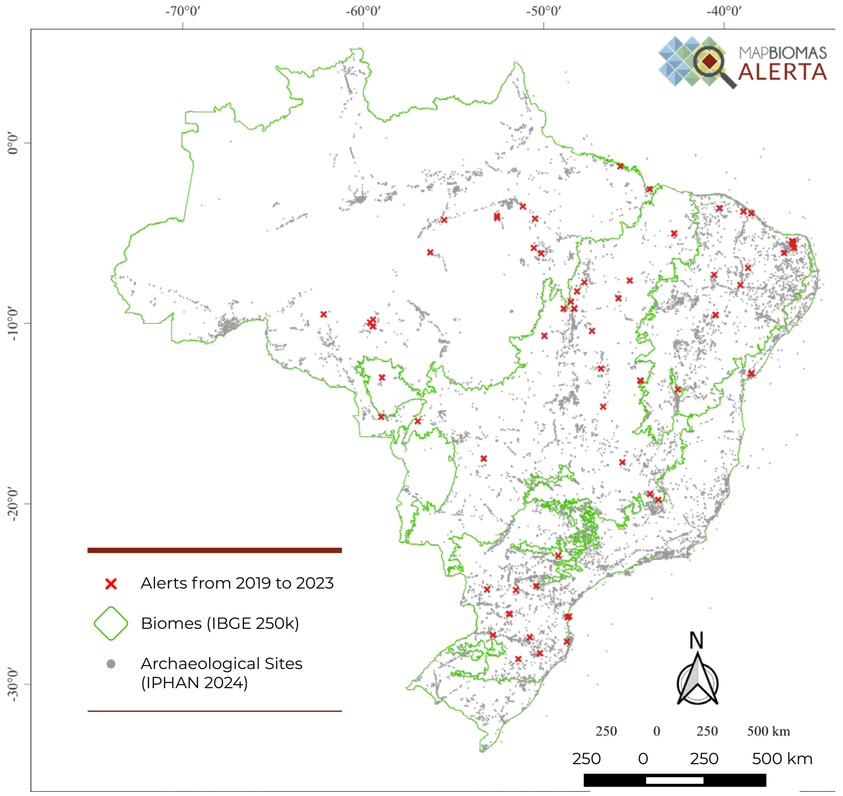


Figure 31 Deforestation alerts at archaeological sites from 2019 to 2023.

3.4.6 | Deforestation on private properties registered with INCRA

When cross-referencing the deforestation alerts from 2019 to 2023 with the areas registered in the SIGEF (private) and SNCI (private-removing areas overlapping with the private SIGEF) databases, it is observed that **44% of all deforestation in the country in the last 5 years occurred in private areas registered with INCRA** (Table 45).

If we only consider 2023, there were 1,114,626 ha of loss of native vegetation in these areas, which is equivalent to **61% of deforestation in Brazil**. In the Amazon, deforestation in these areas accounts for 28% of the total detected in 2023. In the Pantanal, this percentage is 93%, and in the Cerrado 77% (Table 46).

Table 45 DEFORESTED AREA (HA) IN AREAS REGISTERED WITH SNCI AND SIGEF (INCRA) BY BIOMES AND PER YEAR

Biome	2019	2020	2021	2022	2023	Total
Amazon	153,147	181,446	226,915	227,925	128,208	**917,642**
Caatinga	7,583	30,557	53,980	51,916	83,573	**227,609**
Cerrado	304,763	441,714	400,386	406,685	850,938	**2,404,486**
Atlantic Forest	4,305	9,671	12,571	12,949	4,944	**44,441**
Pampa	258	398	1,143	1,120	547	**3,466**
Pantanal	14,167	23,563	28,865	27,450	46,416	**140,461**
Total	**484,224**	**687,350**	**723,861**	**728,044**	**1,114,626**	**3,738,106**
Total Area Alerts	**1,220,236**	**1,639,730**	**1,798,978**	**2,069,695**	**1,829,597**	**8,558,237**
% of Area	**40%**	**42%**	**40%**	**35%**	**61%**	**44%**

Table 46 AREA (HA) OF THE 2023 ALERTS IN EACH CATEGORY OF AREA REGISTERED WITH SNCI AND SIGEF (INCRA)

Biome	Private - SIGEF	Private - SNCI	Total	Total Alerts in Brazil in 2023	SIGEF + Private SNCI
Amazon	104,601	23,607	**128,208**	454,271	28%
Caatinga	76,413	7,160	**83,573**	201,687	41%
Cerrado	754,641	96,297	**850,938**	1,110,326	77%
Atlantic Forest	4,802	142	**4,944**	12,094	41%
Pampa	537	10	**547**	1,547	35%
Pantanal	34,136	12,280	**46,416**	49,673	93%
Grand total	**975,130**	**139,497**	**1,114,626**	**1,829,597**	**61%**

3.4.7 | Deforestation in areas in the Rural Environmental Registry (CAR)

To quantify deforestation in rural properties, the database of alerts validated and published from 2019 to 2023 was cross-referenced with the database of rural properties registered in the Rural Environmental Registry, considering a minimum deforested area of 0.3 hectare (SICAR/SFB, March 2024).

From 2019 to 2023, 339,983 properties experienced deforestation, which represents 4.6% of rural properties registered in the CAR. (Table 47).

In 2023, of the total of 7,458,201 properties registered in the CAR, deforestation with total or partial overlap was detected in 71,689 properties (0.96% of the total properties in the CAR). The Amazon biome has the highest concentration of properties in CAR with deforestation (36.7%), totaling 26,304 (Table 47 and Figure 33).

Of the properties registered in the CAR with deforestation validated in 2023, 30,883 (43.1%) were repeat offenders, that is, they had already had deforestation records in previous years. And 4.6% had recorded deforestation in all of the last five years (Table 48 and Figure 32).

Table 47 NUMBER OF RURAL PROPERTIES WITH DEFORESTATION ALERT BY BIOME AND IN BRAZIL FROM 2019 TO 2023, WITH A MINIMUM DEFORESTED AREA OF 0.3 HA.

Amount	2019	2020	2021	2022	2023	% of 2023	Total
Amazon	39,198	49,868	48,931	40,343	26,304	**36.7%**	**204,644**
Caatinga	487	5,000	9,335	12,318	16,557	**23.1%**	**43,697**
Cerrado	6,971	26,063	6,840	5,842	24,959	**34.8%**	**70,675**
Atlantic Forest	1,189	2,701	4,532	7,055	3,275	**4.6%**	**18,752**
Pampa	59	97	147	387	290	**0.4%**	**980**
Pantanal	191	200	286	254	304	**0.4%**	**1,235**
Total	**48,095**	**83,929**	**70,071**	**66,199**	**71,689**	**100.0%**	**339,983**
Total properties registered in CAR				**7,458,201**			
% of properties in CAR with deforestation	**0.64%**	**1.13%**	**0.94%**	**0.89%**	**0.96%**		**4.6%**

*in March 2024

6 | To generate reports on the MapBiomas Alerta platform, a minimum overlapping area of 0.1 ha is considered between the alert and the property registered in the CAR. For the analysis of this report, the minimum area of 0.3 ha is used for this intersection.

Table 48 RECURRENCE OF DEFORESTATION IN PROPERTIES REGISTERED IN CAR WITH DEFORESTATION DETECTED IN BRAZIL IN 2023 (MINIMUM DEFORESTATION AREA OF 0.3 HA)

Number of years of recidivism between 2019 and 2023	2 years	3 years	4 years	5 years	Total
Number of CAR properties with deforestation	16,710	7,046	3,806	3,321	30,883
Proportion of properties with deforestation in 2023	23.3%	9.8%	5.3%	4.6%	43.1%

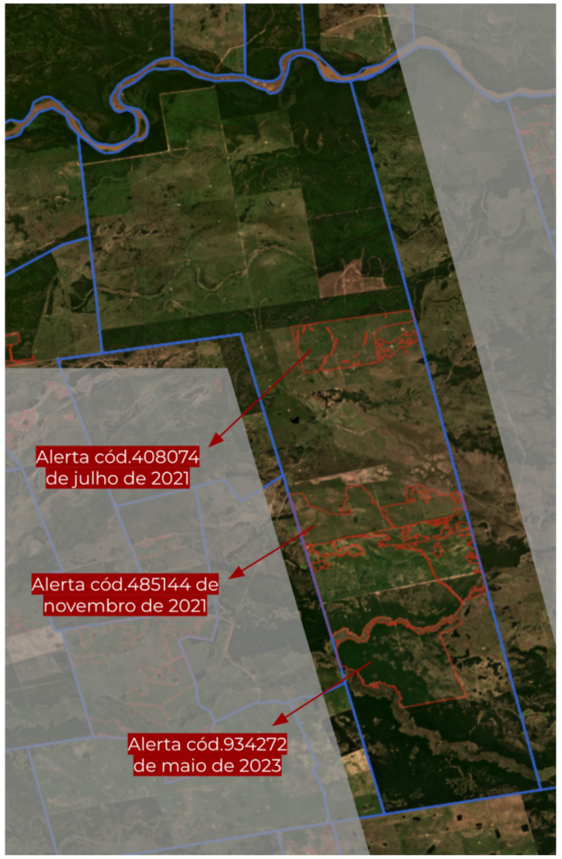


Figure 32 Example of a rural property registered in the CAR that is a repeat offender, with alerts in 2021 and 2023, in the Pantanal.

Although 0.96% of properties registered in the CAR have a record of deforestation in 2023 in Brazil, they accounted for 86% of the country's alerts – of the total of 83,353 alerts validated in 2023, 71,689 overlap totally or partially with areas with CAR.

The deforestation area that fully overlaps with areas registered in the CAR reached 1,630,440 hectares, which represents 89.1% of the entire deforested area in the country in 2023. When considering the area of alerts that also partially intersect with the CAR, this number rises to 1,748,719 hectares, or 95.6% of the deforested area in Brazil. The Pantanal and Cerrado are the biomes that presented the highest proportion of the total area of alerts that fully or partially intersect with CAR (99.9% and 98.2%, respectively) (Table 49).

Table 49 ALERTS WITH TOTAL OR PARTIAL OVERLAP (MINIMUM 0.3 HA) WITH AREAS REGISTERED IN THE RURAL ENVIRONMENTAL REGISTRY (CAR) BY BIOME AND IN BRAZIL IN 2023

Biome	Number of Alerts that intersect with CAR	Deforestation area that intersects with CAR	Total area of alerts that fully or partially intersect with the CAR	Proportion of the total deforestation area that intersects with CAR areas	Proportion of the total area of alerts that fully or partially intersect with CAR
Amazon	26,304	367,817	408,368	81.0%	89.9%
Caatinga	16,557	163,561	187,723	81.1%	93.1%
Cerrado	24,959	1,038,499	1,090,396	93.5%	98.2%
Atlantic Forest	3,275	9,705	11,147	80.2%	92.2%
Pampa	290	1,274	1,464	82.3%	94.6%
Pantanal	304	49,584	49,622	99.8%	99.9%
Total	71,689	1,630,440	1,748,719	**89.1%**	**95.6%**

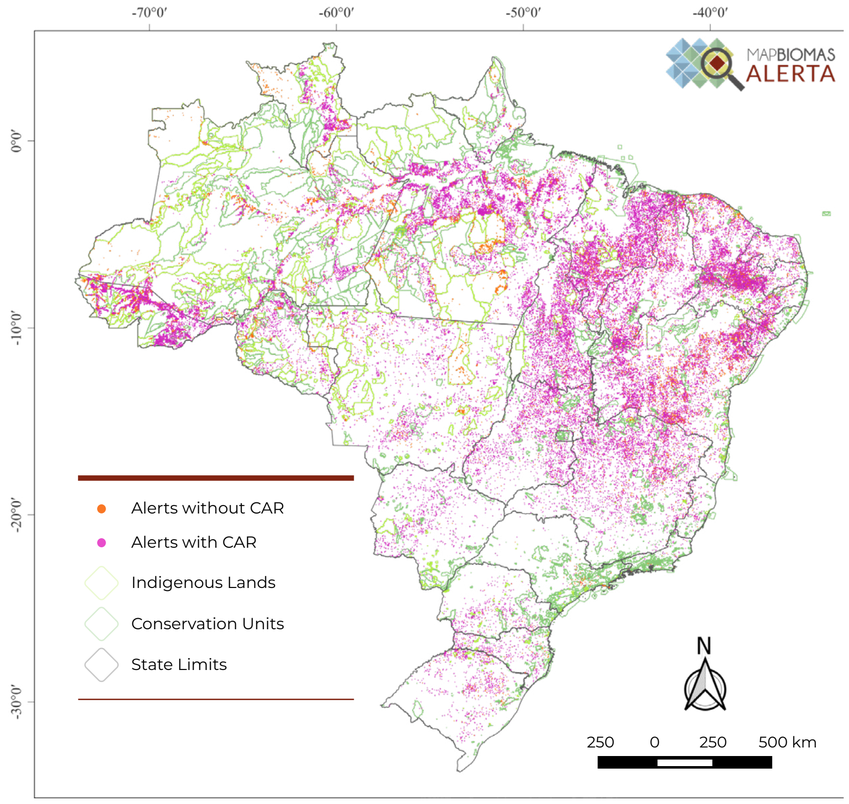


Figure 33 Deforestation alerts that intersect with CAR in Brazil in 2023

3.4.8 | Deforestation in undesignated Public Forests

By cross-referencing deforestation alerts with the database of non-designated Public Forests (Type B) (MMA, 2022), it is observed that the country lost 525,568 ha of native vegetation in these areas in the last five years. Deforestation growth can be observed in these areas each year, despite the decrease in the number of deforestation events. Comparing 2022 and 2023, there is an increase of 14.8% in the deforested area (Table 50 and Figure 34).

Table 50 DEFORESTED AREA (HA) WITHIN NON-DESIGNATED PUBLIC FORESTS FROM 2019 TO 2023

Year	Number of Alerts	Deforested Area (ha)	% of deforested area in Public Forest
2019	13,574	37,044	0.06%
2020	19,081	48,316	0.08%
2021	19,177	69,062	0.11%
2022	18,190	172,801	0.27%
2023	13,358	198,345	0.31%
TOTAL 2019-2023	**83,380**	**525,568**	**0.83**

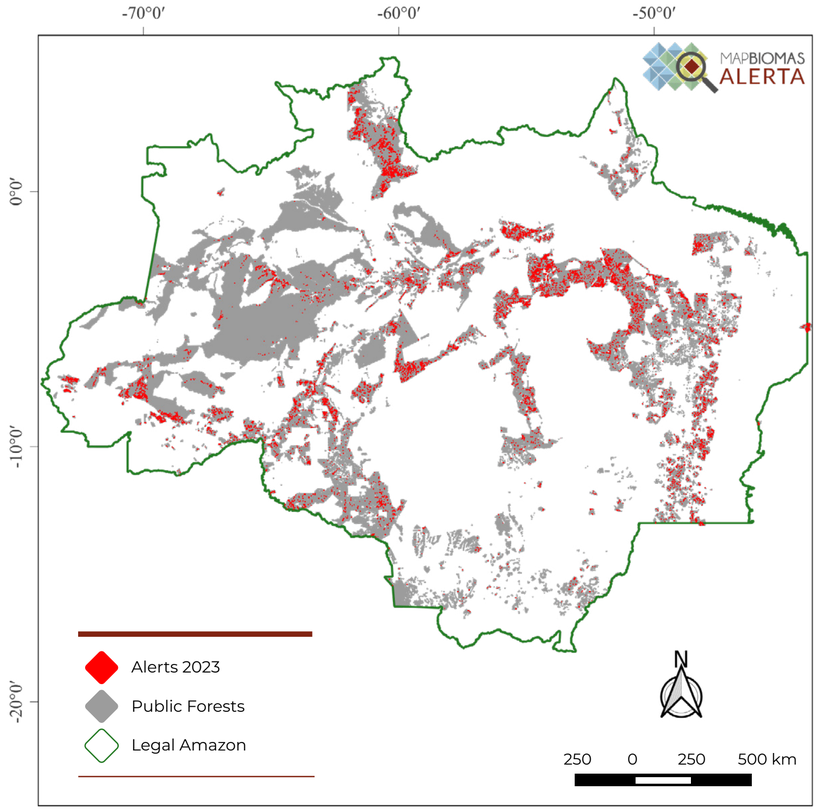


Figure 34 Area deforested in 2023 within Public Forests in the Legal Amazon (MMA, 2023).

3.4.9 | Deforestation by land category

The analysis of this session was carried out by cross-referencing data from deforestation alerts with Brazil's land matrix matrix (2024), produced by a collaboration between the ESALQ/USP Public Policy Group, CITE and Imaflora[7].

In 2023, 67.4% of all deforestation occurred in private areas (which occupy 33.5% of the national territory) and 9% in public lands (which represent 20.4% of the national territory and include Indigenous Lands, public land and military areas).

When only areas without georeferenced land registration but with self-declared CAR registration are considered, they represent 18% of the national territory and account for 13.1% of all deforestation in the country in 2023. In the Pampa biome, these areas account for 47. 1% of deforestation, and in the Atlantic Forest, it accounts for 38.8%.

7 | GPP (ESALQ/USP), IMAFLORA and CITE, 2024. Technical note: Matricial land network of Brazil – Piracicaba, SP, Brazil. Access: https://cartasdaterra.com.br/

Table 51 PERCENTAGE OF LAND CATEGORY FOR BIOME AREA AND DEFORESTED AREA (HA) FOR 2023 IN BRAZIL

	Amazon		Caatinga		Cerrado		Atlantic Forest		Pampa		Pantanal		Brazil	
	Land Categories	Total Biome	Alert 2023	Total Biome	Alert 2023	Total Biome	Alert 2023	Total Biome	Alert 2023	Total Biome	Alert 2023	Total Biome	Alert 2023	Total Brazil
Land under the SNUC regime (Dom. pub ., priv. or priv.-collectivo)	**22.6%**	**5.5%**	**5.9%**	**2.7%**	**3.2%**	**0.7%**	**6.1%**	**2.6%**	**1.8%**	**0.7%**	**1.1%**		**13.4%**	**2.1%**
Full Protection Conservation Unit (UCPI)	8.0%	1.2%	1.5%		1.1%		1.5%	0.5%	0.3%		0.9%		4.6%	0.3%
Sustainable Use Conservation Unit (UCUS)	11.6%	2.4%	0.1%		0.1%		0.1%		0.0%		0.1%		5.8%	0.6%
APA Conservation Unit (UCUS-APA)	2.6%	2.0%	4.2%	2.7%	1.9%	0.6%	4.0%	2.0%	1.4%	0.7%	0.0%		2.7%	1.2%
Overlap between lands under the SNUC regime	0.5%		0.1%		0.1%		0.5%		0.0%		0.0%		0.3%	0.0%
Public Lands	**38.0%**	**30.7%**	**1.1%**	**0.7%**	**5.6%**	**2.1%**	**0.6%**	**0.4%**	**0.6%**	**0.3%**	**3.6%**	**0.1%**	**20.4%**	**9.0%**
Declared Indigenous Land	22.4%	2.6%	0.3%	0.1%	3.8%	0.1%	0.3%	0.3%	0.0%		2.6%		12.1%	0.7%
Undeclared Indigenous Land	0.2%	0.1%	0.1%		0.1%	0.1%	0.1%	0.1%	0.0%		0.0%		0.1%	0.1%
Public Land	14.8%	27.9%	0.7%	0.6%	1.6%	1.9%	0.1%		0.2%	0.3%	1.0%	0.1%	7.8%	8.1%
Military Area	0.6%		0.0%		0.1%		0.0%		0.4%		0.0%		0.3%	0.0%
Private Lands (Individual or Collective Domain)	**22.1%**	**47.0%**	**23.5%**	**43.2%**	**59.6%**	**79.0%**	**30.9%**	**40.7%**	**39.1%**	**35.4%**	**77.0%**	**98.9%**	**33.5%**	**67.4%**
Private Rural Property	15.1%	28.0%	18.8%	40.0%	56.6%	76.7%	29.6%	39.4%	38.1%	34.5%	76.4%	98.6%	28.7%	60.9%
Quilombola territory	0.1%	0.1%	0.4%	0.1%	0.1%		0.1%		0.0%		0.0%		0.14%	0.05%
Settlement	6.5%	18.7%	4.1%	3.0%	2.6%	1.9%	1.1%	1.3%	0.9%	0.8%	0.6%	0.3%	4.4%	6.2%
Overlap between private lands	0.3%	0.2%	0.3%	0.2%	0.2%	0.3%	0.1%		0.0%		0.0%		0.2%	0.3%
Cross-domain overlap zones	**5.1%**	**2.2%**	**2.8%**	**1.9%**	**5.4%**	**4.4%**	**3.4%**	**1.7%**	**1.0%**	**1.1%**	**3.3%**	**0.0%**	**4.6%**	**3.5%**
Public Lands/SNUC Lands	2.5%	0.0%	0.0%		0.3%	0.0%	0.1%		0.0%		0.1%		1.3%	0.0%
Public Lands/Private Lands	0.2%	0.3%	0.0%		0.2%	0.3%	0.1%		0.0%		0.3%		0.2%	0.3%
UCUS APA/Settlement	0.4%	0.2%	0.2%	0.1%	0.2%	0.1%	0.2%		0.0%		0.0%		0.3%	0.1%
UCUS APA/ Private Rural Property	0.6%	0.9%	1.7%	1.7%	3.3%	3.7%	2.4%	1.3%	0.8%	1.1%	0.0%		1.5%	2.7%
Other SNUC Lands/Private Lands	1.4%	0.9%	0.8%	0.0%	1.4%	0.3%	0.7%	0.4%	0.2%		2.9%		1.3%	0.4%
Others (urban areas , water bodies and others)	2.4%	0.1%	2.0%	0.3%	1.2%	0.0%	3.9%	0.2%	10.0%	1.3%	2.5%	0.1%	2.4%	0.1%
Areas Without Land Registration Georeferenced with CAR	7.1%	10.5%	38.0%	35.3%	17.9%	10.3%	41.8%	37.8%	38.8%	47.1%	9.0%	0.8%	18.0%	13.1%
Areas Without Georeferenced Land Registration	2.8%	4.0%	26.7%	15.9%	7.1%	3.4%	13.3%	16.6%	8.7%	14.2%	3.6%	0.1%	7.7%	5.0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5 | Degree of regularity or legality of deforestation

This section presents data on evidence of irregularities related to deforestation events in Brazil in 2023. To this end, we examine the existence of vegetation suppression authorizations and their overlap with areas protected by law (Conservation Units and Lands Indigenous), protected areas within rural properties (Legal Reserve and Permanent Preservation Area), areas under embargo and areas of the Sustainable Forest Management Plan (PMFS).

3.5.1 | Deforestation in Legal Reserves and Permanent Preservation Areas

Legal Reserve Areas (RL) and Permanent Preservation Areas (APP) cannot be subjected to deforestation except under very specific and authorized conditions. Thus, the overlap of deforestation with Legal Reserve and APP is a strong indication of irregularity. Therefore, this is one of the criteria used to assess the degree of illegality of deforestation in Brazil. A spatial cross-referencing was carried out between the validated alerts from 2019 to 2023 and the RL and APPs base available in SICAR (SFB, March/2024), considering a minimum cross-referencing of 0.3 hectare.

In the last five years, Brazil lost 1,215,096 ha of native vegetation within Legal Reserves declared in the CAR. This corresponds to 14.2% of the entire deforested area in the country in this period (Table 52).

In 2023, there were 27,627 alerts superimposed on the Legal Reserve. This means that 33.1% of alerts validated for the year overlap with RL. In terms of area, 250,414 hectares overlapped with RL, which represents 13.7% of the total deforested area in 2023 (Table 52).

The Cerrado was the biome with the greatest increase in deforested area within Legal Reserves in 2023, when compared to the previous year. There was a 136% increase, totaling 136,368 ha of loss of native vegetation in RLs of the biome in one year (Table 52).

Table 52 NUMBER OF ALERTS AND DEFORESTED AREA (HA) OVERLAPPING WITH **LEGAL RESERVE (RL)** PER BIOME AND IN BRAZIL PER YEAR BETWEEN 2019 AND 2023

Number of alerts in RL:

Biome	2019	2020	2021	2022	2023	Total
Amazon	13,766	17,054	17,740	14,686	9,327	**72,573**
Caatinga	148	1,407	2,563	3,663	5,244	**13,025**
Cerrado	3,169	10,198	3,308	2,825	11,734	**31,234**
Atlantic Forest	427	1,035	1,626	2,280	1,131	**6,499**
Pampa	23	33	57	163	104	**380**
Pantanal	67	56	71	85	87	**366**
Total	**17,600**	**29,783**	**25,365**	**23,702**	**27,627**	**124,077**
Total Alerts	**56,511**	**98,987**	**81,641**	**76,667**	**83,353**	**397,162**
% of alerts in RL	**31.1%**	**30.1%**	**31.1%**	**30.9%**	**33.1%**	**31.2%**

Deforested area (ha) in RL

Biome	2019	2020	2021	2022	2023	Total	Variation 2022-2023
Amazon	128,440	144,017	187,022	217,485	85,672	**762,636**	**-61%**
Caatinga	1,111	6,236	14,579	15,018	24,110	**61,055**	**61%**
Cerrado	38,271	78,270	56,824	57,727	136,368	**367,461**	**136%**
Atlantic Forest	1,766	3,443	4,728	4,774	2,272	**16,984**	**-52%**
Pampa	48	101	187	439	226	**1,000**	**-49%**
Pantanal	728	702	539	2,225	1,767	**5,961**	**-21%**
Total deforested area in RL	**170,363**	**232,770**	**263,880**	**297,670**	**250,414**	**1,215,096**	**-16%**
Grand total	**1,220,236**	**1,639,730**	**1,798,978**	**2,069,695**	**1,829,597**	**8,558,237**	
% of deforested area in RL	**14.0%**	**14.2%**	**14.7%**	**14.4%**	**13.7%**	**14.2%**	

Permanent Preservation Areas (APPs) are self-declared by land owners and are underestimated. Even so, in 2023, there were 2,203 overlapping alerts (2.6% of the total) with at least 0.3 hectares cross-referencing APPs. In terms of area, the overlap was 5,338 hectares, or 0.29% of the total deforested in the country (Table 53).

In Brazil, Cerrado, Caatinga and Pantanal, there was an increase in the deforested area in APPs in 2023 compared to 2022 (Table 53).

Table 53 ALERTS AND DEFORESTED AREA (HA) OVERLAPPED WITH **PERMANENT PRESERVATION AREA (APP)** BY BIOME AND IN BRAZIL BY YEAR BETWEEN 2019 AND 2023

Number of alerts in APP:

Biome	2019	2020	2021	2022	2023	Total
Amazon	1,015	1,160	1,299	1,219	557	**5,250**
Caatinga	16	115	203	265	464	**1,063**
Cerrado	300	747	288	278	1,117	**2,730**
Atlantic Forest	40	65	80	99	39	**323**
Pampa	2	2	15	13	9	**41**
Pantanal	13	10	21	11	17	**72**
Total	**1,386**	**2,099**	**1,906**	**1,885**	**2,203**	**9,479**
Total Validated Alerts per Year	**56,511**	**98,987**	**81,641**	**7,667**	**83,353**	**397,162**
% of Alerts that play RL	**2.5%**	**2.1%**	**2.3%**	**24.6%**	**2.6%**	**2.4%**

Deforested area (ha) in APP:

Biome	2019	2020	2021	2022	2023	Total	Variation 2022-2023
Amazon	1,589	1,713	2,109	2,466	885	**8,762**	**-64%**
Caatinga	33	207	332	350	754	**1,676**	**115%**
Cerrado	695	1,513	1,027	1,357	3,415	**8,008**	**152%**
Atlantic Forest	80	77	82	182	50	**471**	**-73%**
Pampa	1	2	11	14	9	**38**	**-31%**
Pantanal	31	46	105	16	29	**226**	**81%**
Total	**2,535**	**3,751**	**3,820**	**4,530**	**5,338**	**19,974**	**18%**
Grand total	**1,220,236**	**1,639,730**	**1,798,978**	**2,069,695**	**1,829,597**	**8,558,237**	
% of Alerts that play APP	**0.21%**	**0.23%**	**0.2'%**	**0.22%**	**0.29%**	**0.23%**	

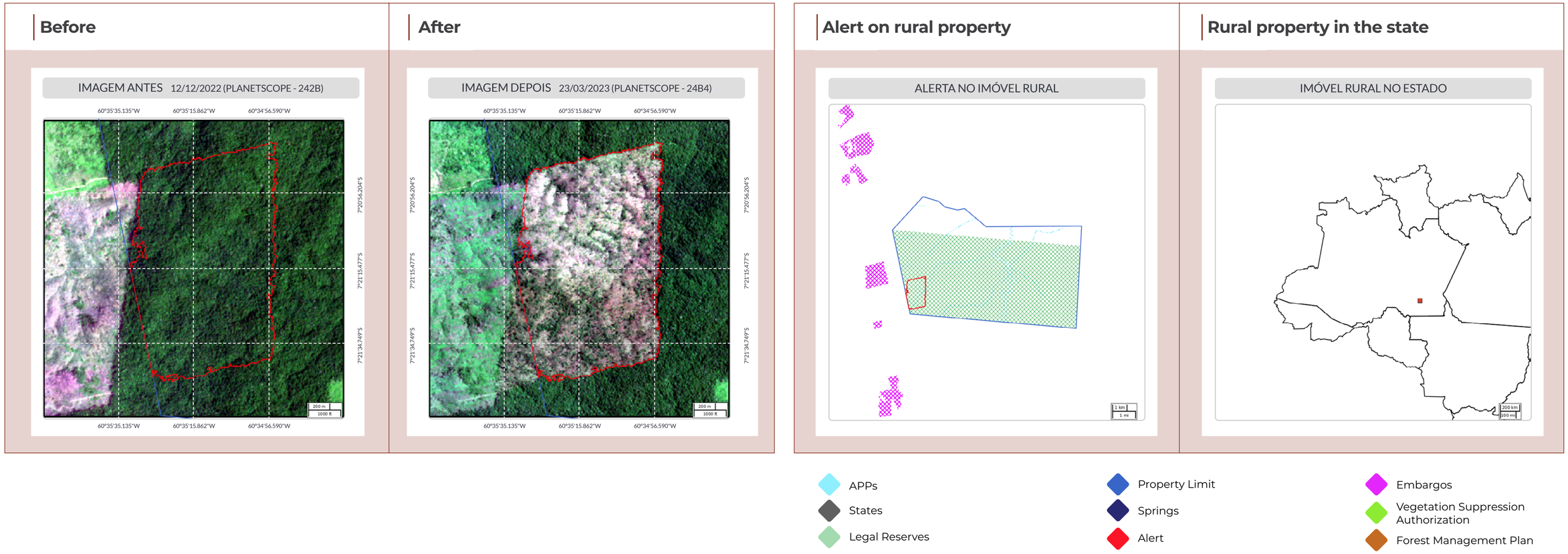


Figure 35 Example of deforestation alert with overlapping Legal Reserve and Permanent Preservation Area in 2023 (alert code 877828, in the municipality of Apuí/AM).

3.5.2 | Deforestation in embargoed areas

IBAMA and ICMBio embargo databases, complemented with databases from the states of **Ceará, Goiás, Mato Grosso, Pará and Rio Grande do Sul**. We emphasize that this analysis differs from the analysis carried out in previous years due to two factors. Firstly, until last year, the spatial cross-referencing was carried out with rural properties that contain embargoed areas, and this year the cross-referencing carried out was between alerts and embargoed areas. Furthermore, new databases were integrated (ICMBio and some states).

23,731 validated alerts were identified that overlap embargoed areas in Brazil from 2019 to 2023, totaling 1,679,948 ha. **This means that 19.6% of the entire area deforested in the country in the last five years corresponds spatially to embargoed areas.** For 2023, there were 2,550 deforestation events overlapping with an embargoed area, resulting in an overlapping area of 162,644 ha (Table 54 and 55).

The Amazon stands out for having 7.9% of alerts from 2019 to 2023 overlapping with embargoed areas, which corresponds to 31.5% of the deforested area in the biome overlapping with embargoed areas in the five-year period. The Cerrado has 3.4% of alerts overlapping embargoed areas, resulting in 7.4% of the deforested area with embargoes. (Table 54 and 55).

Table 54 NUMBER OF ALERTS AND DEFORESTED AREA (HA) WITH TOTAL OR PARTIAL OVERLAP WITH EMBARGOED AREA BY BIOME AND IN BRAZIL FROM 2019 TO 2023*

	Number of Alerts with embargo detected from 2019 to 2023					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	3,927	4,476	5,050	4,493	1,582	**19,528**
Caatinga	10	64	130	176	98	**478**
Cerrado	470	724	339	294	798	**2,625**
Atlantic Forest	106	177	328	276	53	**940**
Pampa	15	20	25	12		**72**
Pantanal	18	15	18	18	19	**88**
Total	**4,546**	**5,476**	**5,890**	**5,269**	**2,550**	**23,731**

	Alerts Area with embargo detected from 2019 to 2023					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	226,188	265,997	378,021	432,275	92,849	**1,395,330**
Caatinga	1,816	1,416	7,030	5,226	6,642	**22,130**
Cerrado	42,032	45,842	37,977	61,384	59,291	**246,527**
Atlantic Forest	954	1,903	2,841	1,694	243	**7,635**
Pampa	231	265	199	59		**753**
Pantanal	970	583	830	1,572	3,618	**7,573**
Total	**272,192**	**316,006**	**426,898**	**502,209**	**162,644**	**1,679,948**

*The numbers of alerts with embargoes and overlapping areas are greater than those observed in the previous report for the period from 2019 to 2022, which may result from increased law enforcement, greater transparency in environmental law enforcement data, and the integration of new bases of data or updates to the methodology described in this item.

Table 55 PERCENTAGE OF ALERTS AND DEFORESTED AREA WITH TOTAL OR PARTIAL OVERLAP WITH EMBARGOED AREA BY BIOME AND IN BRAZIL FROM 2019 TO 2023 IN RELATION TO TOTAL ALERTS AND DEFORESTED AREAS

	Number of Alerts with embargo detected from 2019 to 2023					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	8.4%	7.3%	8.7%	9.4%	4.7%	7.9%
Caatinga	1.9%	1.1%	1.2%	1.3%	0.5%	1.0%
Cerrado	6.4%	2.5%	4.6%	4.7%	3.0%	3.4%
Atlantic Forest	7.7%	5.8%	6.4%	3.5%	1.4%	4.5%
Pampa	22.7%	19.0%	15.6%	2.8%	0.0%	6.7%
Pantanal	8.9%	7.2%	6.2%	6.7%	6.1%	6.8%
Total	**8.0%**	**5.5%**	**7.2%**	**6.9%**	**3.1%**	**6.0%**

	Alerts Area with embargo detected from 2019 to 2023					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	29.3%	30.1%	34.0%	35.9%	20.4%	31.5%
Caatinga	13.0%	2.1%	6.1%	3.7%	3.3%	4.1%
Cerrado	10.4%	7.2%	7.5%	9.3%	5.3%	7.4%
Atlantic Forest	9.1%	7.9%	9.4%	5.7%	2.0%	7.2%
Pampa	36.9%	20.8%	8.2%	1.9%	0.0%	8.4%
Pantanal	6.0%	2.2%	2.8%	5.0%	7.3%	4.9%
Total	**22.3%**	**19.3%**	**23.7%**	**24.3%**	**8.9%**	**19.6%**

3.5.3 | Deforestation in areas with a Forest Management Plan

Areas with a Sustainable Forest Management Plan (PMFS) are licensed to practice selective forestry, with clear cutting and land use conversion being prohibited at least until the management cycle is completed (except in the Caatinga). For the Amazon, this cycle can be 25 to 40 years.

In the Amazon, any deforestation in areas with a Forest Management Plan constitutes a strong indication of illegality. The exception would be in areas of branch lines and log storage yards which, in general, are temporary openings and reduced in area.

In the Caatinga, forest management is characterized by clear cutting in strips, which then need to go through a recovery cycle lasting 10 to 15 years. This is due to the characteristic of the biome's native vegetation with tree species that resprout after cutting. Thus, the existence of clear cutting (detected as deforestation) in PMFS areas in the Caatinga may correspond to authorized suppression. 97 deforestation events of 0.3 hectares or more were identified (0.1% of total alerts) overlapping with areas with a Sustainable Forest Management Plan in Brazil in 2023. This represents a reduction of 53.8% compared to 2022 (with 210 alerts). The overlapping area with PMFS increased from 2,703 ha in 2022 to 1,422 ha in 2023 (Table 51). It is in the Amazon that 78.4% (76) of alerts overlap with PMFS. In the Caatinga, 21 alerts were identified in PMFS areas, totaling 195 ha. In the other biomes, no alerts were identified in PMFS areas (Table 56).

Table 56 ALERTS AND DEFORESTED AREA (HA) OVERLAPPING 0.3 HA OR MORE WITH SUSTAINABLE FOREST MANAGEMENT PLAN (PMFS) AREAS BY BIOME AND IN BRAZIL FROM 2019 TO 2023

Number of alerts:

Biome	2019	2020	2021	2022	2023	Total
Amazon	137	161	166	194	76	734
Caatinga	2	11	35	15	21	84
Cerrado		5		1		6
Atlantic Forest						
Pampa						
Pantanal						
Total alerts overlapped with PMFS	**139**	**177**	**201**	**210**	**97**	**824**
Total Validated Alerts per Year	**56,511**	**98,987**	**81,641**	**7,667**	**83,353**	**397,162**
% of Alerts overlapped with PMFS	**0.2%**	**0.2%**	**0.2%**	**2.7%**	**0.1%**	**0.2%**

Deforested area (ha) in PMFS:

Biome	2019	2020	2021	2022	2023	Total	Variation 2022-2023
Amazon	272	559	1,418	2,575	1,226	**6,051**	**-52%**
Caatinga	45	117	460	124	195	**941**	**58%**
Cerrado		154		3		**157**	**-100%**
Atlantic Forest							
Pampa							
Pantanal							
Total Area (ha) overlapping PMFS	**317**	**829**	**1,878**	**2,703**	**1,422**	**7,149**	**-47%**
Grand total	**1,220,236**	**1,639,730**	**1,798,978**	**2,069,695**	**1,829,597**	**8,558,237**	
% of Area (ha) overlapping with PMFS	**0.0%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	

3.5.4 | Deforestation with Vegetation Suppression Authorizations

Deforestation is an intervention with a high environmental impact and, in Brazil, it must be preceded by a Vegetation Suppression Authorization (ASV) or Alternative Land Use (UAS) in order to be carried out. Authorization, as a rule, is issued by state environmental agencies (OEMAs) and IBAMA, in cases where it involves federal public areas or projects that involve two or more states.

Since 2018, authorizations given by states must be issued or registered in the National System for Control of the Origin of Forest Products (SINAFLOR/IBAMA, 2024). Even though all states are connected to SINAFLOR, there are different levels of integration, and it is notable that the databases are not always updated, so there may be authorizations that are not included in the national system. Therefore, the data was complemented through direct consultation with **with state databases that we already have access to in the following states: Ceará, Espírito Santo, Goiás, Minas Gerais, Mato Grosso, Pará and Rio Grande do Sul**. But, in principle, SINAFLOR is the system consulted to check the existence of authorization in places where there has been a warning of detected deforestation.

The following analysis is only about the existence of authorization in the area where the alert was detected – with overlapping of the deforested area with the authorized area. It is not verified whether the authorization is regular or whether it has been complied with in all its parameters (e.g., expiry date, location). By authorization, we are considering ASV (Vegetation Suppression Authorization), and UAS (Alternative Land Use).

In 2023, 3,573 alerts were identified, totaling 490,038 ha deforested, overlapping with any authorization registered in SINAFLOR or in the state systems consulted. **This means that, 4.3% of alerts and 26.8% of the deforested area in the country in 2023 intersect with authorizations on the analyzed bases** (Tables 57 and 58).

In 2023, the Cerrado biome presented the highest number of alerts (2,753) that overlap with authorizations. The same biome also contains the largest deforested area with authorization, totaling 417,961 ha, which is equivalent to 37.6% of the deforested area in the biome. In second place is the Amazon, with 2,028 alerts and 57,029 ha deforested with registered authorizations, representing 12.6% of the deforested area in the biome (Tables 57 and 58).

Table 57 NUMBER OF ALERTS AND DEFORESTED AREA (HA) THAT OVERLAPS WITH AUTHORIZED AREAS BY BIOME AND IN BRAZIL IN 2019 AND 2023*, **

	Number of Alerts that cross Authorizations						Alerts area that overlaps with Authorizations					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	262	334	454	490	488	**2,028**	23,045	38,661	44,723	70,746	57,029	**234,206**
Caatinga	6	58	159	161	182	**566**	1,517	6,316	10,391	10,901	13,120	**42,245**
Cerrado	450	831	606	740	2,753	**5,380**	76,236	161,424	158,211	247,836	417,961	**1,061,669**
Atlantic Forest	17	70	123	218	141	**569**	140	657	1,282	1,092	784	**3,955**
Pampa	5	5	12	15	4	**41**	35	119	305	86	11	**555**
Pantanal	1	1	2	3	5	**12**	5	40	168	104	1,132	**1,449**
Total	**741**	**1,299**	**1,356**	**1,627**	**3,573**	**8,596**	**100,977**	**207,218**	**215,080**	**330,765**	**490,038**	**1,344,078**

* authorizations that have a CAR code were used.
** does not mean that the entire alert area is within the authorized area.

Table 58 PROPORTION OF ALERTS AND DEFORESTED AREA THAT OVERLAP WITH AUTHORIZED AREAS BY BIOME AND IN BRAZIL BETWEEN 2019 AND 2023

	Number of Alerts that cross Authorizations						Alerts area that overlaps with Authorizations					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	0.6%	0.5%	0.8%	1.0%	1.5%	0.8%	3.0%	4.4%	4.0%	5.9%	12.6%	5.3%
Caatinga	1.1%	1.0%	1.5%	1.2%	1.0%	1.1%	10.9%	9.4%	9.0%	7.8%	6.5%	7.8%
Cerrado	6.1%	2.9%	8.3%	11.8%	10.2%	7.0%	18.8%	25.3%	31.1%	37.4%	37.6%	31.9%
Atlantic Forest	1.2%	2.3%	2.4%	2.8%	3.8%	2.7%	1.3%	2.7%	4.3%	3.7%	6.5%	3.7%
Pampa	7.6%	4.8%	7.5%	3.5%	1.3%	3.8%	5.5%	9.4%	12.6%	2.7%	0.7%	6.2%
Pantanal	0.5%	0.5%	0.7%	1.1%	1.6%	0.9%	0.0%	0.2%	0.6%	0.3%	2.3%	0.9%
Total	**1.3%**	**1.3%**	**1.7%**	**2.1%**	**4.3%**	**2.2%**	**8.3%**	**12.6%**	**12.0%**	**16.0%**	**26.8%**	**15.7%**

Box 7 AUTHORIZATIONS REPORTED BY USERS

On the MapBiomas Alerta data platform, there is a public tool for voluntary reporting of authorization for the suppression of native vegetation. Any user registered on the platform can request the publication of an authorization in the alert report with the rural property of interest. To do this, the user must accept the terms of responsibility for the information they are reporting, including the publication of personal data. MapBiomas does not carry out any analysis of the veracity or regularity of the information and/or documents reported by users. The documents are available in the public alert reports in the "information reported by user" section. The inclusion of an authorization does not result in the cancellation of the alert on the MapBiomas Alerta platform.

572 voluntary cases of authorizations received on the MapBiomas Alerta platform were reported between 2019 and 2023 (Table 59).

Table 59 NUMBER OF CASES OF VOLUNTARY REPORTING OF AUTHORIZATIONS RECEIVED ON THE MAPBIOMAS ALERTA PLATFORM BY THE YEAR OF DETECTION OF THE LINKED ALERT

BIOME	2019	2020	2021	2022	2023	Grand total
AMAZON	3	3	7	16	7	36
CAATINGA		4	5	9	14	32
CERRADO	82	104	69	88	118	465
ATLANTIC FOREST		5	3	14	6	28
PAMPA		0		3		3
PANTANAL	1	1	2	2	2	8
Total Brazil	**86**	**117**	**86**	**132**	**147**	**572**

3.5.5 | Deforestation without signs of irregularity

To estimate how much of deforestation in Brazil has no signs of irregularity or illegality, each alert is evaluated considering five criteria:

(i) whether there is overlap with areas authorized for the suppression of native vegetation;
(ii) if there is no overlap with areas protected by law (Integral Protection Conservation Units and Indigenous Lands);
(iii) if there is no overlap with protected areas within rural properties (Legal Reserve and Permanent Preservation Area);
(iv) if there is no overlap with areas of Sustainable Forest Management Plans;
(v) if there is no overlap with embargoed areas where deforestation occurred.

If there is no authorization (i) or if there is overlap with any of the territories above (ii av), it is considered that there is evidence of irregularity or illegality.

From 2019 to 2023, 4,069 deforestation events, totaling 345,714 ha, showed no signs of illegality. This means that **4.04% of the entire area deforested in Brazil in the last five years has no signs of illegality or irregularity**, according to the bases available for analysis (Tables 60 and 61).

For the year 2023, 1,668 alerts were identified (2% of the total) with no signs of irregularity or illegality in Brazil, which indicates that almost all alerts had some sign of irregularity, according to the analysis of available databases (Tables 60 and 61).

When observing the area of alerts that do not have signs of irregularities, we have 118,602 ha (6.48% of the total deforested) had no signs of irregularities. In other words, more than 93.5% of the area deforested in Brazil in 2023 had at least one indication of irregularity , according to the criteria presented above. In the Cerrado, 9.23% of the area deforested in 2023 has no evidence of irregularity. (Tables 60 and 61).

Table 60 DEFORESTATION ALERTS WITHOUT SIGNS OF IRREGULARITY OR ILLEGALITY BY BIOME AND IN BRAZIL FROM 2019 TO 2023*

	Alerts without signs of irregularity						Total area of Alerts without signs of irregularity (ha)					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	106	134	170	164	179	753	3,792	5,603	9,243	14,191	9,398	42,228
Caatinga	2	38	116	128	137	421	182	3,464	5,132	7,115	5,668	21,560
Cerrado	217	386	271	291	1,227	2,392	24,067	32,616	55,583	63,406	102,504	278,177
Atlantic Forest	11	56	97	186	119	469	56	475	1,031	794	427	2,783
Pampa	3		8	11	4	26	22		74	42	11	149
Pantanal	1	1	2	2	2	8	5	40	168	11	594	818
Brazil	**340**	**615**	**664**	**782**	**1,668**	**4,069**	**28,123**	**42,196**	**71,231**	**85,559**	**118,602**	**345,714**

Table 61 PROPORTION OF ALERTS AND DEFORESTED AREA WITHOUT SIGNS OF IRREGULARITY OR ILLEGALITY*

	Alerts without signs of irregularity						Total area of Alerts without signs of irregularity (ha)					
Biome	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Amazon	0.23%	0.22%	0.29%	0.34%	0.54%	**0.30%**	0.49%	0.63%	0.83%	1.18%	2.07%	**0.95%**
Caatinga	0.38%	0.67%	1.09%	0.92%	0.73%	**0.85%**	1.31%	5.16%	4.46%	5.06%	2.81%	**4.00%**
Cerrado	2.95%	1.34%	3.70%	4.62%	4.57%	**3.12%**	5.93%	5.12%	10.92%	9.58%	9.23%	**8.37%**
Atlantic Forest	0.80%	1.83%	1.90%	2.37%	3.21%	**2.22%**	0.53%	1.98%	3.42%	2.65%	3.53%	**2.61%**
Pampa	4.55%	0.00%	5.00%	2.59%	1.26%	**2.42%**	3.47%	0.00%	3.06%	1.34%	0.70%	**1.65%**
Pantanal	0.49%	0.48%	0.68%	0.75%	0.64%	**0.62%**	0.03%	0.16%	0.56%	0.04%	1.20%	**0.53%**
Brazil	**0.60%**	**0.62%**	**0.81%**	**1.02%**	**2.00%**	**1.02%**	**2.30%**	**2.57%**	**3.96%**	**4.13%**	**6.48%**	**4.04%**

*indications are characterized by at least one of the following situations: (i) total or partial overlap (>0.3ha) with APP and RL; (ii) total or partial overlap (>0.3ha) with Integral Protection UC or IT; (iii) overlap (>0.3ha) with PMFS areas except in the Caatinga; (iv) absence of vegetation suppression authorization (ASV) and (v) if there is no overlap with embargoed areas.

ACTIONS ON DEFORESTATION

Application of MapBiomas Alert data to control and combat deforestation

In this chapter, we present an analysis of the actions carried out by public and private agents to combat, contain, control or discourage deforestation in Brazil.

The analysis focuses on the actions carried out and authorizations issued corresponding to the deforestation areas validated, refined and published by MapBiomas Alerta between the years 2019 and 2023.

4.1 | Action by public authorities: consolidated data for Brazil on law enforcement actions and authorizations on deforestation

To characterize the actions carried out by state environmental agencies (OEMAs) and federal authorities, for the purposes of this report, sanctions, embargoes and other control and punishment measures are considered as law enforcement actions. The sanction is the administrative procedure/act intended to determine the environmental infraction. The embargo is a penalty, applied by the competent environmental agency, to prevent a degrading activity from continuing in progress or harming the regeneration of the area. In the case of Public Ministries, the main actions are characterized by factual news, public civil actions, criminal actions, inquiries and other procedures.

The analysis also included authorizations for vegetation suppression (ASV) and alternative land use (UAS), among other authorization processes, issued by federal and state agencies, and in this report referred to as authorizations.

4.1.1 | Databases considered in the analysis (federal and state)

Table 4 presents the set of databases of authorizations and law enforcement actions on deforestation made available through active transparency (TA) by the OEMAs and which were consulted for the preparation of this report. Active transparency is considered to be the provision of information by bodies and entities regardless of request and mainly using the internet. Active transparency is essential to give visibility to the efforts and actions of law enforcement bodies to control and combat deforestation, also facilitating supervision by external control bodies, social and market control. Currently, it is possible to access these bases in 17 states (Table 4).

Board 4 GENERAL OVERVIEW OF ACCESS TO DATABASES AVAILABLE ON THE PUBLIC PORTALS OF OEMAS AND FEDERAL AGENCIES.

UF	Information	Base accessed	Format	Access date
BR	asv, uas	Sinaflor, Ibama	shp	05/09/2024
BR	infraction notice	Infraction notices - Ibama	shp	05/09/2024
BR	infraction notice	Infraction notices - Ibama	csv	05/09/2024
BR	embargo	Embargoes - Ibama	shp	05/10/2024
BR	embargo	Embargoes - ICMBio	shp	05/20/2024
AC	asv	Licenses (LP/LI/LAU/LO) granted per year	xlsx	02/10/2024
AC	infraction notice	Infraction notices drawn up by IMAC	xlsx	02/10/2024
AC	embargo	Embargo terms drawn up by IMAC	xlsx	02/10/2024
AM	asv	Single Plant Suppression License	xlsx	02/10/2024
AM	infraction notice	Infraction notices	xlsx	02/10/2024
AM	embargo	Embargo and Interdiction Term	xlsx	02/10/2024
AM	embargo	IPAAM Embargoes	shp	02/10/2024
CE	infraction notice	Infraction notices	shp	02/10/2024
CE	regularization	Environmental Damage Recovery Commitment Term	shp	02/10/2024
CE	embargo	Embargo terms	shp	02/10/2024
DF	oversight	Floristic law enforcement	shp	03/13/2024
ES	oversight	Environmental and forestry law enforcement	shp	02/10/2024
GO	asv	State environmental licenses (polygons)	shp	02/10/2024
GO	asv	State environmental licenses (points)	shp	02/10/2024
GO	asv	State environmental licenses (lines)	shp	02/10/2024
GO	infraction notice	State environmental infractions (polygons)	shp	02/10/2024
GO	infraction notice	State environmental infractions (points)	shp	02/10/2024
GO	embargo	State environmental embargoes (polygons)	shp	02/10/2024
GO	embargo	State environmental embargoes (points)	shp	02/10/2024
GO	remove embargo	State environmental clearances (polygons)	shp	02/10/2024
GO	remove embargo	State environmental clearances (points)	shp	02/10/2024
MT	asv	Deforestation authorization	shp	02/10/2024
MT	infraction notice	Infraction notices	shp	02/10/2024
MT	infraction notice	SIGA infraction notices (polygons)	shp	02/10/2024
MT	infraction notice	SIGA infraction notices (points)	shp	02/10/2024
MT	embargo	SEMA embargoed area	shp	02/10/2024
MT	embargo	SIGA embargoed area (polygons)	shp	02/10/2024
MT	embargo	SIGA embargoed area (points)	shp	02/10/2024
MT	remove embargo	SEMA cleared area	shp	02/10/2024
MT	remove embargo	SIGA cleared area (polygons)	shp	02/10/2024
MT	remove embargo	SIGA cleared area (points)	shp	02/10/2024
MG	asv	Environmental intervention authorizations	shp	02/10/2024
MG	oversight	Activities supervised by SEMAD-MG	shp	02/10/2024
PA	asv	Suppression	shp	02/10/2024
PA	embargo	Deforestation embargoes	shp	02/10/2024
PB	infraction notice	Infraction Notice Report	xlsx	02/10/2024
PI	embargo	Embargoes	xlsx	02/10/2024
PR	embargo	Embargoes	shp	03/21/2024
RS	asv	Native vegetation management authorizations	shp	02/10/2024
RS	infraction notice	Infraction notices	shp	02/10/2024
RS	embargo	Embargoed areas	shp	02/10/2024
RO	asv	Vegetation suppression authorizations	xlsx	02/10/2024
RO	infraction notice	Infraction notices	xlsx	02/10/2024
RO	embargo	Embargo terms	xlsx	02/10/2024
SP	asv	Authorized deletion	shp	02/10/2024
SP	infraction notice	Infraction notices	shp	02/10/2024
SP	embargo	Areas with flora interventions	shp	02/10/2024
TO	infraction notice	Infraction notice	shp	02/10/2024
TO	embargo	Embargo	shp	02/10/2024
RR	asv	Licensed areas	shp	02/10/2024
RR	embargo	Embargoes (Ibama)	shp	02/10/2024

In addition to the data made available in active transparency by public authorities and accessed by the MapBiomas network team, the complementary databases sent by the OEMAs in response to the consultation carried out as part of the preparation of RAD2023 were also considered in the analysis of this report. All state environmental agencies were contacted via email by the MapBiomas team. Twenty-one states responded to the data sharing request. Of these, 17 voluntarily sent public data on authorizations and law enforcement actions corresponding to alerts published by the initiative, using the action reporting tool on the MapBiomas Alerta platform. Two other states did not submit data but recommended accessing the data from their active transparency portals; one state recommended using the federal basis for authorization and a final state sent a spreadsheet in a format that was unusable (Table 5).

Ainda, das 15 bases enviadas pelos Ministérios Públicos estaduais e uma base do MPF, somente os dados do MPES, MPGO, MPPI, MPPR, MPRS, MPTO e MPF foram considerados, visto que os demais não enviaram dados em formato adequado ou com informações suficientes para serem utilizadas nas análises conforme metodologia adotada. Mais informações reportadas pelos MPs estaduais sobre a atuação no combate ao desmatamento podem ser encontradas no Apêndice 9.

Active transparency is considered to be the provision of information by bodies and entities regardless of request and using mainly the internet.

Table 5 SUMMARY OF THE BASES RECEIVED FROM OEMAS AND PUBLIC MINISTRIES VIA THE AUTHORIZATION DATA SUBMISSION TOOL AND LAW ENFORCEMENT ACTIONS IN DATA COLLECTION FOR RAD2023.

UF	RESPONSIBLE BODY	BASES SENT
AC	IMAC	Authorizations + Actions (2023)
AL	MAGNET	Authorizations
AP	SEMA	Suppression authorizations 2018 to 2023
AM	IPAAM	Suppression authorizations from 2020 to 2023 + Areas embargoed between the years 2020 to 2023 + Infringement notices in the metropolitan region of Manaus in 2023 + Areas fined in the south of Amazonas in 2023 and Embargoed areas in the south of Amazonas in 2023
BA	INEMA	Authorizations + Actions
CE	SEMACE	Terms of Embargo 2019 to 2023 + Specific infraction notices (fines and warnings) 2019 to 2023 + law enforcement actions from 2019 to 2023
DF	IBRAM	He recommended using the Sinaflor authorization basis. Did not send other information.
ES	IDAF	Authorizations from 2019 to 2023 + Actions
GO	SEMAD	Authorizations + Actions
MT	SEMA	He recommended accessing the data on the agency's transparency portal.
MG	IEF	Authorizations + Actions from 2020 to 2023
PA	SEMA	Complementary Embargo Base
PB	SUDEMA	Base sent out of format viable for use. Therefore, disregarded.
PR	IAT	Authorizations + Actions
PE	CPRH	Authorizations
PI	SEMARH	Authorizations from 2019 to 2023 + Actions
RJ	INEA	Actions
RN	IDEMA	Authorizations from 2019 to 2023
RS	FEPAM	Authorizations + Actions
SC	MAGNET	Authorizations + Actions from 2019 to 2023
SP	SEMIL	He recommended accessing the agency's transparency portal.
TO	NATURATINS	Authorizations + Actions
AC	MPAC	Sent document that does not meet the request
AP	MPAP	He only sent a letter in PDF, without data suitable for use.
AM	MPAM	He only sent a letter in PDF, without data suitable for use.
ES	MPES	law enforcement actions
GO	MPGO	law enforcement actions
MG	MPMG	You sent a document that does not meet the request.
MS	MPMS	Sent document that does not meet the request
PR	MPPR	law enforcement actions
PE	MPPE	Sent document that does not meet the request
PI	MPPI	law enforcement actions
RS	MPRS	law enforcement actions
RR	MPRR	He only sent a letter in PDF, without data suitable for use.
SC	MPSC	He only sent a letter in PDF, without data suitable for use.
SP	MPSP	You sent a document that does not meet the request.
TO	MPTO	law enforcement actions
BR	MPF	law enforcement actions

Ten states did not make environmental data available on public platforms in the appropriate format for applying the methodology of this report (AL, AP, BA, MA, MS, PE, RJ, RN, SC and SE), when the data collection was carried out. Of these, **in addition to not providing data in the appropriate format, three also did not send databases of authorizations and actions** in response to the consultation carried out to prepare this report. They are: **Maranhão, Mato Grosso do Sul and Sergipe**. For these states, only data available in federal databases (Ibama and ICMBio) were considered. Details about the methodology used to analyze this data are in Appendix 6.

4.1.1.1 | General overview regarding active transparency

MapBiomas has worked with OEMA public bodies, in partnership with civil society organizations, to propose solutions that can be operationalized to improve methods and processes with agility, effectiveness and transparency in actions to combat illegal deforestation. In November 2023, the Guide to Good Practices for Transparency of Government Data on Controlling and Combating Deforestation in Brazil was published - available on the MapBiomas Alerta website[8].

Active transparency of information about authorized deforestation and actions to monitor illegal deforestation are fundamental. The systematization and availability of this data by states is heterogeneous and significantly impacts the potential for analysis, use and integration of this data. In this sense, the transparency of this data and the quality with which this information is made available to society is monitored, considering criteria such as updating (data from the last three months prior to the evaluation date - May/2024), format and georeferencing of the data (Figure 37).

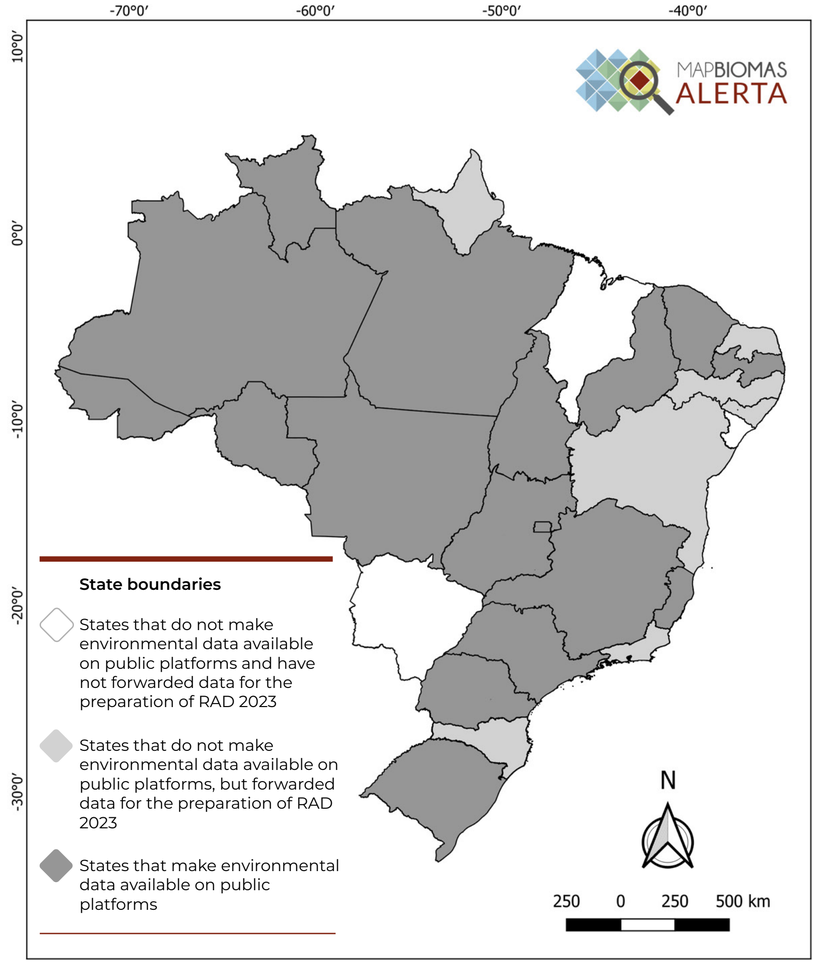
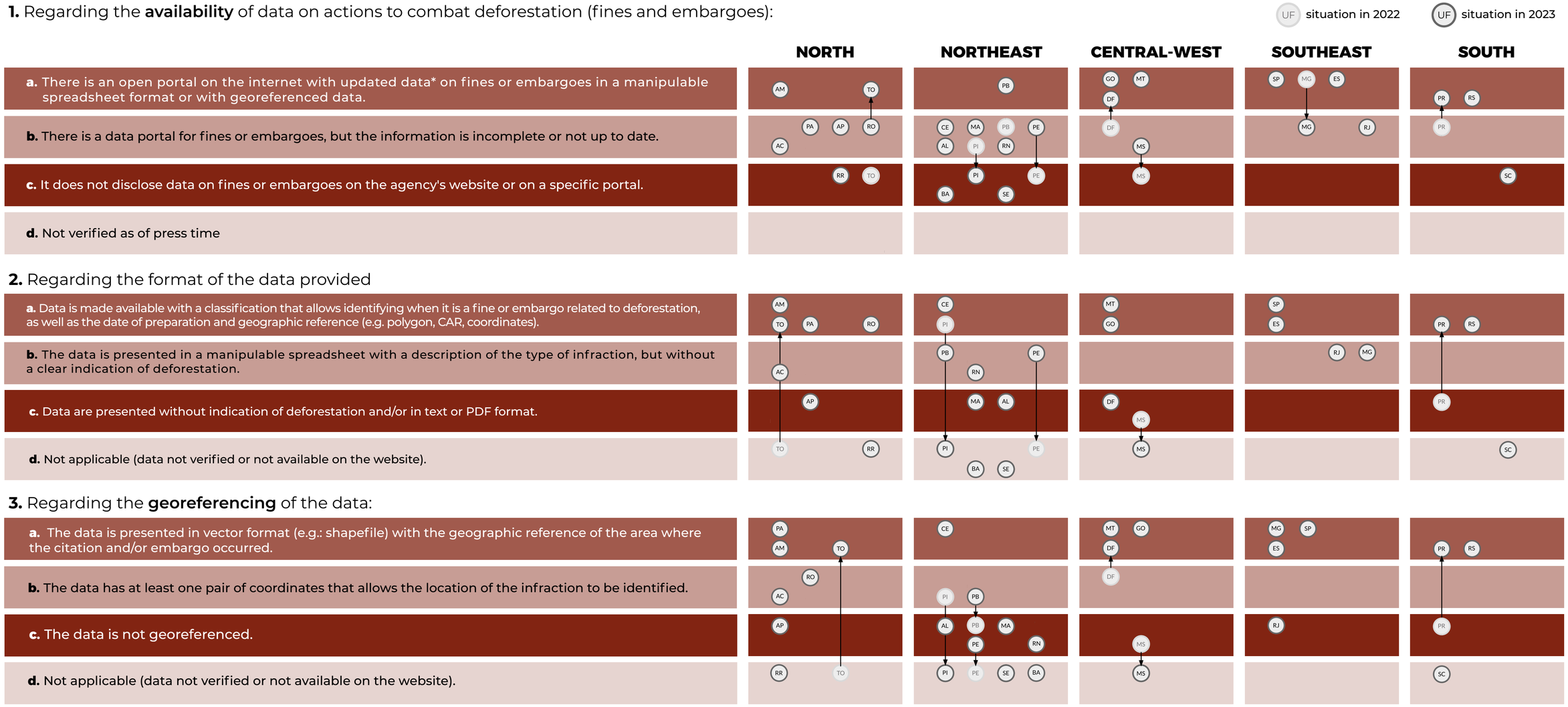


Figure 36 . Map of states classified in terms of access to data related to authorizations and deforestation law enforcement actions.

8 | Access the Guide to Good Practices for Government Data Transparency on Controlling and Combating Deforestation in Brazil at https://alerta.mapbiomas.org/relatorio/

Figure 37 OVERVIEW OF THE AVAILABILITY OF LAW ENFORCEMENT ACTIONS AND EMBARGOES DATA BY STATE AND REGION IN BRAZIL BETWEEN 2023 AND 2024



When compared to the data transparency assessment carried out for the previous RAD, three states **(TO, PB, PR) and the DF stood out in presenting improvements in data availability** - they now have an open internet portal with updated action data law enforcement in a manipulable spreadsheet format or with georeferenced data. On the other hand, three other states (PI, MS and PE) stopped disclosing the information.

Appendix 8 of this report presents a supplement on the classification of data availability and transparency by state reported in Figure 37.

Both authorizations for the suppression of native vegetation or alternative land use, as well as law enforcement actions (embargoes, notices of infraction, etc.) need to be systematized, georeferenced and available to public bodies, financial institutions, private companies and civil society for them to take effect. This responsibility falls mainly on state environmental agencies (OEMAs) due to their responsibilities.

Public institutions need to be able to differentiate between authorized deforestation and what has already been monitored for planning operations. Financial institutions and private companies need access to this data for proper analysis of financing agricultural production and production chains. However, active transparency in the availability of georeferenced data on authorizations and law enforcement actions is not yet a reality for all OEMAs.

Furthermore, the level of quality of the data made available in some cases limits the use and reuse of this information - e.g., information that is incomplete, out of date or without a history that includes previous years; lack of data such as date, reason for fines and embargoes; and data without geographic reference. Other limitations found in the databases when carrying out the survey to prepare this report were: the lack of a data dictionary and other information relevant to users, such as the last data update date; lack of concentration of data on just one page or portal; and technical connection security challenges when accessing state agency websites. The availability of data on environmental infractions and the respective penalties imposed by environmental agencies, as well as vegetation suppression authorizations granted, is provided for in Law No. 10,650/2003. To improve active transparency and access to this information, it is recommended that OEMAs strengthen the improvement of management and maintenance of these databases, ensuring their completeness, updating and availability in an open format, enabling society to use and reuse of public information.

It is important to mention that the quantities of law enforcement actions mentioned here refer to the data that MapBiomas had access to until the publication of this report, and for which it was possible to carry out spatialization, cross referencing and analysis. Therefore, the results may not represent the totality of actions actually carried out by the executing institutions in the federation units across the country.

MapBiomas provides the **Guide to Good Practices for Government Data Transparency on Controlling and Combating Deforestation in Brazil**[9], which contains guidance for bodies responsible for environmental control and law enforcement.

9 | Access the Guide to Good Practices for Government Data Transparency on Controlling and Combating Deforestation in Brazil at https://alerta.mapbiomas.org/relatorio/

4.1.2 | Authorized and supervised deforestation by biome (consolidated federal and state)

In the last five years, **41.7% of the entire deforested area in the country crosses spatially with an authorization or law enforcement action**, considering the federal and state bases included in this analysis. In terms of number of alerts, the percentage of alerts that contain authorization or law enforcement actions drops to 12.5%. This is due to the prioritization of monitoring larger deforestation.

When we analyze how much deforestation was authorized and how much was monitored in each biome, Pampa stands out with the highest percentage of area and number of alerts with authorization or law enforcement actions (55.8% and 43.1% respectively) . On the other hand, the Caatinga and Pantanal had the lowest percentage of authorized or supervised deforestation (3.6% of alerts in the Caatinga and 7.8% of the area in the Pantanal) (Table 62).

Table 62 DEFORESTATION ALERTS IN BIOMES AND IN BRAZIL FROM 2019 TO 2023 THAT INTERSECT WITH AUTHORIZATIONS AND/OR LAW ENFORCEMENT ACTIONS BY FEDERAL AND STATE AGENCIES.

Biome	Area Deforested (ha)	Total area of the alert that crosses with permission or action (ha)	% of area deforeste with authorizat on or action	Alerts (no.)	Alerts Crossed with authorization or action (no.)	% of number of alerts with authorizations or actions
AMAZON	4,425,905.1	1,939,501.8	43.8%	247,470	28,301	11.4%
CAATINGA	538,452.7	78,516.9	14.6%	49,625	1,764	3.6%
CERRADO	3,325,354.3	1,496,617.3	45%	76,586	12,934	16.9%
ATLANTIC FOREST	106,512.8	39,650.3	37.2%	21,123	5,918	28.0%
PAMPA	8,990.9	5,020.3	55.8%	1,073	462	43.1%
PANTANAL	153,021.0	11,873.5	7.8%	1,285	137	10.7%
TOTAL	**8,558,236.7**	**3,571,180.1**	**41.7%**	**397,162**	**49,516**	**12.5%**

4.1.3 | Deforestation authorized and monitored by state

This year, the results are presented differently, in authorizations and law enforcement actions. Considering the data made available by federal and state agencies, 2.2% of the country's deforestation alerts overlapped with authorizations. However , when analyzing the area, 1,344,078 hectares deforested in the last five years spatially intersect with authorizations, which corresponds to 15.7% of the total area deforested in this period (Tables 63 and 64).

When analyzing how much deforestation was monitored, 10.5% of all alerts in the country from 2019 to 2023 correspond to federal or state law enforcement actions. In terms of area, 27.9% of the deforested area overlaps with data from federal and state law enforcement actions (Tables 63 and 64).

The three states with the highest proportion of deforested area with federal or state authorizations were: Bahia (51.8%), Tocantins (47.7%) and Espírito Santo (39.4%). In absolute numbers, 439,376 ha deforested in Bahia in the last five years are subject to authorizations. In Tocantins, there were 281,444 ha (Table 64).

The states that stand out with more than half of the area deforested from 2019 to 2023 with federal and/or state law enforcement actions were: Espírito Santo (90.5%), Paraná (66.3%), Rio de Janeiro (55, 2%), Goiás (54.1%) and Mato Grosso (54%) (Table 64).

Table 63 NUMBER OF DEFORESTATION ALERTS IN THE STATES AND IN BRAZIL FROM 2019 TO 2023 THAT INTERSECT WITH AUTHORIZATIONS AND LAW ENFORCEMENT ACTIONS BY STATE AND/OR FEDERAL BODIES.

UF	Alerts (no.)	Number of alerts cross-referencing with authorization federal or state	% of alerts with authorization federal or state	Number of alerts that intersect with law enforcement action federal (A)	Number of alerts that intersect with Law enforcement action state (B	Number of alerts that cross federal or state law enforcement action (A+B)	% of alerts with federal or state law enforcement action
AC	49,350	254	0.5%	1,576	391	1,917	3.9%
AL	970	9	0.9%	96	0	96	9.9%
AM	40,206	68	0.2%	3,369	1,311	4,290	10.7%
AP	2,038	10	0.5%	52	0	52	2.6%
BA	26,466	1,368	5.2%	252	240	478	1.8%
CE	10,476	83	0.8%	90	154	236	2.3%
DF	62	7	11.3%	0	0	0	0.0%
ES	524	179	34.2%	3	450	450	85.9%
GO	8,771	375	4.3%	158	3,194	3,322	37.9%
MA	29,078	398	1.4%	121	0	121	0.4%
MG	14,590	631	4.3%	188	3,956	4,012	27.5%
MS	3,582	3	0.1%	37	0	37	1.0%
MT	22,851	1,429	6.3%	924	8,572	8,950	39.2%
PA	101,539	270	0.3%	4,876	6,507	10,128	10.0%
PB	4,442	39	0.9%	129	0	129	2.9%
PE	6,540	35	0.5%	27	0	27	0.4%
PI	13,418	255	1.9%	12	296	299	2.2%
PR	4,923	100	2.0%	229	2024	2030	41.2%
RJ	296	3	1.0%	3	163	163	55.1%
RN	1986	69	3.5%	2	0	2	0.1%
RO	23,246	32	0.1%	2,114	225	2,314	10.0%
RR	10,077	390	3.9%	459	0	459	4.6%
RS	4,127	99	2.4%	7	1,425	1,427	34.6%
SC	2,290	51	2.2%	3	23	26	1.1%
SE	1,217	1	0.1%	44	0	44	3.6%
SP	824	78	9.5%	0	221	221	26.8%
TO	13,273	2,360	17.8%	184	418	529	4.0%
Brazil	**397,162**	**8,596**	**2.2%**	**14,955**	**29,570**	**41,759**	**10.5%**

Table 64 DEFORESTED AREA IN THE STATES AND IN BRAZIL FROM 2019 TO 2023 THAT CROSSES WITH AUTHORIZATIONS AND LAW ENFORCEMENT ACTIONS BY STATE AND/OR FEDERAL BODIES.

UF	Deforested Area (ha)	Alert area cross-referencing with authorization federal or state (ha)	% of the area with authorization federal or state	Alert area that intersect with law enforcement action federal	Alert area that intersect with law enforcement action state	Area of alerts that intersect with federal or state enforcement action	% of area with federal or state law enforcement action
AC	312,428.4	5.855,7	1.9%	28,006.6	7,415.3	33,142.1	10.6%
AL	10,440.1	79,7	0.8%	1,871.2	0.0	1,871.2	17.9%
AM	837,376.4	932,1	0.1%	323,854.1	186,940.6	413,100.9	49.3%
AP	6,361.1	325,3	5.1%	772.5	0.0	772.5	12.1%
BA	848,874.3	439.376,0	51.8%	30,332.5	49,982.2	71,892.0	8.5%
CE	85,873.6	3.446,2	4.0%	2,724.0	1,680.8	4,270.5	5.0%
DF	1,101.2	184,6	16.8%	0.0	0.0	0.0	0.0%
ES	1,269.6	499,9	39.4%	7.4	1,149.4	1,149.4	90.5%
GO	220,641.8	14.858,7	6.7%	8,173.1	114,694.8	119,446.3	54.1%
MA	993,818.4	129.613,3	13.0%	12,863.4	0.0	12,863.4	1.3%
MG	245,161.7	36.509,8	14.9%	12,003.4	107,413.9	108,604.2	44.3%
MS	268,847.6	15,9	0.0%	1,874.9	0.0	1,874.9	0.7%
MT	1,005,202.7	273.737,5	27.2%	102,114.7	516,204.5	543,066.1	54.0%
PA	1,805,479.1	13.901,7	0.8%	483,834.5	451,741.4	694,832.4	38.5%
PB	29,274.1	1.566,9	5.4%	1,699.8	0.0	1,699.8	5.8%
PE	56,462.9	2.103,0	3.7%	654.3	0.0	654.3	1.2%
PI	472,645.8	116.774,7	24.7%	10,406.1	117,370.2	119,063.5	25.2%
PR	19,901.4	441,0	2.2%	2,338.4	13,183.3	13,198.5	66.3%
RJ	1,257.5	45,3	3.6%	43.0	694.1	694.1	55.2%
RN	23,230.7	3.363,8	14.5%	12.3	0.0	12.3	0.1%
RO	570,567.6	3.548,8	0.6%	149,180.7	14,106.9	158,047.8	27.7%
RR	116,427.1	14.200,9	12.2%	13,015.8	0.0	13,015.8	11.2%
RS	14,605.6	745,7	5.1%	23.5	6,985.4	6,987.2	47.8%
SC	6,772.1	211,3	3.1%	57.5	90.3	147.8	2.2%
SE	11,333.5	5,5	0.0%	669.2	0.0	669.2	5.9%
SP	2,397.8	290,7	12.1%	0.0	665.1	665.1	27.7%
TO	590,484.2	281.444,0	47.7%	26,152.2	53,521.3	63,054.0	10.7%
Brazil	**8,558,236.7**	**1.344.078,2**	**15.7%**	**1,212,685.4**	**1,643,839.5**	**2,384,795.5**	**27.9%**

For each year of deforestation alerts validated and published by MapBiomas, the accumulated data from law enforcement actions by federal and/or state agencies carried out until May 2024 were cross-referenced. This is because an alert registered in one year can only be monitored in the following year.

Considering the alerts validated in 2023, 12.4% of them had authorizations and/or law enforcement actions until the period analyzed within the universe of databases to which MapBiomas had access (Table 65). The area of alerts validated in 2023 that had authorizations or law enforcement actions reached 41% (Table 66).

Some states stand out for the increase in the percentage of deforested area with authorization or law enforcement action in recent years. Goiás, for example, went from 58% of authorized or inspected area in 2021 and 2022 to 74.5% in 2023. Piauí went from 33% in 2021 to 57.2% in 2023. Espírito Santo, Mato Grosso and Tocantins maintained their Authorized or inspected deforested area rates above 60%.

Table 65 NUMBER OF ALERTS WITH AUTHORIZATION OR LAW ENFORCEMENT ACTION FROM FEDERAL AND/OR STATE AGENCIES CARRIED OUT UNTIL MAY 2024 IN THE STATES AND IN BRAZIL

UF	2019	2020	2021	2022	2023	Total
AC	4.9%	4.2%	4.1%	5.0%	3.5%	4.4%
AL	66.7%	26.8%	21.3%	11.1%	6.7%	10.8%
AM	11.6%	6.9%	12.1%	16.3%	7.8%	10.8%
AP	2.6%	2.3%	2.0%	11.5%	2.7%	3.0%
BA	13.5%	5.5%	6.8%	8.5%	5.3%	6.7%
CE	24.1%	5.8%	3.9%	2.9%	1.5%	3.0%
DF	25.0%	3.7%	50.0%	33.3%	11.5%	11.3%
ES	87.5%	97.2%	100.0%	99.0%	100.0%	98.9%
GO	38.9%	16.7%	37.5%	35.3%	65.7%	41.6%
MA	2.4%	1.4%	2.6%	2.5%	1.7%	1.8%
MG	33.3%	23.7%	49.8%	27.5%	27.2%	30.3%
MS	3.0%	1.1%	0.6%	1.5%	0.6%	1.1%
MT	39.1%	39.7%	51.4%	51.4%	45.1%	44.7%
PA	11.1%	10.4%	11.2%	10.8%	6.1%	10.2%
PB	33.3%	5.7%	6.0%	4.4%	2.1%	3.7%
PE		1.2%	1.1%	1.1%	0.7%	0.9%
PI	3.7%	1.9%	3.8%	4.3%	5.1%	3.9%
PR	70.8%	70.6%	45.3%	28.7%	22.0%	43.1%
RJ	38.1%	52.4%	32.0%	72.0%	35.4%	55.4%
RN		1.9%	2.9%	4.8%	4.6%	3.6%
RO	10.4%	9.4%	10.3%	11.3%	7.6%	10.1%
RR	7.8%	7.1%	7.9%	12.9%	7.0%	8.2%
RS	43.4%	42.4%	45.4%	34.7%	31.8%	36.7%
SC	0.8%	5.9%	3.4%	2.1%	4.3%	3.3%
SE	33.3%	12.7%	8.7%	4.3%	0.5%	3.7%
SP	35.8%	38.6%	52.5%	29.6%	30.1%	36.0%
TO	14.3%	9.2%	35.3%	37.4%	30.3%	21.1%
Brazil	**13.2%**	**10.4%**	**13.5%**	**13.6%**	**12.4%**	**12.5%**

Subtitle:
- less than or equal to 10%
- between 10 and 40%
- between 40 and 70%
- above 70%

Table 66 AREA DEFORESTED WITH AUTHORIZATION OR LAW ENFORCEMENT ACTION FROM FEDERAL AND/OR STATE AGENCIES CARRIED OUT UNTIL MAY 2024 IN THE STATES AND IN BRAZIL

UF	2019	2020	2021	2022	2023	Total
AC	11.0%	10.4%	11.0%	15.4%	12.1%	12.3%
AL	44.7%	42.4%	34.1%	19.6%	11.0%	18.7%
AM	44.9%	42.0%	50.5%	57.7%	38.5%	49.4%
AP	25.0%	9.0%	8.1%	39.6%	6.4%	17.3%
BA	61.6%	45.1%	57.0%	57.4%	55.8%	55.5%
CE	70.2%	19.4%	10.9%	5.3%	4.8%	8.5%
DF	27.6%	10.6%	23.4%	31.0%	13.3%	16.8%
ES	94.8%	98.4%	100.0%	99.4%	100.0%	99.1%
GO	61.97%	39.29%	58.56%	57.84%	74.46%	59.2%
MA	13.0%	27.1%	14.7%	9.6%	7.5%	14.2%
MG	38.5%	41.1%	68.9%	61.3%	43.8%	51.2%
MS	1.6%	0.5%	0.4%	0.3%	0.9%	0.7%
MT	64.5%	72.7%	81.4%	84.2%	82.6%	77.1%
PA	37.2%	39.0%	42.6%	41.4%	27.5%	39.1%
PB	30.9%	10.6%	15.2%	20.1%	3.9%	10.7%
PE		2.4%	3.3%	8.7%	1.7%	4.9%
PI	22.8%	34.0%	33.3%	50.9%	57.2%	44.9%
PR	74.8%	82.6%	67.8%	54.4%	37.6%	68.2%
RJ	35.2%	42.7%	41.0%	80.8%	34.2%	55.7%
RN		12.6%	6.3%	15.1%	21.2%	14.5%
RO	25.7%	28.6%	29.1%	32.1%	20.0%	28.3%
RR	19.0%	28.5%	21.5%	28.8%	13.8%	22.4%
RS	63.4%	56.9%	70.7%	40.4%	35.0%	51.5%
SC	2.7%	7.6%	5.8%	3.0%	5.8%	5.1%
SE	29.7%	11.3%	10.4%	8.9%	0.4%	6.0%
SP	47.8%	45.4%	56.7%	25.6%	29.5%	39.8%
TO	27.8%	36.8%	65.3%	63.0%	69.5%	54.7%
Brazil	38.1%	38.5%	43%	46.1%	41%	41.7%

Subtitle:
- less than or equal to 10%
- between 10 and 40%
- between 40 and 70%
- above 70%

4.1.4 | Authorized and supervised deforestation in priority municipalities in the Amazon

The List of Priority Municipalities for Actions to Prevent, Monitor and Control Deforestation in the Amazon was established by Decree No. 6,321/2007. In art. 2nd of this decree, it is established that the Ministry of the Environment (MMA) is responsible for annually issuing an ordinance with the list of municipalities located in the Amazon biome to be considered priorities for actions to prevent and control deforestation.

The criteria for inclusion in the list of priority municipalities consider the dynamics of recent deforestation and are established by ordinances from the Ministry of the Environment. Currently, the list has 70 municipalities (Appendix 7), determined by Ordinance GM/MMA No. 834, of November 9, 2023.

In the 70 priority municipalities in the Amazon, 0.8% of deforestation alerts crossed-referenced with federal or state authorizations. 14.9% of deforestation alerts in these municipalities were fined or embargoed by federal and/or state agencies. This corresponds to 4.8% of the area deforested with authorizations and 46.5% of the area deforested with law enforcement actions (Tables 67 and 68)**.**

Table 67 NUMBER OF ALERTS WITH AUTHORIZATIONS AND LAW ENFORCEMENT ACTIONS FROM 2019 TO 2023 IN PRIORITY MUNICIPALITIES IN THE AMAZON

UF	County	Number of alerts	Number of alerts cross-referencing with authorization federal or state	% of alerts with authorization federal or state	Number of alerts that intersect with law enforcement action federal	Number of alerts that intersect with law enforcement action state	Number of alerts that intersect with law enforcement action federal and/or state	% of alerts with law enforcement action federal or state	Total
AC	FEIJÓ	9,177	103	1.1%	287	73	340	3.7%	4.8%
AC	MANOEL URBANO	2,307	22	1.0%	141	37	169	7.3%	8.2%
AC	RIO BRANCO	3,745	17	0.5%	136	21	155	4.1%	4.6%
AC	SENA MADUREIRA	5,892	15	0.3%	207	43	249	4.2%	4.5%
AC	TARAUACÁ	6,497	40	0.6%	71	78	139	2.1%	2.7%
AM	APUÍ	3,058	0	0.0%	558	490	923	30.2%	30.2%
AM	BOCA DO ACRE	4,527	8	0.2%	315	19	332	7.3%	7.5%
AM	CANUTAMA	1,676	2	0.1%	296	106	363	21.7%	21.7%
AM	HUMAITÁ	2023	0	0.0%	297	244	499	24.7%	24.7%
AM	ITAPIRANGA	114	2	1.8%	0	1	1	0.9%	2.6%
AM	LABREA	3,703	0	0.0%	1,239	195	1,315	35.5%	35.5%
AM	MANICORÉ	1,387	0	0.0%	262	70	307	22.1%	22.1%
AM	MAUÉS	1,104	0	0.0%	30	13	40	3.6%	3.6%
AM	NOVO ARIPUANÃ	1,566	0	0.0%	182	89	285	18.2%	18.2%
MT	APIACÁS	605	30	5.0%	71	332	362	59.8%	64.5%
MT	ARIPUANÃ	1,600	18	1.1%	148	689	749	46.8%	47.9%
MT	BOM JESUS DO ARAGUAIA	50	1	2.0%	0	10	10	20.0%	22.0%
MT	CLAUDIA	216	32	14.8%	8	102	104	48.1%	58.8%
MT	COLNIZA	2,535	34	1.3%	287	1,123	1,216	48.0%	49.2%
MT	COMODORO	388	33	8.5%	1	194	195	50.3%	57.7%
MT	COTRIGUAÇU	706	19	2.7%	15	245	248	35.1%	37.7%
MT	FELIZ NATAL	332	75	22.6%	16	50	62	18.7%	38.9%

CONTINUE

UF	County	Number of alerts	Number of alerts cross-referencing with authorization federal or state	% of alerts with authorization federal or state	Number of alerts that intersect with law enforcement action federal	Number of alerts that intersect with law enforcement action state	Number of alerts that intersect with law enforcement action federal and/or state	% of alerts with law enforcement action federal or state	Total
MT	GAÚCHA DO NORTE	401	11	2.7%	7	34	40	10.0%	12.7%
MT	JUARA	539	76	14.1%	28	243	260	48.2%	61.6%
MT	JUINA	634	11	1.7%	3	279	280	44.2%	45.7%
MT	MARCELANDIA	370	25	6.8%	14	135	140	37.8%	43.8%
MT	NOVA BANDEIRANTES	974	37	3.8%	81	459	486	49.9%	53.6%
MT	NOVA MARINGÁ	163	40	24.5%	12	54	59	36.2%	59.5%
MT	NOVA UBIRATÃ	276	34	12.3%	4	106	109	39.5%	51.1%
MT	PARANAÍTA	375	30	8.0%	23	182	194	51.7%	58.4%
MT	PARANATINGA	334	37	11.1%	10	94	96	28.7%	38.9%
MT	PEIXOTO DE AZEVEDO	801	16	2.0%	3	311	311	38.8%	40.8%
MT	QUERÊNCIA	434	25	5.8%	5	153	153	35.3%	40.3%
MT	RONDONLANDIA	301	0	0.0%	15	109	128	42.5%	42.5%
MT	SÃO JOSÉ DO XINGÚ	51	3	5.9%	0	7	7	13.7%	19.6%
MT	UNIÃO DO SUL	350	40	11.4%	26	156	171	48.9%	58.0%
PA	ALTAMIRA	6,778	4	0.1%	935	874	1,475	21.8%	21.8%
PA	ANAPU	4,223	15	0.4%	61	322	375	8.9%	9.2%
PA	CUMARU DO NORTE	1,217	0	0.0%	0	4	4	0.3%	0.3%
PA	DOM ELISEU	302	1	0.3%	4	11	15	5.0%	5.3%
PA	ITAITUBA	5,432	2	0.0%	249	137	350	6.4%	6.5%
PA	ITUPIRANGA	1,336	3	0.2%	2	0	2	0.1%	0.4%
PA	JACAREAGANGA	2,061	0	0.0%	36	178	214	10.4%	10.4%
PA	MARABÁ	1,524	32	2.1%	5	94	99	6.5%	8.6%
PA	MEDICILÂNDIA	1,941	0	0.0%	103	55	155	8.0%	8.0%
PA	MOJU	1,954	5	0.3%	3	96	99	5.1%	5.3%
PA	MOJUÍ DOS CAMPOS	1,489	0	0.0%	58	146	188	12.6%	12.6%

CONTINUE

UF	County	Number of alerts	Number of alerts cross-referencing with authorization federal or state	% of alerts with authorization federal or state	Number of alerts that intersect with law enforcement action federal	Number of alerts that intersect with law enforcement action state	Number of alerts that intersect with law enforcement action federal and/or state	% of alerts with law enforcement action federal or state	Total
PA	NOVO PROGRESSO	1,846	1	0.1%	422	355	672	36.4%	36.4%
PA	NOVO REPARTIMENTO	3,882	16	0.4%	34	65	92	2.4%	2.8%
PA	PACAJÁ	5,832	26	0.4%	243	487	675	11.6%	12.0%
PA	PARAGOMINAS	309	15	4.9%	10	66	71	23.0%	26.2%
PA	PLACAS	2,795	0	0.0%	70	190	250	8.9%	8.9%
PA	PORTEL	4,204	1	0.0%	615	334	853	20.3%	20.3%
PA	PRAINHA	2,140	15	0.7%	25	93	108	5.0%	5.7%
PA	RONDON DO PARÁ	956	0	0.0%	10	18	28	2.9%	2.9%
PA	RUROPOLIS	2,473	0	0.0%	111	97	200	8.1%	8.1%
PA	SANTANA DO ARAGUAIA	319	0	0.0%	0	2	2	0.6%	0.6%
PA	SÃO FÉLIX DO XINGU	8,551	0	0.0%	792	1,150	1,652	19.3%	19.3%
PA	SENADOR JOSÉ PORFÍRIO	4,422	11	0.2%	306	599	760	17.2%	17.4%
PA	TRAIRÃO	1,524	0	0.0%	143	50	187	12.3%	12.3%
PA	ULIANÓPOLIS	183	0	0.0%	3	5	8	4.4%	4.4%
PA	URUARÁ	3,323	0	0.0%	255	359	544	16.4%	16.4%
RO	BURITIS	519	0	0.0%	12	3	15	2.9%	2.9%
RO	CANDEIAS DO JAMARI	2,168	0	0.0%	269	41	306	14.1%	14.1%
RO	CUJUBIM	1,340	0	0.0%	270	9	279	20.8%	20.8%
RO	MACHADINHO D'OESTE	1,302	1	0.1%	86	13	99	7.6%	7.7%
RO	NOVA MAMORÉ	1,901	0	0.0%	107	5	111	5.8%	5.8%
RO	PORTO VELHO	5,898	1	0.0%	1,166	49	1,199	20.3%	20.3%
RR	MUCAJAÍ	610	8	1.3%	25	0	25	4.1%	5.4%
RR	RORAINÓPOLIS	2,263	193	8.5%	186	0	186	8.2%	15.9%
Grand total		**142,300**	**1,186**	**0.8%**	**11,181**	**12,077**	**21,168**	**14.9%**	**15.6%**

Table 68 DEFORESTED AREA WITH AUTHORIZATIONS AND LAW ENFORCEMENT ACTIONS FROM 2019 TO 2023 IN PRIORITY MUNICIPALITIES IN THE AMAZON

UF	County	Area Deforested (ha)	Total alert area cross-referencing with authorization federal and/or state (ha)	% of the area with authorization federal or state	Total alert area that intersect with law enforcement action federal (ha)	Total alert area that intersect with law enforcement action state (ha)	Total alert area that intersect with law enforcement action federal and/or state (ha)	% of the area with law enforcement action federal or state	Total
AC	FEIJÓ	54,883.4	2,783.2	5.1%	6,902.9	1,293.9	7,708.3	14.0%	18.7%
AC	MANOEL URBANO	21,635.9	339.8	1.6%	4,640.5	1,892.8	5,443.6	25.2%	26.7%
AC	RIO BRANCO	35,457.8	615.7	1.7%	2,670.9	317.2	2,980.3	8.4%	10.1%
AC	SENA MADUREIRA	39,333.4	275.7	0.7%	3,021.9	609.4	3,525.8	9.0%	9.7%
AC	TARAUACÁ	33,399.7	1,253.0	3.8%	1,367.0	1,185.5	2,243.3	6.7%	9.7%
AM	APUÍ	163,425.7	0.0	0.0%	66,494.2	70,820.0	102,128.5	62.5%	62.5%
AM	BOCA DO ACRE	70,192.1	136.7	0.2%	16,185.1	1,444.9	17,425.3	24.8%	25.0%
AM	CANUTAMA	50,800.1	439.0	0.9%	19,550.0	13,770.2	27,232.6	53.6%	53.9%
AM	HUMAITÁ	58,463.3	0.0	0.0%	15,630.7	19,591.2	31,130.1	53.2%	53.2%
AM	ITAPIRANGA	520.8	4.6	0.9%	0.0	7.8	7.8	1.5%	2.4%
AM	LABREA	198,038.9	0.0	0.0%	138,208.1	43,989.6	147,782.7	74.6%	74.6%
AM	MANICORÉ	57,107.1	0.0	0.0%	24,276.9	11,644.5	28,649.7	50.2%	50.2%
AM	MAUÉS	21,570.3	0.0	0.0%	5,528.9	3,367.6	7,481.7	34.7%	34.7%
AM	NOVO ARIPUANÃ	84,851.2	0.0	0.0%	22,230.5	9,683.6	36,264.7	42.7%	42.7%
MT	APIACÁS	29,214.9	2,378.4	8.1%	7,289.9	22,860.1	24,386.5	83.5%	90.7%
MT	ARIPUANÃ	61,661.3	2,261.5	3.7%	13,302.1	43,149.0	44,966.2	72.9%	76.4%
MT	BOM JESUS DO ARAGUAIA	2,209.9	968.8	43.8%	0.0	235.4	235.4	10.7%	54.5%
MT	CLAUDIA	13,152.8	6,438.7	49.0%	83.6	7,000.3	7,036.2	53.5%	88.6%
MT	COLNIZA	108,304.4	4,280.9	4.0%	32,979.6	76,953.7	83,619.2	77.2%	80.6%
MT	COMODORO	20,696.9	12,983.4	62.7%	440.4	8,872.5	9,312.9	45.0%	93.0%
MT	COTRIGUAÇU	16,846.6	3,255.0	19.3%	901.0	7,294.8	7,499.3	44.5%	62.4%
MT	FELIZ NATAL	26,085.1	19,655.9	75.4%	2,283.1	5,637.9	6,593.3	25.3%	90.6%
MT	GAÚCHA DO NORTE	8,459.4	1,955.9	23.1%	398.2	2,989.9	3,352.0	39.6%	62.7%

CONTINUE

UF	County	Area Deforested (ha)	Total alert area cross-referencing with authorization federal and/or state (ha)	% of the area with authorization federal or state	Total alert area that intersect with law enforcement action federal (ha)	Total alert area that intersect with law enforcement action state (ha)	Total alert area that intersect with law enforcement action federal and/or state (ha)	% of the area with law enforcement action federal or state	Total
MT	JUARA	34,141.3	14,394.0	42.2%	1,755.1	15,431.1	16,564.3	48.5%	86.6%
MT	JUINA	15,575.9	2,306.4	14.8%	297.6	8,318.2	8,420.0	54.1%	66.3%
MT	MARCELANDIA	27,568.1	4,059.5	14.7%	3,768.9	16,563.3	17,312.0	62.8%	75.2%
MT	NOVA BANDEIRANTES	46,414.0	3,764.1	8.1%	10,081.3	35,960.5	36,650.0	79.0%	86.5%
MT	NOVA MARINGÁ	19,286.6	11,970.5	62.1%	1,189.2	4,011.8	4,706.7	24.4%	84.0%
MT	NOVA UBIRATÃ	19,739.5	8,076.2	40.9%	679.9	8,775.8	9,398.7	47.6%	83.7%
MT	PARANAÍTA	12,765.9	1,564.2	12.3%	1,695.3	8,670.3	9,249.0	72.5%	82.5%
MT	PARANATINGA	23,791.1	9,695.4	40.8%	790.8	6,772.8	6,952.2	29.2%	67.7%
MT	PEIXOTO DE AZEVEDO	26,370.7	5,498.3	20.9%	2,363.5	13,906.6	13,906.6	52.7%	73.6%
MT	QUERÊMCIA	17,307.8	10,065.9	58.2%	357.8	5,201.5	5,201.5	30.1%	85.4%
MT	RONDONLANDIA	20,439.2	0.0	0.0%	1,322.2	14,218.7	16,019.1	78.4%	78.4%
MT	SÃO JOSÉ DO XINGÚ	1,428.9	896.0	62.7%	0.0	113.8	113.8	8.0%	70.7%
MT	UNIÃO DO SULUNIÃO DO SUL	27,471.1	9,756.4	35.5%	2,686.6	14,486.3	15,167.9	55.2%	79.9%
PA	ALTAMIRA	268,593.8	162.9	0.1%	151,286.2	151,455.3	203,010.0	75.6%	75.6%
PA	ANAPU	49,562.9	475.9	1.0%	3,548.8	6,329.1	8,999.2	18.2%	18.8%
PA	CUMARU DO NORTE	9,655.7	0.0	0.0%	0.0	86.0	86.0	0.9%	0.9%
PA	DOM ELISEU	17,468.5	47.5	0.3%	877.3	621.4	1,498.6	8.6%	8.9%
PA	ITAITUBA	109,351.8	133.9	0.1%	36,808.8	17,085.6	45,691.5	41.8%	41.9%
PA	ITUPIRANGA	13,064.7	14.1	0.1%	6.8	0.0	6.8	0.1%	0.2%
PA	JACAREAGANGA	0.0	0.0	0.0%	3,658.3	5,474.6	9,132.9	23.3%	23.3%
PA	MARABÁ	19,023.1	583.4	3.1%	81.4	1,038.5	1,120.0	5.9%	9.0%
PA	MEDICILÂNDIA	41,951.8	0.0	0.0%	8,613.3	1,946.3	10,202.4	24.3%	24.3%
PA	MOJU	29,692.1	2,040.1	6.9%	120.7	4,628.0	4,748.8	16.0%	21.9%
PA	MOJUÍ DOS CAMPOS	28,560.6	0.0	0.0%	8,394.5	8,277.7	11,589.7	40.6%	40.6%

CONTINUE

UF	County	Area Deforested (ha)	Total alert area cross-referencing with authorization federal and/or state (ha)	% of the area with authorization federal or state	Total alert area that intersect with law enforcement action federal (ha)	Total alert area that intersect with law enforcement action state (ha)	Total alert area that intersect with law enforcement action federal and/or state (ha)	% of the area with law enforcement action federal or state	Total
PA	NOVO PROGRESSO	113,862.8	12.7	0.0%	67,091.6	49,499.2	86,617.3	76.1%	76.1%
PA	NOVO REPARTIMENTO	55,625.7	251.4	0.5%	2,770.0	2,634.4	4,533.4	8.1%	8.6%
PA	PACAJÁ	90,249.8	511.2	0.6%	12,321.3	15,724.2	22,378.1	24.8%	25.2%
PA	PARAGOMINAS	13,287.7	1,891.2	14.2%	1,357.2	4,175.8	4,851.5	36.5%	45.6%
PA	PLACAS	48,386.5	0.0	0.0%	5,126.1	8,085.9	11,265.2	23.3%	23.3%
PA	PORTEL	93,734.9	82.0	0.1%	42,260.9	17,271.3	50,219.4	53.6%	53.7%
PA	PRAINHAPRAINHA	25,696.0	1,753.9	6.8%	1,264.5	3,050.1	3,549.8	13.8%	20.6%
PA	RONDON DO PARÁ	19,325.9	0.0	0.0%	392.9	554.0	946.9	4.9%	4.9%
PA	RUROPOLIS	45,897.1	0.0	0.0%	7,218.2	3,514.7	9,802.6	21.4%	21.4%
PA	SANTANA DO ARAGUAIA	11,315.4	0.0	0.0%	0.0	23.7	23.7	0.2%	0.2%
PA	SÃO FÉLIX DO XINGU	205,012.9	0.0	0.0%	69,126.8	85,200.7	107,830.3	52.6%	52.6%
PA	SENADOR JOSÉ PORFÍRIO	53,574.0	26.9	0.1%	14,604.3	16,339.0	22,718.0	42.4%	42.5%
PA	TRAIRÃOTRAIRÃO	39,754.7	0.0	0.0%	11,688.4	5,439.8	13,771.1	34.6%	34.6%
PA	ULIANÓPOLIS	9,017.8	0.0	0.0%	867.9	111.0	978.9	10.9%	10.9%
PA	URUARÁ	64,874.3	0.0	0.0%	20,392.9	20,601.8	28,938.4	44.6%	44.6%
RO	BURITIS	12,078.9	0.0	0.0%	667.3	93.4	760.7	6.3%	6.3%
RO	CANDEIAS DO JAMARI	62,751.6	0.0	0.0%	18,459.1	2,670.7	20,676.9	33.0%	33.0%
RO	CUJUBIM	41,136.8	0.0	0.0%	19,012.9	721.0	19,733.9	48.0%	48.0%
RO	MACHADINHO D'OESTE	24,648.2	222.5	0.9%	5,922.6	178.5	6,101.1	24.8%	25.7%
RO	NOVA MAMORÉ	49,733.9	0.0	0.0%	5,707.3	158.6	5,856.2	11.8%	11.8%
RO	PORTO VELHO	196,521.4	110.7	0.1%	86,683.6	5,815.0	88,361.2	45.0%	45.0%
RR	MUCAJAÍ	7,373.3	163.9	2.2%	496.4	0.0	496.4	6.7%	9.0%
RR	RORAINÓPOLIS	31,372.7	5,132.0	16.4%	5,823.8	0.0	5,823.8	18.6%	33.4%
Grand total		**3,265,478.0**	**155,689.3**	**4.8%**	**996,815.0**	**916,471.1**	**1,517,571.1**	**46.5%**	**50.3%**

4.1.5 | Highlights of Public Prosecutor's Office activities

4.1.5.1 | Task force of the Federal Public Prosecution Service

Amazônia Protege (AmzPro) is a project created by the Federal Public Prosecution Service (MPF) that aims to combat illegal deforestation in the Brazilian Amazon Forest through the use of satellite images and cross-referencing of public data to initiate Public Civil Actions (ACP) against responsible for the illegal deforestation detected.

It is expected that the resulting products make it possible, above all, to guide the actions to be taken in conducting the issuance of Public Civil Actions by the MPF, not only to the detriment of the defendants identified who are directly responsible for the deforestation caused in the Amazon Biome, but also of those deforested areas where it was not possible to identify those responsible. The result will discourage the dynamics of deforestation in the Amazon, through the prevention or repair of environmental damage by illegal deforesters.

Since the beginning of the project, in 2017, the actions have been divided into three phases, depending on the year the processes began: 1st (first) Phase: 2017; 2nd (second) Phase: 2018 and 3rd (third) Phase: 2019. Currently, the 4th (fourth) Phase of AmzPro, which covers the period from 2020 to 2022, is in the final stage of generating results and uses MapBiomas Alerta as data source for deforested areas.

Earlier on, the **4th phase of the Amazônia Protege project** resulted in the automated generation of **more than 1.84 thousand Technical Reports** that contain all the information necessary for the filing of public civil action processes in federal justice, including the entire characterization of deforested areas, its geolocation on high spatial resolution satellite images before and after the occurrence of deforestation, identification of the overlapping rural property (if any), overlap or distance from protected areas, among others.

These reports contain more **than 8.35 thousand polygons of deforested areas ,** which total **more than 1.32 million deforested hectares.** Finally, **more than 7.73 thousand rural properties overlapped with these deforested areas,** whose owners must be cited in the ACPs for the due process of legal responsibility for the environmental damage caused and the respective recovery of these deforested areas.

4.1.5.2 | Operation Atlantic Forest in Foot

Operation "Mata Atlântica em Pé" is a national initiative, launched in 2016, which seeks to identify illegally deforested areas in the biome, stop illicit activities, hold offenders accountable in the administrative, civil and criminal spheres and contribute to the recovery of degraded areas. In 2018 the task force began to be carried out in the 17 states (Figure 38) that make up the Atlantic Forest area, with its results expanded annually.

The Public Prosecution Service of Paraná is responsible for coordinating the Operation, which takes place in conjunction with the Public Ministries of other states. In the operation, the actions of the MPs and competent environmental bodies go through the following phases:

1. survey of deforested areas with support from Fundação SOS Mata Atlântica and MapBiomas Alerta,
2. identification of owners, any environmental licenses obtained, the history of use and conservation of the area and cross-referencing with specific databases on the topic;
3. law enforcement and assessment; and
4. liability for environmental damage.

The balance of the Operation's results in 2023 reported the monitoring of 1,399 alerts in 17 states, allowing the identification of almost 18 thousand hectares of illegal deforestation, an increase of 49% compared to the previous year's edition (Table 69).

Figure 38 States of Operation Mata Atlântica em Pé. Source: MPPR

Table 69 RESULTS OF OPERATION MATA ATLÂNTICA EM PÉ FROM 2019 TO 2023. SOURCE: MPPR

Indicator	2019	2020	2021	2022	2023	Increment 2022/2023
States	16	17	17	17	17	
Verified polygons	559	647	649	1,279	1,399	9.4%
Extent of illegal suppression (ha)	5,473	6,306	8,189	12,009	17,931	49%
Total value of fines applied (R$)	R$ 25,137,359.00	R$ 32,554,818.29	R$ 55,531,184.19	R$ 72,392,049.57	R$ 81,763,889.28	12.95%

4.2 | Performance of private entities and financial institutions

The private sector and financial institutions play an important role in preventing the sale and financing of products from illegally deforested areas. The production sector, to comply with standards and requirements for access to credit and markets, already adopts practices to combat illegal deforestation and actions to prevent deforestation within its own businesses and monitor production chains. Financial institutions operate attentive to the sector's regulations and regulations, considering environmental responsibility criteria in risk management and mitigation and in decision-making regarding rural credit and portfolio analysis, avoiding benefiting the commercial use of illegally deforested areas.

Several financial institutions already access and use MapBiomas Alerta data to analyze rural credit proposals and avoid financing production in deforested areas. MapBiomas provides a methodological note for using data in the financial sector and rural credit analysis to guide good data application practices[10]. However, it is important to mention that each financial institution freely chooses to use this data and has internal policies and procedures that follow the Rural Credit Manual (MCR) of the Central Bank of Brazil[11].

Table 70 presents some results of the use of MapBiomas Alerta data in rural credit analyses in some financial institutions, for example, the BNDES and Caixa Econômica Federal banks.

Table 70 RESULTS OF THE USE OF MAPBIOMAS ALERTA DATA IN RURAL CREDIT ANALYZES IN SOME FINANCIAL INSTITUTIONS.

Financial institution	Analysis period	Total number of customer requests	Total value of requests	Number of requests with MapBiomas alerts	Total value of requests with MapBiomas alerts	Number of requests with alerts that were in compliance	Value of requests with alerts that were in compliance	Number of requests with alerts that were denied funding	Value of requests with alerts that were denied funding
BNDES	Feb/2023 - Dec/2023	135,466	R$ 35,860,664,188	2,219	R$ 974,296,024	845	R$ 639,363,840	1,374	R$ 334,932,184
CAIXA	May/2023 - Dec/2023	19,961	-	960	-	651	-	303	R$ 173,204,692

10 | Access the methodological note for using MapBiomas alert data in the financial sector and rural credit analysis here: https://alerta.mapbiomas.org/nota-ao-setor-financeiro/
11 | MCR page: https://www3.bcb.gov.br/mcr

FINAL CONSIDERATIONS

This is the fifth edition of RAD - the Annual Report on Deforestation in Brazil. The MapBiomas Alerta initiative has been deepening the understanding of the dynamics of deforestation in Brazil and in different territorial and land areas, in addition to its relationships with signs of illegality and the actions taken by supervisory bodies to combat illegal deforestation in the country.

We seek to demonstrate where, when, how much and how deforestation evolved in all Brazilian biomes from 2019 to 2023, adding new detection systems (such as SAD Cerrado/IPAM in this edition). Unlike previous reports, deforestation has reduced in the country, but with an increase in the Cerrado, Caatinga and Pantanal biomes. We also improved territorial cross-references in order to better describe deforestation (such as new cross-referencing in this report for hydrographic macroregions, coastal system, archaeological sites, private properties registered by INCRA, new land networks, Public Forests and UCs divided by administrative sphere and protection category).

Likewise, we seek to expand our access to environmental databases relating to deforestation, especially with the states, represented by the OEMAs.
Even so, we encountered challenges in accessing and using data on authorizations and actions to combat deforestation at the federal and state levels, with some points regarding active transparency, systematization and georeferencing of data that we recommend improvements to.

All data used to prepare this report, such as alerts, statistics and reports, are available free of charge on the MapBiomas Alerta platform - http://alerta.mapbiomas.org.

This is a contribution from the MapBiomas Project to support public, private, and financial institutions, as well as society in general, in the process of reducing deforestation and promoting the conservation and sustainable use of Brazilian territory.

APPENDICES

APPENDIX 1 | Who We Are - MapBiomas Alert

MapBiomas is a collaborative network, formed by NGOs, universities and technology startups. We produce annual mapping of land cover and use and monitor the water surface and fire scars monthly with data from 1985. We also validate and prepare reports for each deforestation event detected in Brazil since January 2019, through MapBiomas Alerta . All data and methods are publicly available, open and free of charge. To find out more visit: www.mapbiomas.org

MapBiomas Alerta is conducted by the following institutions:

Coordination in biomes:

- **Amazon** – Institute of People and the Environment of the Amazon (IMAZON) in partnership with LAPIG/UFG
- **Caatinga** – State University of Feira de Santana (UEFS) in partnership with Geodatin
- **Cerrado** – Amazon Environmental Research Institute (IPAM) with support from LAPIG and University of Brasília (UnB)
- **Mata Atlântica** – SOS Mata Atlântica Foundation and ArcPlan
- **Pampa** – Federal University of Rio Grande do Sul (UFRGS) and GeoKarten
- **Pantanal** – Instituto SOS Pantanal and ArcPlan

Technology and Systems Partners:

- Google
- EcoStage
- Solved
- LAPIG/UFG

Technical Coordination: Marcos Rosa
Scientific Coordination: Julia Shimbo
General Coordination: Tasso Azevedo

Funding:

- Children's Investment Fund Foundation (CIFF), Climate and Land Use Alliance (CLUA), Amazon Fund, Global Wildlife Conservation (GWC), Good Energies Foundation, Gordon & Betty Moore Foundation, Norwegian International Climate and Forestry Initiative (NICFI), Institute Arapyaú, Instituto Clima e Sociedade (ICS), Instituto Humanize, Montepelier Foundation, Mulago Foundation, OAK Foundation, Quadracture Climate Foundation (QCF), Walmart Foundation (USA), Sequoia Climate Foundation and Skoll Foundation.

Institutional Partners:

- MapBiomas Support Institute (IAMap)
- Arapyaú Institute
- The Nature Conservancy (TNC)
- Avina Fundation

Parceiros Técnicos:

- Brazil IO
- Centro de Vida Institute (ICV)
- Democracy and Sustainability Institute (IDS)
- Socioenvironmental Institute (ISA)
- Institute of Forestry and Agricultural Management and Certification (Imaflora)

Visit https://alerta.mapbiomas.org/equipe/ to see all the people who make MapBiomas Alerta happen.

Team of analysts working on validating and refining deforestation alerts:

Name	Biome	Institution
Mariana Dias Ramos	Atlantic Forest and Pantanal	ArcPlan
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Name	Biome	Institution
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Roberta Rocha	Cerrado	IPAM
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Name	Biome	Institution
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Anne Alencar	Cerrado	IPAM
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Jessica Renata Rodrigues	Cerrado	UnB
Laura Alves	Cerrado	UnB
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Lázaro Pinheiro de Brito	Caatinga	UEFS
Daniela dos Reis Miranda	Caatinga	UEFS
Bruno Manoel Lôbo Soares	Caatinga	UEFS
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Juliano Schirmbeck	Pampa	GeoKarten
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Vanessa Iorati	Pampa	UFRGS

APPENDIX 2 | Description of deforestation detection systems in Brazil and original alert numbers used by MapBiomas Alerta

Deforestation detection systems used in MapBiomas Alerta from 2019 to 2023:

System	Institution	Scope	Characteristics	Reference	Usage period
DETER Amazon	INPE	Forest areas of the Brazilian Amazon	Uses images from the Amazônia 1-WFI (64m), CBERS4-WFI (64m), AWiFS (56m) and CBERS4A-WFI (55m) satellites to map weekly forest clearcutting, forest degradation in preparation for deforestation and forest fire scars , and may also include areas with logging activities.	http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/deter/deter	From 2019 to 2023
DETER Cerrado	INPE	Cerrado, except areas covered by DETER Amazônia	Uses CBERS-4 (64m) and Resourcesat2 (56m) images with visual interpretation for weekly mapping of deforested areas in the biome.	http://cerrado.obt.inpe.br	From 2019 to 2023
SAD Amazon	Imazon	Forest Areas of the Brazilian Amazon	Uses images from Landsat and Sentinel satellites (with spatial resolution of 10 to 30 m) to detect monthly deforestation in primary forests in the Amazon.	https://imazon.org.br/categorias/sad-alerta/	From 2019 to 2023
GLAD	University of Maryland	Forest areas of the tropical region	Has been monitoring tropical forest loss and gain on a weekly basis with Landsat imagery since 2015.	https://glad.umd.edu	2019 for Caatinga, Atlantic Forest, Pantanal and Pampa. 2020 and 2021 for Atlantic Forest, Pantanal and Pampa. 2022 and 2023 for Pampa
SIRAD-X	ISA	Xingu River Basin	Based on radar images from the Sentinel-1 satellite, it has produced monthly deforestation data since the beginning of 2018.	https://xingumais.org.br/siradx	From 2020 to 2023
ATLAS OF THE ATLANTIC FOREST	SOS Mata Atlântica and INPE	Atlantic Forest Law Area	Annually monitors the deforestation of the Atlantic Forest with visual interpretation of Landsat images (30m) since 1985.	https://www.sosma.org.br/iniciativa/atlas-da-mata-atlantica/	From 2020 to 2022

System	Institution	Scope	Characteristics	Reference	Usage period
SIPAMSAR	SIPAM/ Ministry of Defense	Priority areas in the Amazon	Based on radar images, it delivers weekly data in the rainy months between October and April of each year to IBAMA in priority areas. Data is not public.	https://panorama.sipam.gov.br/panorama/pages/index.phpr	2019
SAD Caatinga	GEODATIN/UEFS	Caatinga	Generates monthly alerts, based on Sentinel 2A images with a spatial resolution of 10 m and machine learning methods.	at	From 2020 to 2023
SAD Atlantic Forest	SOS Mata Atlântica and ArcPlan	4 river basins (Tietê, Jequitinhonha, Iguaçu and Miranda/ Aquidauana) in 2021 and the entire biome from 2022	Generates monthly alerts based on Sentinel 2 images with 10 m spatial resolution that are a source for validation in MapBiomas Alerta.	https://www.sosma.org.br/iniciativas/alertas/	From 2021 to 2023
SAD Pantanal	SOS Pantanal and ArcPlan	Pantanal	Generates monthly alerts based on Sentinel 2 images with 10m spatial resolution that are a source for validation in MapBiomas Alerta.	at	From 2021 to 2023
SAD Pampa	Geokarten and UFRGS	Pampa	Generates monthly alerts based on Sentinel-2 imagdies with 10 m spatial resolution	at	2022 and 2023
SAD Cerrado	IPAM and LAPIG-UFG	thickCerrado	Generates monthly alerts based on Sentinel-2 images with 10 m spatial resolution, with machine learning and artificial intelligence techniques.	https://sadcerrado.ipam.org.br/	2022 and 2023 *
PRODES	INPE	Amazon, Cerrado, Pampa and Pantanal	Annually monitors deforestation in Brazilian biomes with Landsat satellite images	http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes	2020 to 2022 in the Amazon, 2020 and 2021 in the Cerrado, and 2022 some alerts in Pampa and Pantanal

*In 2022, SAD Cerrado alerts were incorporated into MapBiomas Alerta in test form (345 deforestation alerts). In 2023, all alerts generated by SAD Cerrado between January and June were included, and from July to December only alerts larger than 10 hectares were validated and refined.

There are also other initiatives more localized in states and municipalities that also monitor deforestation and were used occasionally. Among these systems are:

- IEF/MG - 12 alerts were used in 2020 and 7 alerts in 2019.
- INEMA/BA - 38 alerts were used in 2020.

In 2023, 296,099 original deforestation alert polygons were imported from 10 different sources.

Number of original alerts from detection systems that were used for the year 2023:

Detection System	Number of alerts
SAD (Amazon)	40,201
SIRADX	10,208
DETERB-AMAZONIA	22,344
SAD-CAATINGA	46,131
DETER-CERRADO	16,923
SAD-CERRADO	118,811
SAD-MATA-ATLANTICA	30,452
SAD-PAMPA	2,843
GLAD	363
SAD-PANTANAL	7,823
Total	**296,099**

APPENDIX 3 | Criteria for validating alerts

Reasons for discarding Alerts during pre-validation:

- Duplicate: several polygons very close to each other can be grouped as a single larger alert (the other polygons in the overlapping area are discarded as duplicates); polygons that overlap already published alerts are also considered duplicates;
- Reforestation: the alert is due to the cutting of forested areas (e.g., pine or eucalyptus);
- Seasonality: the alert is a false positive generated in native vegetation that had seasonal variation (drought or humidity);
- Agriculture: the alert is a false positive generated in an agricultural area (normally after harvest);
- Relief Shading: the alert is a false positive generated by the variation in the relief shading;
- Fire: the alert is a false positive generated by a fire;
- Cloud noise: the alert is a false positive probably generated by atmospheric contamination in the original images (clouds or shadows);

Reasons for not validating alerts by biome in 2023

STATUS	AMAZON	CAATINGA	CERRADO	ATLANTIC FOREST	PAMPA	PANTANAL	BRAZIL
Duplication	**18,134**	**9,071**	**12,467**	**1,435**	**385**	**701**	**42,193**
False-positive	**4,735**	**14,005**	**11,406**	**23,584**	**2,712**	**6,073**	**62,515**
Anthropic Before	2,994	7,982	5,600	14,085	273	774	31,708
Burned	459	882	2,622	331		575	4,869
Degradation	612	69	36	3			720
Farming	46	844	1,105	1,267	342	369	3,973
Mining							
Natural without change	10	76	50				136
Reforestation	1	46	106	4,727	427	two	5309
Seasonality	611	3,920	1,883	3,122	1,666	4,353	15,555
Shadow relief	two	186	4	49	4		245
non-observed	**801**	**48**	**228**	**4**			**1,081**
Others	**51**	**124**	**93**	**6**			**274**
TOTAL Not validated	**23,721**	**23,248**	**24,194**	**25,029**	**3,097**	**6,774**	**106,063**

- Degradation: the alert was generated by a process of forest degradation;

- Already altered: The alert was generated in an area that was already altered before the detection date.

In certain situations, deforestation alerts published on the MapBiomas Alerta platform may be rectified, or even cancelled. Whenever there is a formal note or a reasoned request indicating possible errors associated with alerts, whether by environmental agencies or platform users, the MapBiomas Alerta technical team performs a new and thorough technical analysis of these alerts. We emphasize that cancellation only occurs if it is proven that the vegetation removed is not native vegetation. MapBiomas does not make any assessment of legality, regularity or liability related to deforestation. Over the five years of monitoring, 880 alerts were canceled after publication, representing 0.2% of published alerts. Additionally, each year, the number of alerts canceled after publication has been reduced.

Number of alerts canceled after publication per biome per year*

Biomes	2019	2020	2021	2022	2023	Total
Amazon	420	108	28	23	3	582
Caatinga	7	7	2	2	2	20
Cerrado	51	4	9	13	5	82
Atlantic Forest	13	29	54	83	11	190
Pampa	2					two
Pantanal	2			2		4
Brazil	**495**	**148**	**93**	**123**	**21**	**880**

*All cases of doubts regarding specific alerts and possible re-analyses are handled via email support.alerta@mapbiomas.org

APPENDIX 4 | Auxiliary data for spatial crossings

Databases and rules used for the spatial overlap analysis performed for RAD2023:

Layer	Source	Month/year of access	Crossover Rule
country	IBGE, 07/2022	03/2024	Assigns the territory with the largest cross-referenced area
biomes (refined_biomes)	IBGE, 10/2019 1:250,000	03/2024	Assigns the territory with the largest cross-referenced area
states	IBGE, 07/2022	03/2024	Assigns the territory with the largest cross-referenced area
municipalities	IBGE, 07/2022	03/2024	Assigns the territory with the largest cross-referenced area
PNRH Basins (National Water Resources Plan)	ANA, 2006	03/2023	Assigns the territory with the largest cross-referenced area
AMACRO	IBGE Municipalities, 07/2022 1:250,000	03/2024	Assigns it to the territory if it exceeds 1 hectare
Limit of Application of the Atlantic Forest Law	SOS Mata Atlântica (refined IBGE 1:5,000,000 based on RADAM 1:1,000,000)	03/2022	Assigns it to the territory if it exceeds 1 hectare
Boundaries of the Brazilian Amazon	TerraBrasilis, 2016	03/2022	Assigns it to the territory if it exceeds 1 hectare
Boundaries of the Semiarid	EMBRAPA, 2015	03/2022	Assigns it to the territory if it exceeds 1 hectare
MATOPIBA boundary	ANA, 2017	03/2022	Assigns it to the territory if it exceeds 1 hectare
Geoparks	UNESCO,2023	03/2024	Assigns it to the territory if it exceeds 1 hectare
Biosphere Reserves	MMA	03/2022	Assigns it to the territory if it exceeds 1 hectare
Conservation Units	MMA/ICMBio, 03/2024	03/2024	Assigns it to the territory if it exceeds 1 hectare
Indigenous Lands	FUNAI, 03/2023	03/2024	Assigns it to the territory if it exceeds 1 hectare
Quilombos	INCRA 12/2023	03/2024	Assigns it to the territory if it exceeds 1 hectare
SINAFLOR authorizations (ASV, EFP, PMFS, UAS, UPA)	IBAMA 02/2024	03/2024	Calculates overlapping quantity and area (ha)
Federal Embargoes (ICMBio/IBAMA)	IBAMA/ICMBio 03/2024	03/2024	Calculates quantity and overlapping area
SICAR property boundary	SFB 01/2024	03/2024	Calculates overlapping quantity and area (ha) of properties with status indicators other than Canceled (CA) and Suspended (SU)
SICAR Legal Reserve	SFB 01/2024	03/2024	Calculates overlapping quantity and area (ha) of properties with status indicators other than Canceled (CA) and Suspended (SU)
SICAR APP	SFB 01/2024	03/2024	
SIGEF	INCRA 03/2024	03/2024	Calculates overlapping quantity and area (ha) of properties with status indicators other than Canceled (CA) and Suspended (SU)
SNCI	INCRA 03/2024	03/2024	
Rural Settlements	INCRA 10/2023	03/2024	Calculates overlapping quantity and area (ha)
Archaeological Sites	IPHAN 04/2024	04/2024	Calculates overlapping quantity and area (ha)
Public Forests	MMA, 06/2023	03/2024	Assigns it to the territory if it exceeds 1 hectare
Matrix land network of Brazil	GPP (ESALQ/USP), IMAFLORA and CITE, 2024.	04/2024	Coordinates within the alert polygons
Forest concessions	SFB/MMA, 08/2023	03/2024	Calculates overlapping quantity and area (ha)
IBGE Vegetation Map	IBGE, 08/2021	03/2024	Calculates overlapping quantity and area (ha)
Priority Areas for Biodiversity Conservation	MMA, 2018	03/2024	
Coastal and Marine System	IBGE, 10/2019	03/2024	Calculates overlapping quantity and area (ha)

Classes of the Brazilian Land Network Matrix (GPP(ESALQ/USP), IMAFLORA and CITE, 2024)*:

Classes	ID Without CAR	ID With CAR
Lands under the SNUC regime (Public, private or private-collective property)		
Full Protection Conservation Unit (UCPI)	21	2110
Sustainable Use Conservation Unit (UCUS)	22	2210
Conservation Unit APA (UCUS-APA)	23	2310
Overlap between lands under the SNUC regime	29	2910
Public Lands		
Declared Indigenous Land	10	1010
Undeclared Indigenous Land	11	1110
Public Land	12	1210
Military area	13	1310
Overlap between public lands	19	1910
Private Lands (Individual or Collective Ownership)		
Private Rural Property	61	6110
Quilombola territory	62	6210
Settlement	63	6310
Overlap between private lands	69	6910
Overlap zones between domains		
Public Lands/ SNUC Lands		
Declared Indigenous Land / UCPI	31	3110
Declared Indigenous Land / UCUS	32	3210
Undeclared Indigenous Land / UCPI	33	3310
Undeclared Indigenous Land / UCUS	34	3410
TID / UCUSAPA	35	3510
TIND / UCUSAPA	36	3610
Other overlaps between public lands and lands under the SNUC regime	39	3910
Public Lands/Private Lands		
Declared Indigenous Land / Private Rural Property	71	7110
Undeclared Indigenous Land / Private Rural Property	72	7210
Declared Indigenous Land / Settlement	73	7310
Undeclared Indigenous Land / Settlement	74	7410
Other overlaps between public lands and private lands	79	7910
SNUC Lands/Private Lands		
UCPI / Private Rural Property	81	8110
UCUS / Private Rural Property	82	8210
UCPI / Settlement	83	8310
UCUS / Settlement	84	8410
UCPI / Quilombola Territory	85	8510
UCUS / Quilombola Territory	86	8610
UCUSAPA / Settlement	87	8710
UCUSAPA / Private Rural Property	88	8810
Other overlaps between lands under the SNUC regime and private lands	89	8910
Lands under SNUC regime / Private Lands / Public Lands		
Other overlaps between lands under the SNUC regime, private and public	99	9910
Urban areas	**41**	**4110**
Water bodies	**51**	**5110**
Areas Without Georeferenced Land Registration	**101**	**10110**

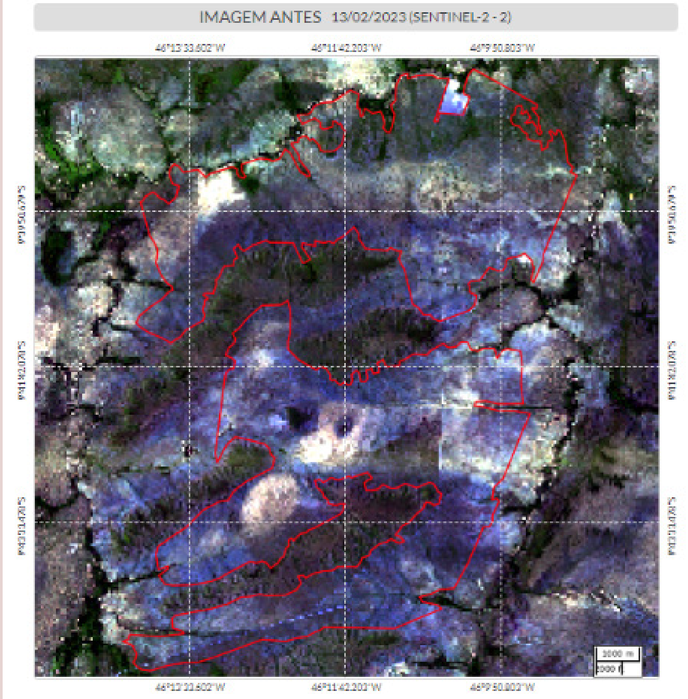
** GPP (ESALQ/USP), IMAFLORA and CITE, 2024. Technical note: Matrix land network of Brazil – Piracicaba, SP, Brazil. Access: https://cartasdaterra.com.br/

APPENDIX 5 | Situation of the largest deforestation detected in 2023 in each biome

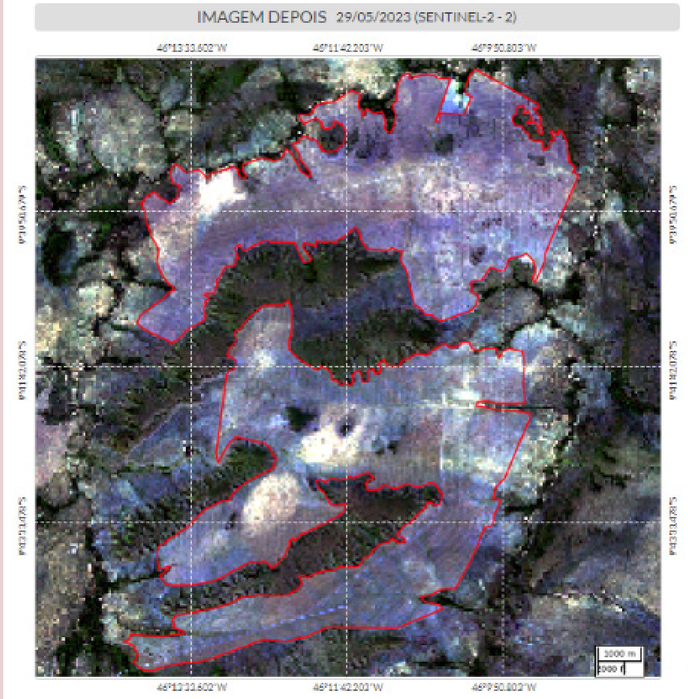
Highest deforestation Brazil in 2023 (Cerrado)

The largest deforestation detected in 2023 in Brazil (alert code 918727), with 6,691.29 ha, occurred in the **Cerrado** biome in the state of Maranhão, municipality of Alto Parnaíba. The Sema-MA Inspection Department was contacted about possible authorizations and/or inspection actions corresponding to the area but did not respond in time for the text of this report to be completed.

Before



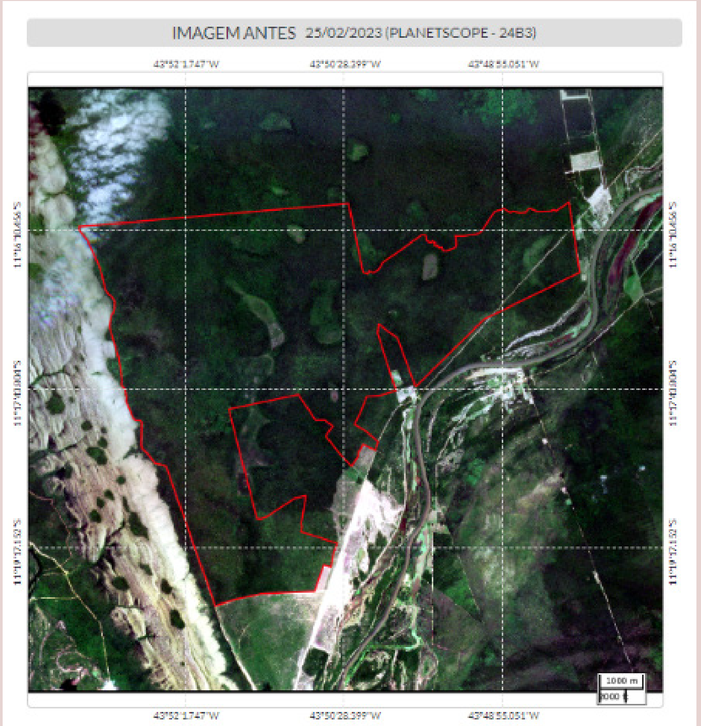
After



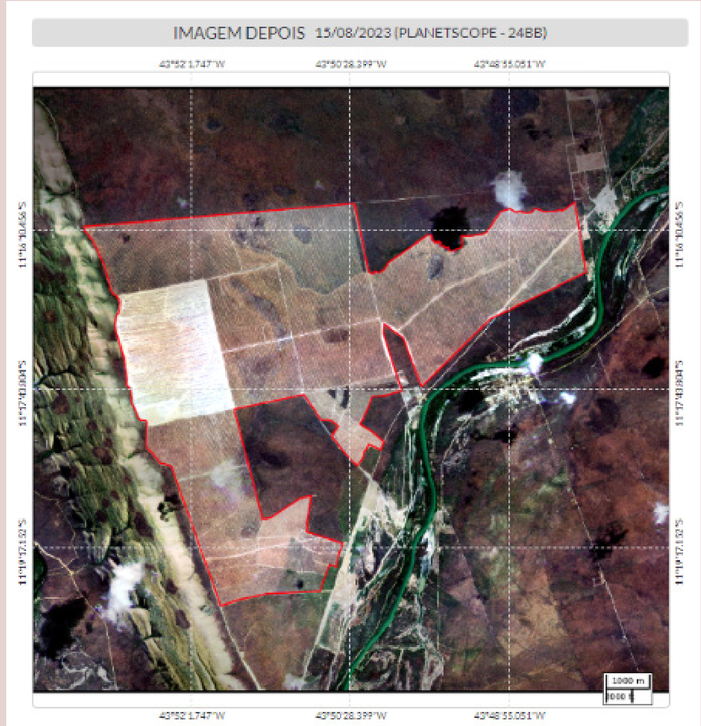
Largest deforestation in the Caatinga in 2023

The largest deforestation detected in the **Caatinga biome** in 2023 (alert code 912386) covers an area of 4,729.99 ha and occurred in the municipality of Barra, in the state of Bahia. According to INEMA-BA (consulted via email), the area is registered under CEFIR/CAR no . CEFIR). In a search of the SEIA System, no Native Vegetation Suppression Authorization - ASV granted by INEMA in the name of the registered holder was identified. Additionally, INEMA reported that, in a survey of the Official Gazette of the Municipality of Barra, the existence of 03 (three) ASVs issued by the Municipal Government through the Secretariat of Economic Development, Environment and Tourism, was identified, and all for the polygons indicated inside the aforementioned property. INEMA also informs that it is possible to deduce that the area related to alert code 912386 was suppressed due to the issuance of ASV published by Barra Municipal Government. Regardless of the scenario previously described, the Fazenda Boqueirão rural property was subjected to technical inspection by the team of DIFIS/COFIS employees who are evaluating the situation and, consequently, the application of possible penalties.

Before

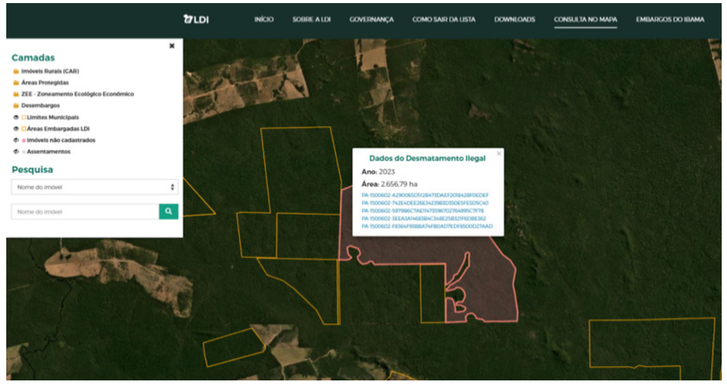


After

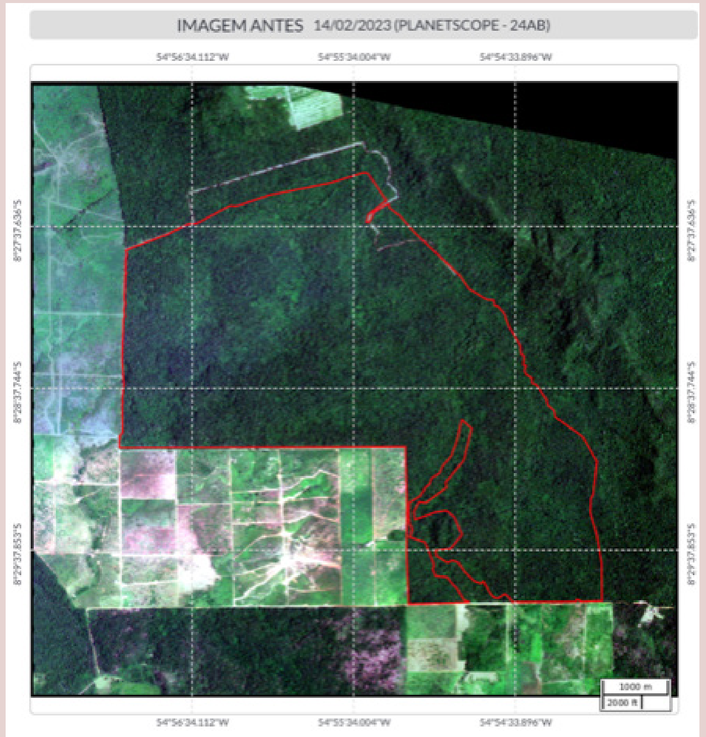


Largest deforestation in the Amazon biome in 2023

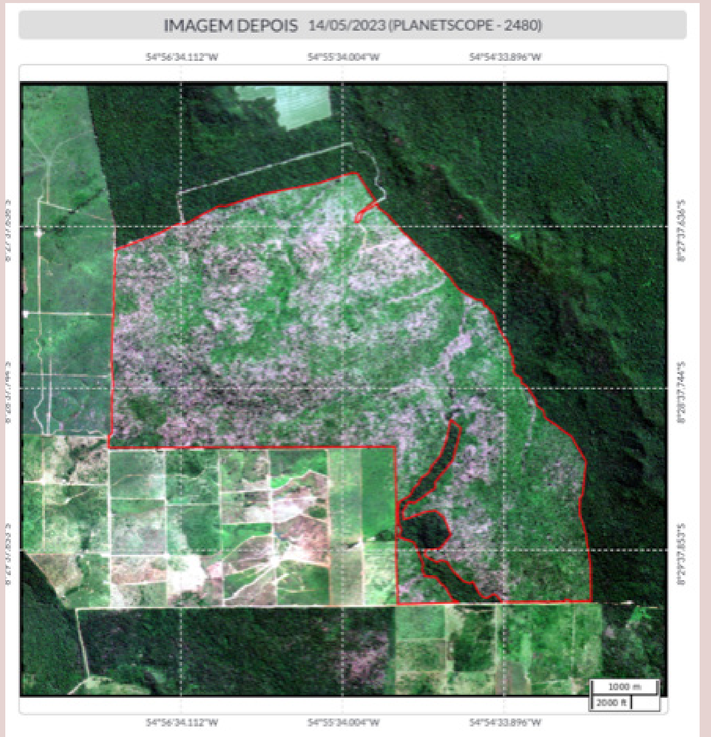
The largest deforestation detected in the **Amazon biome** in 2023 (alert code 887194)covers an area of 2683.41 ha and occurred in the municipality of Altamira, in the state of Pará. According to Semas-PA, there is no licensing in progress that affects this area . Furthermore, this deforestation was identified and monitored by this CFISC at the beginning of 2023, which directed the inspection team within the scope of Curupira operations in March /2023 and maintains monitoring in this region continuously to this day (Decree No. 2,887/2023). Semas-PA also reported that the aforementioned deforestation is already underway. **Embargoed** by the state and available for consultation on the LDI website (https://monitoramento.semas.pa.gov.br/ldi/consultaMapa/mapa).



Before



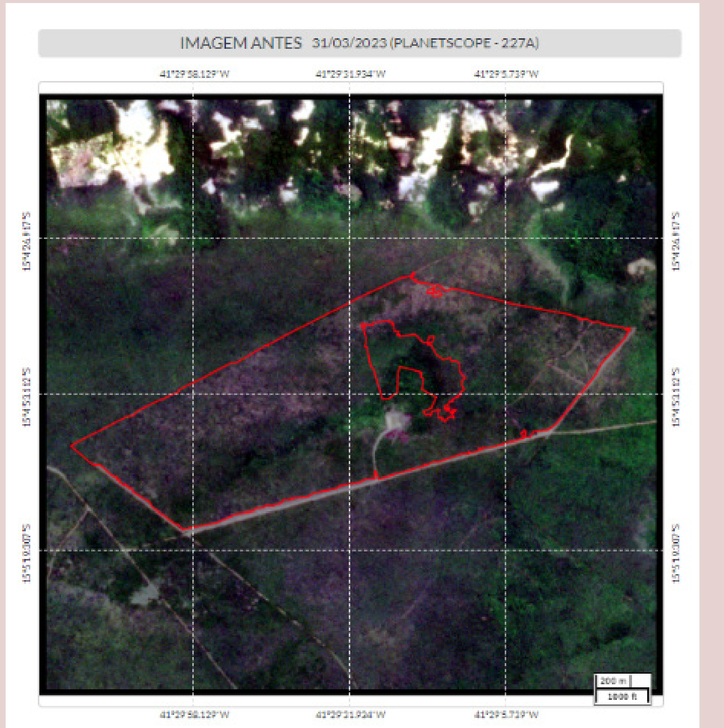
After



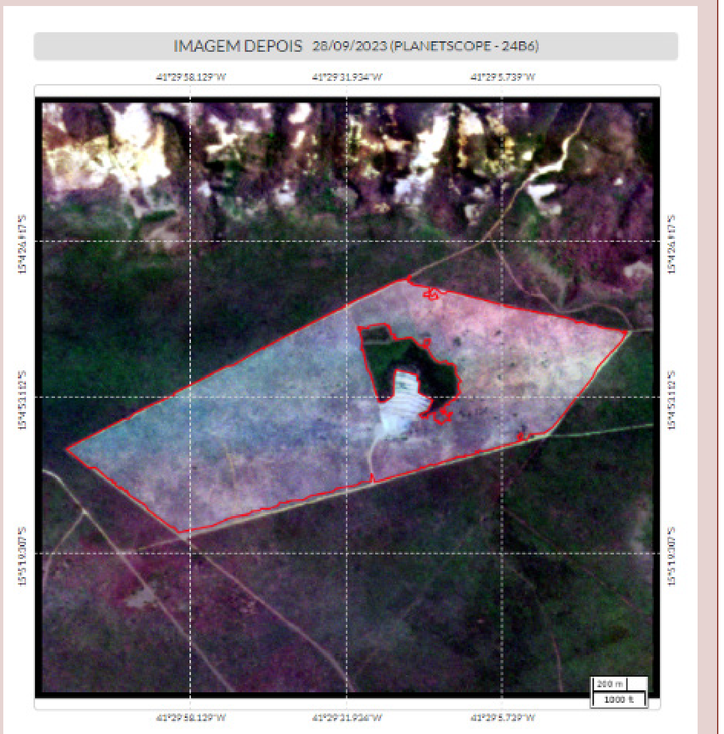
Largest deforestation in the Atlantic Forest in 2023

The largest deforestation detected in the Atlantic Forest biome in 2023 (alert code 1060704) covers an area of 217.91ha and occurred in the municipality of Tremedal, in Bahia. According to INEMA-BA (consulted via email), with regard to alert code 1060704, the area subject to the suppression of native vegetation is not included in a rural property registered with CEFIR/CAR. INEMA technicians were in the field to carry out environmental inspection and did not obtain information on site from the person responsible for the area and the suppression observed. After contact with municipal representatives and people living close to the rural property, it was possible to identify the person responsible for the activity. As a result of what was found, the person responsible will be penalized for the unauthorized activity of suppressing native vegetation, infraction notices will be drawn up applying current environmental legislation and other measures applicable to the situation will be issued, including for the recovery of the area.

Before



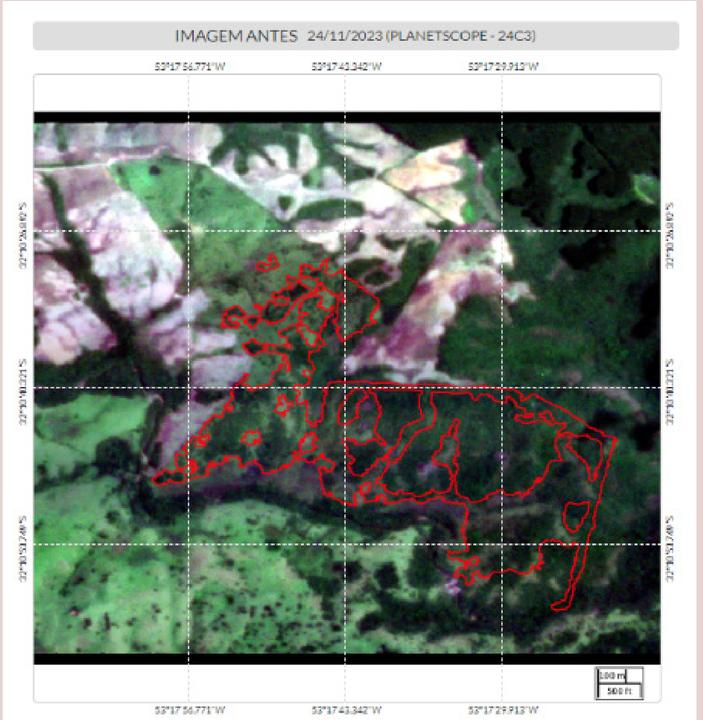
After



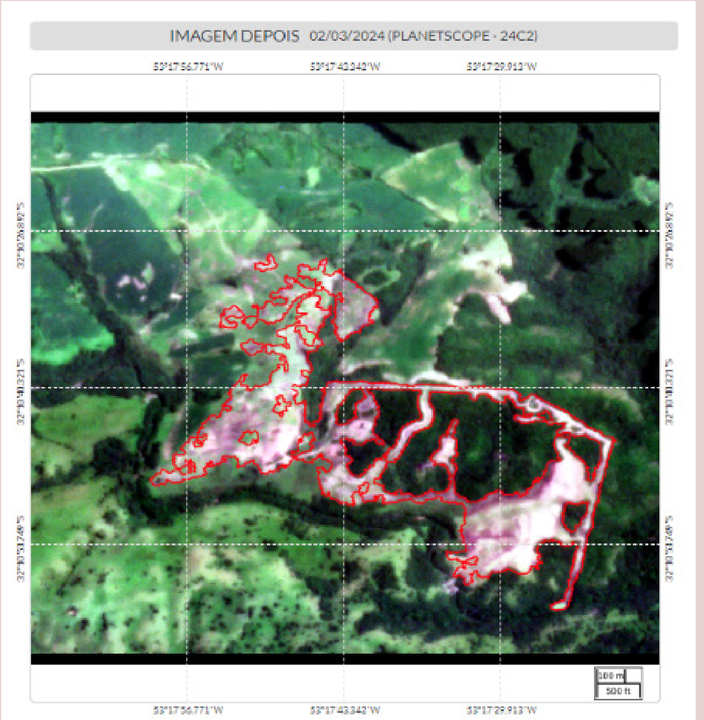
Largest deforestation in the Pampa biome in 2023

Pampa biome in 2023 (alert code 1204419) covers an area of 39.04ha and occurred in the municipality of Herval, in Rio Grande do Sul. According to Fepam -RS there was no licensing for the deforestation in question. At the time this report was being prepared, the site had not been inspected, but Fepam -RS declared that it was organizing inspection for future field verification.

Before



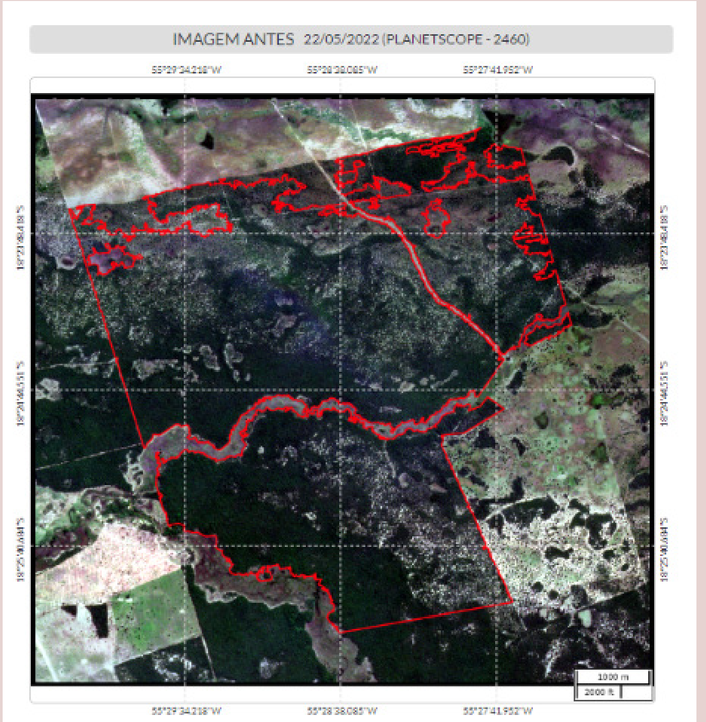
After



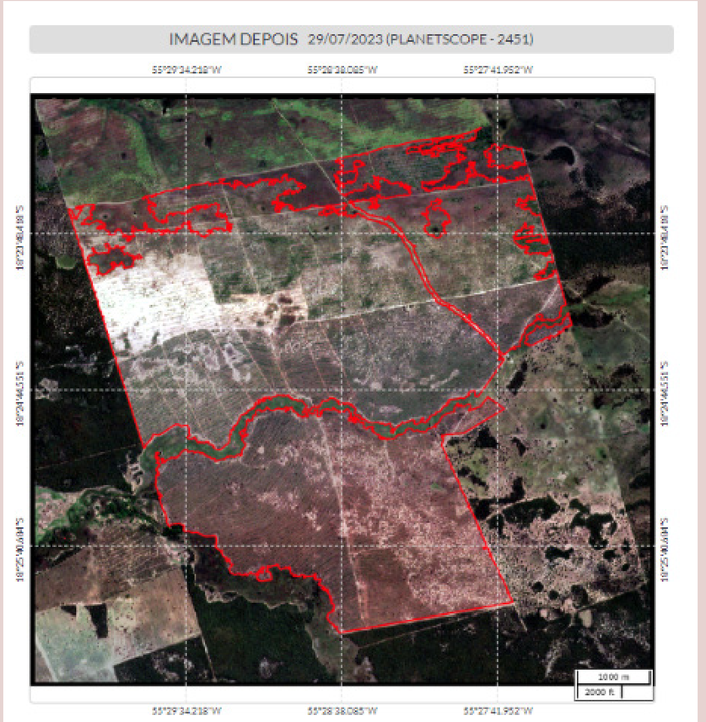
Largest deforestation in the Pantanal biome in 2023

The largest deforestation detected in the Pantanal biome in 2023 (alert code 934272) covers an area of 2,603.36 ha and occurred in the municipality of Corumbá, in Mato Grosso do Sul. According to the Licensing Directorate of Imasul -MS, the area where the deforestation occurred is duly authorized through Environmental Authorization (AA) No. 447/2021, which was replaced by AA No. 14/2022.

Before



After



APPENDIX 6 | Method for Analyzing Actions to Combat Deforestation

Survey of Actions in State and Federal Public Bodies

The analysis performed adopted and cross-referenced the databases of deforestation alerts, deforestation authorizations, areas embargoed and fined by environmental agencies and areas with civil actions filed by Public Prosecution Services.

The deforestation alert databases considered in the analysis are the official RAD2023 database, in shapefile format. The data refers to deforestation areas validated and refined using high-resolution images by MapBiomas Alerta.

At the federal level, the following bases were adopted:

i. embargoed areas issued by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), on May 10, 2024;
ii. infraction notices issued by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), on May 9, 2024;
iii. embargoed areas issued by the Chico Mendes Institute for Biodiversity Conservation (ICMBio), on May 20, 2024;
iv. authorizations for vegetation suppression and alternative land use from Sinaflor, accessed in its Shared Environmental Information System (Siscom) on May 9, 2024.

At the state level, two forms of data acquisition were considered. Databases obtained both by direct submission to MapBiomas and through collaboration between OEMAs and the network (AC, AP, AM, BA, CE, ES, GO, MG, PA, PB, PI, PR, RJ, RN) were considered. The data from RS, SC, TO - Table 1 were also considered, as well as access to public data portals from environmental agencies, when available (Table A). The data was also added to the databases used for reports from previous years, so as to consolidate cumulative information.

Table A GENERAL OVERVIEW OF OEMA RESPONSES TO GEOREFERENCED DATA ON AUTHORIZATIONS, ASSESSMENTS AND EMBARGOES FOR THE YEARS 2018 - 2022

UF	Sent Share data	Sent stock data via Platform	Sent Authorization data via the Platform	In the Inspection Monitor (05/2022)
AC	X	X	X	X
AL	-	-	X	-
AM	X	X	X	X
AP	-	-	X	-
BA	X	X	X	-
CE	X	X	-	X
DF	X	-	-	X
ES	X	X	X	X
GO	X	X	X	X
MA	-	-	-	-
MG	X	X	X	X
MS	-	-	-	-
MT	X	-	-	X
PA	X	X	-	X
PB	X	-	X	-
PE	X	-	X	-
PI	X	X	X	X
PR	X	X	X	X
RJ	-	X	-	-
RN	X	-	X	-
RO	-	-	-	X
RR	X	-	-	-
RS	X	X	X	X
SC	-	X	X	-
SE	-	-	-	-
SP	X	-	-	X
TO	X	X	X	-
Total	19	14	16	14

Table B GENERAL OVERVIEW OF ACCESS TO DATABASES AVAILABLE ON THE OEMA PUBLIC PORTALS.

UF	Information	Base	Format	Access date
BR	asv, uas	Sinaflor	shp	05/09/2024
BR	infraction notice	Infraction notices – Ibama	shp	05/09/2024
BR	infraction notice	Infraction notices – Ibama	csv	09/052024
BR	embargo	Embargoes – Ibama	shp	05/10/2024
BR	embargo	Embargoes – ICMBio	shp	05/20/2024
B.C	asv	Licenses (LP/LI/LAU/LO) granted per year	xlsx	02/10/2024
B.C	infraction notice	Infraction notices drawn up by IMAC	xlsx	02/10/2024
B.C	embargo	Embargo terms drawn up by IMAC	xlsx	02/10/2024
AM	asv	Single Plant Suppression License	xlsx	02/10/2024
AM	infraction notice	Infraction notices	xlsx	02/10/2024
AM	embargo	Embargo and Interdiction Term	xlsx	02/10/2024
AM	embargo	IPAAM Embargoes	shp	02/10/2024
CE	infraction notice	Infraction notices	shp	02/10/2024
CE	regularization	Environmental Damage Recovery Commitment Term	shp	02/10/2024
CE	embargo	Embargo terms	shp	02/10/2024
DF	oversight	Floristic inspection	shp	03/13/2024
ES	oversight	Environmental and forestry inspection	shp	02/10/2024
GO	asv	State environmental licenses (polygons)	shp	02/10/2024
GO	asv	State environmental licenses (points)	shp	02/10/2024
GO	asv	State environmental licenses (lines)	shp	02/10/2024
GO	infraction notice	State environmental infractions (polygons)	shp	02/10/2024
GO	infraction notice	State environmental infractions (points)	shp	02/10/2024
GO	embargo	State environmental embargoes (polygons)	shp	02/10/2024
GO	embargo	State environmental embargoes (points)	shp	02/10/2024
GO	embargo lifted	State environmental clearances (polygons)	shp	02/10/2024
GO	embargo lifted	State environmental clearances (points)	shp	02/10/2024
MT	asv	Deforestation authorization	shp	02/10/2024
MT	infraction notice	Infraction notices	shp	02/10/2024
MT	infraction notice	SIGA infraction notices (polygons)	shp	02/10/2024
MT	infraction notice	SIGA infraction notices (points)	shp	02/10/2024
MT	embargo	SEMA embargoed area	shp	02/10/2024
MT	embargo	SIGA embargoed area (polygons)	shp	02/10/2024
MT	embargo	SIGA embargoed area (points)	shp	02/10/2024
MT	embargo lifted	SEMA cleared area	shp	02/10/2024
MT	embargo lifted	SIGA cleared area (polygons)	shp	02/10/2024
MT	embargo lifted	SIGA cleared area (points)	shp	02/10/2024
MG	asv	Environmental intervention authorizations	shp	02/10/2024
MG	oversight	Activities supervised by SEMAD-MG	shp	02/10/2024
PA	asv	Suppression	shp	02/10/2024
PA	embargo	Deforestation embargoes	shp	02/10/2024
PB	infraction notice	Infraction Notice Report	xlsx	02/10/2024
PI	embargo	Embargoes	xlsx	02/10/2024
PR	embargo	Embargoes	shp	03/21/2024
LOL	asv	Native vegetation management authorizations	shp	02/10/2024
LOL	infraction notice	Infraction notices	shp	02/10/2024
LOL	embargo	Embargoed areas	shp	02/10/2024
RO	asv	Vegetation suppression authorizations	xlsx	02/10/2024
RO	infraction notice	Infraction notices	xlsx	02/10/2024
RO	embargo	Embargo terms	xlsx	02/10/2024
SP	asv	Authorized deletion	shp	02/10/2024
SP	infraction notice	Infraction notices	shp	02/10/2024
SP	embargo	Areas with flora interventions	shp	02/10/2024
TO	infraction notice	Infraction notice	shp	02/10/2024
TO	embargo	Embargo	shp	02/10/2024
RR	asv	Licensed areas	shp	02/10/2024
RR	embargo	Embargoes (Ibama)	shp	02/10/2024

The state Public Prosecution Services of Acre (MPAC), Amapá (MPAP), Amazonas (MPAM), Espirito Santo (MPES), Goiás (MPGO), Minas Gerais (MPMG), Mato Grosso do Sul (MPMS), of Paraná (MPPR), Pernambuco (MPPE), Piauí (MPPI), Rio Grande do Sul (MPRS), Roraima (MPRR), Santa Catarina (MPSC), São Paulo (MPSP) and Tocantins (MPTO), in addition to the Federal Public Prosecution Service (MPF), sent information related to the inspection actions executed. However, only data from MPES, MPGO, MPPI, MPPR, MPRS, MPTO and MPF were considered, as the others did not send data in an appropriate format or with sufficient information to be used in the analyses according to the adopted methodology.

Data analysis

The databases were standardized in the coordinate system with equivalent conic projection of Albers and Sirgas 2000 datum. ArcGIS 10.8 software was adopted for data processing and spatial analysis.

After standardizing the coordinate systems, the database geometries were checked and repaired. This step has the function of freeing the base from topological inconsistencies, empty geometries and other errors that compromise the processing of the next steps.

Subsequently, the Identity tool was used to cross-reference the alerts with deforestation authorizations valid for the period of analysis. This tool calculates the geometric intersection between the databases, so that the alert polygons that fell on authorized areas loaded information relating to authorizations into its database. With this, it was possible to identify in the database of deforestation alerts which were legal (authorized) and illegal (unauthorized). Areas with intersections greater than or equal to 10% of the total alert area were considered.

For databases in point format, as in the case of infraction notices from Ibama and some states, a 60-meter buffer was generated and adopted to cross-reference with deforestation alerts. The area assigned to the infraction notice was that of the deforestation alert that crossed with the infraction notice.

For the states in which the data was in spreadsheet format, the geographic coordinates indicated in the database or the deforestation alert code identified by the body responsible for sending the data as requested by MapBiomas were used for spatialization. The area assigned to the actions that crossed deforestation alerts was the total area of the alerts.

Data from state Public Prosecution Services and the MPF were considered as inspection actions. The main actions of these bodies are characterized by factual news, public civil actions, criminal actions, inquiries and other procedures.

APPENDIX 7 | List of priority municipalities

List of municipalities located in the Amazon Biome that are considered priorities for actions to prevent, control and reduce deforestation and forest degradation, according to Ordinance GM/MMA nº 834, of November 9, 2023:

	Municipality	UF	STATE	Priority according to criteria in Article 2 of Decree 11,687, of 2023 and items I to III of Article 1 of Ordinance GM/MMA No. 833, of November 9, 2023	Priority in accordance with the criteria of Article 2 of Decree 11,687, of 2023 and the sole paragraph of Article 1 of Ordinance GM/MMA No. 833, of November 9, 2023
1	FEIJÓ	AC	ACRE	X	
2	MANOEL URBANO	AC	ACRE	X	
3	RIO BRANCO	AC	ACRE	X	
4	SENA MADUREIRA	AC	ACRE	X	
5	TARAUACÁ	AC	ACRE	X	
6	APUÍ	AM	AMAZONAS	X	
7	BOCA DO ACRE	AM	AMAZONAS	X	
8	CANUTAMA	AM	AMAZONAS	X	
9	HUMAITÁ	AM	AMAZONAS	X	
10	ITAPIRANGA	AM	AMAZONAS		X
11	LABREA	AM	AMAZONAS	X	
12	MANICORÉ	AM	AMAZONAS	X	
13	MAUÉS	AM	AMAZONAS	X	
14	NOVO ARIPUANÃ	AM	AMAZONAS	X	
15	APIACÁS	MT	MATO GROSSO	X	
16	ARIPUANÃ	MT	MATO GROSSO	X	
17	BOM JESUS DO ARAGUAIA	MT	MATO GROSSO		X
18	CLAUDIA	MT	MATO GROSSO	X	
19	COLNIZA	MT	MATO GROSSO	X	
20	COMODORO	MT	MATO GROSSO		X
21	COTRIGUAÇU	MT	MATO GROSSO	X	
22	FELIZ NATAL	MT	MATO GROSSO	X	
23	GAÚCHA DO NORTE	MT	MATO GROSSO	X	
24	JUARA	MT	MATO GROSSO	X	
25	JUINA	MT	MATO GROSSO	X	
26	MARCELANDIA	MT	MATO GROSSO	X	
27	NOVA BANDEIRANTES	MT	MATO GROSSO	X	
28	NOVA MARINGÁ	MT	MATO GROSSO	X	
29	NOVA UBIRATÃ	MT	MATO GROSSO	X	
30	PARANAÍTA	MT	MATO GROSSO	X	
31	PARANATINGA	MT	MATO GROSSO		X
32	PEIXOTO DE AZEVEDO	MT	MATO GROSSO	X	
33	QUERÊNCIA	MT	MATO GROSSO	X	
34	RONDONLANDIA	MT	MATO GROSSO		X

	Municipality	UF	STATE	Priority according to criteria in Article 2 of Decree 11,687, of 2023 and items I to III of Article 1 of Ordinance GM/MMA No. 833, of November 9, 2023	Priority in accordance with the criteria of Article 2 of Decree 11,687, of 2023 and the sole paragraph of Article 1 of Ordinance GM/MMA No. 833, of November 9, 2023
35	SÃO JOSÉ DO XINGÚ	MT	MATO GROSSO		X
36	UNIÃO DO SUL	MT	MATO GROSSO	X	
37	ALTAMIRA	PA	PARÁ	X	
38	ANAPU	PA	PARÁ	X	
39	CUMARU DO NORTE	PA	PARÁ	X	
40	DON ELISEU	PA	PARÁ	X	
41	ITAITUBA	PA	PARÁ	X	
42	ITUPIRANGA	PA	PARÁ	X	
43	JACAREAGANGA	PA	PARÁ	X	
44	MARABÁ	PA	PARÁ	X	
45	MEDICILÂNDIA	PA	PARÁ	X	
46	MOJU	PA	PARÁ	X	
47	MOJUÍ DOS CAMPOS	PA	PARÁ	X	
48	NOVO PROGRESSO	PA	PARÁ	X	
49	NOVO REPARTIMENTO	PA	PARÁ	X	
50	PACAJÁ	PA	PARÁ	X	
51	PARAGOMINAS	PA	PARÁ	X	
52	PLACAS	PA	PARÁ	X	
53	PORTEL	PA	PARÁ	X	
54	PRAINHA	PA	PARÁ		X
55	RONDON DO PARÁ	PA	PARÁ	X	
56	RUROPOLIS	PA	PARÁ	X	
57	SANTANA DO ARAGUAIA	PA	PARÁ	X	
58	SÃO FÉLIX DO XINGU	PA	PARÁ	X	
59	SENADOR JOSÉ PORFÍRIO	PA	PARÁ	X	
60	TRAIRÃO	PA	PARÁ	X	
61	ULIANÓPOLIS	PA	PARÁ	X	
62	URUARÁ	PA	PARÁ	X	
63	BURITIS	RO	RONDONIA	X	
64	CANDEIAS DO JAMARI	RO	RONDONIA	X	
65	CUJUBIM	RO	RONDONIA	X	
66	MACHADINHO D'OESTE	RO	RONDONIA	X	
67	NOVA MAMORÉ	RO	RONDONIA	X	
68	PORTO VELHO	RO	RONDONIA	X	
69	MUCAJAÍ	RR	RORAIMA	X	
70	RORAINÓPOLIS	RR	RORAIMA	X	

APPENDIX 8 | Supplement on the classification of availability and active transparency of data by State

UF	Organ	Status of online availability of data on an open portal during the preparation of this report
AC	IMAC	Classification: (b), (b), (b) IMAC provides information on infraction notices for the years 2019 to 2023 (information only referring to the first half of the year). Spreadsheet with information for 2022 has been downloaded from the website, making access unavailable. The spreadsheets (xls) contain columns of: process number, name of the interested party, name of the person responsible, alert ID (for some), address, municipality, damage, auto/notifc number, sanction applied, value, coordinates 1 (for some), coordinates 2 (for some), volume (for some), area in hectares (for some), burning, deposit term (information unavailable in 2023), TC (information unavailable in 2023). The spreadsheets present the sanction applied based on the article of legislation that is not indicated (probably environmental crimes law). Furthermore, the spreadsheets do not present coordinated information for all infraction notices in all years. When presented, the information is organized in different ways that make spatialization difficult.
AL	IMA	The IMA provides notices of final arguments, the last being dated April 12, 2024. PDF file, containing: name of the interested party, CNPJ/CPF, opening process number, infraction notice number. The information is presented without indication of deforestation. The IMAGEO portal does not allow downloading of information such as embargoes.
AM	IPAAM	Classification: (a), (a), (a) The transparency section on the IPAAM website provides spreadsheets of infraction notices and embargoes, until December 2023. In the infraction notice spreadsheet, it is possible to identify the type of infraction from the infraction description column (whether due to deforestation or not). Geographic coordinates are available. Identification is also possible in the embargoes spreadsheet using the description column. Geographic coordinates are available. Furthermore, the IPAAM Geoportal provides information on embargoes issued by the agency, in addition to other embargoes and notices of infringement by federal agencies. This information is mostly outdated and incomplete. The spreadsheets (xlsx) of the infraction notices and embargoes and shapefile of the embargoes drawn up by IPAAM are available. The IPAAM Geoportal provides information on embargoes issued by the agency, in addition to other embargoes and notices of infraction by federal agencies.
AP	SEMA	Classification: (b), (c), (c) SEMA-AP provides environmental reports in PDF, containing infraction notices from 2018 to 2020 (outdated). A PDF file is available, without the date of the assessment (only the reference to the year in the file name and date of the infraction), or a clear description of the deforestation. Information on infractions and penalties is indicated based on the article of legislation that is not indicated (incomplete). There is no georeferenced data from the infraction notices or information on coordinates. Information about the location of the offense is presented as an address.
BA	INEMA	Classification: (c), (d), (d) No databases on assessments and embargoes were found on the agency's website.
CE	SEMACE	Classification: (b), (a), (a) SEMACE makes PDF maps, spreadsheets and KML/shapefile files available for download, showing infraction notices (2012 - Jun. 2023), embargo terms (2012 - Jun. 2023) and areas under recovery. The files are in shapefile, spreadsheet and PDF format. In the terms of the embargo there is no description of the reason (to identify whether it was deforestation), but the type of infraction is presented in the notice of infraction, clarifying which cases actually involve deforestation. The basis for the embargo is also indicated and specifies the law/decree, article, item and paragraph to which the infraction corresponds.
DF	Brasília Ambiental	Classification: (a), (c), (a) IBRAM provides information on infringement notices and embargoes. Embargo data is made available via the ONDA geoservice page and downloads in shapefile format, with access to the data spreadsheet. The file update is from Jan 23rd. 2024. The file is georeferenced (geographical coordinates). The infraction notice data is presented as a PDF list. This contains basic information (process number, subject, infraction notice number, term number, legal provision violated, penalty, fine, interested party, first instance result and decision). Coordinate pairs are not included. None of the data presents a clear indication in the case of deforestation; however, for the infraction notices, the legal provision violated is presented.
ES	IDAF	Classification: (a), (a), (a) IDAF provides information regarding environmental and forestry inspections with complete and updated data as of April 2024. The information available is in spreadsheet and shapefile format. It is possible to identify the type of inspection and whether it is related to deforestation. The data from inspection actions are in vector format (shapefile) and, in a spreadsheet, contain geographic coordinates.
GO	SEMAD	Classification: (a), (a), (a) The SIGA-GO portal provides data on infraction notices and embargoes in a complete and updated vector format. The information available is from the SIGA-GO system. Database differentiated between notices and embargoes (points and polygons), with indication in the attribute table regarding the reason for the notice/embargo (identifies whether there was deforestation). The data is georeferenced (shapefile).
MA	SEMA	Classification: (b), (c), (c) SEMA-MA makes infraction notice data available via on-screen listing. The infractions are dated until April 2022 (out of date). Unable to download the database. The information is available as a list on screen, containing in detail the date the notice was drawn up and a text that explains the reason for the infraction notice (where information can be extracted as to whether it is due to deforestation). Geographic coordinates are only included in some of the records. No georeferenced data were found.

UF	Organ	Status of online availability of data on an open portal during the preparation of this report
MG	SEMAD	Classification: (b), (b), (a) SEMAD-MG provides information on supervised activities through IDE-SISEMA. The available data was outdated and only available until December 2023. Geographic information is represented by points and contains different types of damage, including damage to flora. The data is available regarding the points of concern and has an indication of deforestation. However, there is no indication of which action (notification, notice, embargo) was generated by the agency, only the indication that the area was inspected. The information is georeferenced (shapefile).
MS	IMASUL	Classification: (c), (d), (d) IMASUL provides a search tool for processes; however, it is only possible to consult the process with its number or details of the author/interested party, which are unavailable for full consultation by the general public.
MT	SEMA	Classification: (a), (a), (a) SEMA-MT provides information on infraction notices and embargoes on an open portal with updated data and in a georeferenced format. The information is available in shapefiles and spreadsheets, containing a subtype category that allows identification of whether it was deforestation, inspection and reporting, among other classifications. In addition, there is the date of issuance of the notice, or of issuing of the embargo. Both are georeferenced information, in shapefile format, with embargoes in polygons and records in points.
PA	SEMAS	Classification: (b), (a), (a) SEMAS-PA makes data on embargoes by "LDI" available on two different portals (LDI monitoring and the CAR Analysis Portal). The data does not contain a complete date for all embargoes, apparently they go until 2021. The data is in georeferenced format. The spreadsheet (XLSX) made available by the Illegal Deforestation List (LDI) is exclusively for deforestation embargoes. The attributes table does not contain the inspection date for all embargoes (only for 53% of entries), but presents the year for all, going up to 2021. Information on infraction notices is only available through the transparency portal. Data is updated (April 2024). The infraction notices are available for download in PDF and XLSX format. This data is not georeferenced but presents a location field with geographic coordinates (decimal format). The spreadsheet (XLSX) of infraction notices shows the date it was drawn up and the reason for the notice, making it clear whether there was deforestation (indicates the area and volume deforested).
PB	SUDEMA	Classification (a), (b), (b) SUDEMA provides reports on infraction notices between 2022 and 2024. The reports are available in spreadsheet format, containing pairs of geographic coordinates. No georeferenced data were found.
PE	CPRH	Classification (c), (d), (d) The CPRH has a search system that identifies the infraction notice. However, to access it, one must fill in prior data such as no. of the infraction notice or CPF/CNPJ of the person charged or name/business name. The website will inform that one of these fields needs to be filled in to be able to carry out the search. The current Sig Caburé is temporarily out of service. No georeferenced data were found.
PI	SEMARH	Classification: (c), (d), (d) SEMARH has a page on its website dedicated to environmental transparency. However, the pages on infraction notices (records drawn up) and embargoes (terms of sanctions) were under maintenance at the time of this check.
PR	IAT	Classification (a), (a), (a) The IAT provides information in PDF format on infraction notices drawn up, adjudicated or with terms of embargo. Additionally, it provides embargoed areas on a georeferenced basis (polygon format), from 2001 to 2023.
RJ	INEA	Classification: (b), (b), (c) INEA makes the information available on a PowerBi dashboard, which can be accessed with graphs and tables. The last update appears in a report from February 2022. Therefore, has not been updated. No georeferenced data were found.
RN	IDEMA	Classification: (b), (b), (c) IDEMA provides a search tool on the website, presenting a general list of the files, with the possibility of accessing a PDF file for each file, containing detailed information. The data in the description makes it clear when the report refers to deforestation, but few have geographic coordinates. IDEMA's SEIA portal does not provide data on infraction notices or embargoes. Therefore, no georeferenced data was found.
RO	SEDAM	Classification: (b), (a), (b) SEDAM has a Transparency Portal for environmental information of interest. This Portal contains the report on the embargoed areas for 2013 and 2022, indicating the geographic coordinates. A spreadsheet is also available containing the report of infraction notices from 2005 to 2022. Therefore, outdated data. The SEDAM GeoPortal page provides data on infraction notices and fined areas; however, no way was found to download the data.

UF	Organ	Status of online availability of data on an open portal during the preparation of this report
RR	FEMARH	Classification: (c), (d), (d) FEMARH has a transparency page on its website, with environmental information about licensing and burning. However, the inspection section, linked to the Environmental Monitoring and Control Directorate, is being updated. The body still has the Roraima Geographic Information and Environmental Management System (SIGGARR); however, the embargo base made available refers to embargoes drawn up by Ibama.
RS	FEPAM	Classification: (a), (a), (a) FEPAM presents a data transparency portal, providing shapefile information (based on points) of infraction notices (2017 - 2024) and embargoes (2017 - 2024). The reason for the infraction notice or embargo is presented in the attributes table, making it possible to identify when it was due to deforestation.
SC	IMA	Classification: (c), (d), (d) The IMA only publishes a search tool for infraction notices; however, it is necessary to have the report number or name of the person charged. It also has a portal with an interactive map and a module on inspection. However, it was not possible to access the inspection layer during the evaluation.
SE	ADEMA	Classification: (c), (d), (d) Information not available.
SP	SEMIL	Classification: (a), (a), (a) SEMIL provides shapefile databases of infringement notices and also of areas with intervention in the flora (embargoes). Contains information until April 2024 (assessments and embargoes).
TO	NATURATINS	Classification: (a), (a), (a) Naturatins provides shapefile databases on infraction notices and embargoes between the years 2022 and 2023. The infraction notice database describes the reason, making it possible to identify when it was "due to deforestation," not on the basis of embargoes.

APÊNDICE 9 | Additional information on the role of State Public Prosecutor's Offices in combating deforestation

All State Public Prosecution Services were contacted by the MapBiomas team by email, via interlocution with the CNMP team, in accordance with the partnership formalized under the ACT Technical Cooperation Agreement no.11/09/2020. Some MPs responded with relevant information regarding their actions on the agenda to combat deforestation. These responses are summarized below:

MPAM:

"In relation to the requests, I inform you that Item 1 was affected due to MPAM not yet having made data available on actions carried out by the institution on public bases.
Item 2 was also affected due to MPAM not yet having provided a system that allows the extraction of the actions taken in each case. Furthermore, the unified tables of subjects used by the Brazilian Public Prosecutor's Office do not allow for a precise individualization of cases of "deforestation", which led to the referral of OFFICIAL NOTICE no. to the President of the Environmental Commission of the National Council of the Public Prosecution Service.
Regarding Item 3, I wish to inform that all procedures received from environmental agencies regarding deforestation are forwarded to the member with responsibilities, both in the capital and in the interior of the State. Furthermore, the Operational Support Center has already carried outofficial distributions in specific cases, using the Brasil MAIS platform.
With a view to expanding its operations, this Coordination has already requested the MPAM Higher Administration to create a Geoprocessing Laboratory (SEI 2024.000889) and a Specialized Action Group on Environment and Urbanism (SEI 2023.008617).
Still with reference to Item 3 as explained above, the unified subject tables
used by the Brazilian Public Prosecutor's Office do not allow for a precise individualization of cases of "deforestation", making it impossible to extract "general quantities of the MP's activity related to the agenda of combating and holding deforestation accountable". I note that this Operational Support Center requested that the MPAM systems (SAJ-MP and MP Virtual) use subclassifications for deforestation and fires (SEI 2021.008784). Despite being created within the scope of the MPAM, their use was made unfeasible because they generated errors when filling out the Functional Activity Report (RAF). As a solution, we understand that the necessary changes to the unified tables should be discussed by the National Management Committee for Unified Tables (CGNTU) of the CNMP Strategic Planning Commission (CPE/CNMP), and the Environment Commission (CMA/CNMP) should be heard."

MPAP:

"With cordial regards, I would like to inform you that 79 extrajudicial procedures were initiated to combat deforestation in the State of Amapá, being divided
between the municipalities of Macapá, Pedra Branca do Amaparí, Calçoene, Tartaruzalginho and Amapá, according to the attached documentation.
Finally, I conclude with renewed expressions of esteem and consideration and am at your service should you have any further doubts."

MPGO:

"The MPGO, through the Environment and Consumer Area of Operations of the Operational Support Center (CAOMA/Consumer), receives and distributes infraction notices arising from inspections carried out by federal, state and municipal environmental agencies, including the State Secretariat of Environment and Sustainable Development (SEMAD) and the Municipal Secretariat for the Environment of the Capital, AMMA-Goiânia These records are entered into the Atena system as News of Fact and distributed to the Public Prosecutor's Offices with environmental attribution for action. The infraction will be forwarded by the aforementioned entities and distributed to the Public Prosecutor's Offices, as can be seen in the tables below:

ANNUAL REPORT OF EXTRAJUDICIAL RECORDS - TRAFFIC VIOLATION (IBAMA)	
2019	98
2020	22
2021	
2022	
2023	
2024	

ANNUAL REPORT OF EXTRAJUDICIAL RECORDS - TRAFFIC VIOLATION (SEMAD)	
2019	267
2020	488
2021	639
2022	854
2023	833
2024	566

ANNUAL REPORT OF EXTRAJUDICIAL RECORDS - TRAFFIC VIOLATION (SEMAD)	
2019	707
2020	348
2021	1.173
2022	1.088
2023	924
2024	126

Furthermore, the Public Prosecutor's Office can obtain information about illegal deforestation through various sources, including communications from civil society, public and private entities, police investigations, detailed terms of occurrence and other municipal environmental departments. In these cases, it is up to the Public Prosecutor's Office to assess the need for intervention and adopt preliminary measures in accordance with the guidelines established by CPJ Resolution No. 09, of August 27, 2018.

Since 2018, the Support Center has assisted in the Nationwide Operation Mata Atlântica em Pé, facilitating coordination between IBAMA, SEMAD and the Environmental Military Police Battalion to protect the remnants of this biome in Goiás territory. Detailed information about this activity can be found in the attached spreadsheet. Additionally, the MPGO created the Special Action Group for the Defense of the Environment (GAEMA), which works jointly with the Public Prosecutor's Offices on major deforestation events, especially those detected during Operation Zero Illegal Deforestation, carried out by SEMAD in municipalities such as Mineiros and Caiapônia."

MPMG:

"We inform you that, in the general framework, multiple judicial and extrajudicial measures are adopted by the MPMG in relation to the matter. However, the Institution still does not quantify the results of these measures in terms of estimates or precisely in the territory.

Quantification has been possible in focused initiatives, such as what occurred in the project Implementation of Legal Reserve Areas in Minas Gerais (cf. p. 25 of the PGA report - Final General Action Plan 2018-2019), in addition to the results of the Operation Mata Atlântica."

Productivity of the Atlantic Forest Operation Phase VII 2023

Description	Quantification
Municipalities covered by inspection	21
Inspected Properties	49
Inspected Polygons	85
Embargo/Suspension Area	1,019.34 hectares
Seized Timber Yield	12,779.86
Native/Planted Coal Seized	191.68 MDC
Traffic tickets	44
Value of fines	R$ 9,115,909.17

MPPE:

"Please be informed that, for the period from 01/01/2019 to 12/31/2023, grouped Class According to the CNMP taxonomy, the following numbers of files were created in the Archimedes System for subjects (9994- Environmental Damage, 11828- Area of Permanent Preservation, 15301- Collective Moral Damage Resulting from Environmental Damage, 10113- Flora, 11823- Legal Reserve, 10118- Nature Conservation Unit):

QTY. CLASS
1 Suspension of Injunction and Verdict
30 Notification of Fact
7 Interlocutory appeal
2 Special Court Procedure Civil
15 Civil Appeal
137 Civil Inquiry
2 Shipping Required Civil
2 Police Inquiry
47 Procedure Preparatory
6 Common Procedure Civil
11 Criminal Representation/Crime News

1 Criminal Investigative Procedure (PIC-MP)
1 Collective Civil Action
1 Writ of Mandamus Civil
19 Procedure Administrative
1 Appeal / Remittance Required
1 Arrest report in flagrante delicto
61 Public Civil Action
1 Administrative Procedure for monitoring Policies Public
1 Notification of Crime
12 Detailed Term
1 Criminal Action - Ordinary Procedure
4 Class Action
2 Environmental Crimes"

MPPI:

In compliance with the order of the CAO-MA/MPPI Coordinator, Public Prosecutor Áurea Emília Bezerra Madruga, we communicate the following regarding the related actions for controlling and fighting deforestation/suppression of native vegetation carried out by the Public Prosecution Service in the years 2019 to 2023:
Since 2018, this CAOMA/MPPI has participated in the "Operação Nacional Mata Atlântica em Pé", through which technical inspections are carried out by the engineer of this MPPI, by the Environmental Policing Battalion, by IBAMA-PI, by the State Secretariat for the Environment (SEMARH-PI) and the Municipal Secretariat for the Environment of Teresina-PI (SEMAM), which result in technical reports on of what was found in the polygons where there are remnants of the Atlantic Forest in the State.
Subsequently, this CAOMA forwards the technical reports and draft parts, so that the Public Prosecutor's Offices with responsibility in the municipalities can propose the measures that they deem appropriate. However, we do not have control over the number of judicial proceedings initiated by the Prosecutor's Offices.
Furthermore, this CAOMA/MPPI has been participating in the execution of the "Alerta MATOPIBA" Project, since the year 2023, so that ABRAMPA sends us the alerts of deforestation occurring in the MATOPIBA region, whose reports we pass on to respective Public Prosecutor's Offices, accompanied by the draft Ordinance for establishment of a Civil Inquiry, for which we have a control table and case numbers in the "SIMP" system for initiated investigations, as per annex.
Furthermore, regarding the other specific actions of the Public Prosecutor's Offices on the the issue of deforestation of native vegetation, we do not have other controls on information regarding the actions carried out by the Public Prosecutor's Offices within the scope of their counties."

MPRR:

"Considering that PJMA does not go to the field to carry out assessments and does not provide data on deforestation inspection actions in public geospatial databases, the way in which PJMA/MPR operates was informed in general terms. MapBiomas representatives provided the necessary guidance so that the information is in accordance with PJMA's actions and suggested changing the way in which information is sent, which is necessary to better contribute to RAD 2023.
It was agreed to request an extension of the deadline for sending information on the amount of deforestation that arrived at PJMA in 2023.
Below is information on how the Public Prosecutor's Office for the Defense of the Environment operates in the municipalities of Boa Vista/RR and Cantá/RR, referring to the deforestation received.

2. FORM OF ACTION
The inspection bodies of the Federal Government (IBAMA), State Government (FEMARH), Military Police/RR (CIPA) and Municipal Government (SEMMA) forward infraction reports environmental documents drawn up in the municipalities of Boa Vista/RR and Cantá/RR for the Public Prosecution Service, among them are those involving the ENVIRONMENTAL CRIME of DEFORESTATION. The files receive dispatches for establishing Notification of the Fact, which may, during the investigation, be converted into Preparatory Procedures, Civil Inquiries or sent, in the form of Notification of Fact, to the Environmental Police Stations - DPMA and/or the municipal Police Station from Cantá. All infraction notices are accompanied by reports with detailed data on the occurrence and geographic coordinates of the location of the incident."

MPSC:
"It should be noted that the State of Santa Catarina, given the reality of the existence of many small properties, and the possibility of deforestation resulting from forestry activities, has a different role in detecting deforestation. Thus, the Environmental Military Police carries out the comparison of alerts received from MapBiomas, but also uses other tools available to environmental agencies in Santa Catarina.
I inform you that Operation Mata Atlântica em Pé, in the year 2023, in the State of Santa Catarina, carried out jointly by the MPSC and the Environmental Military Police, resulted in inspection operations in 66 municipalities in Santa Catarina, with a view to inspecting 176 alerts of possible deforestation that were registered between January and August 2023. Inspections revealed that 102 of these alerts corresponded to illegal deforestation, resulting in a total of 644 hectares irregularly deforested. Consequently, fines worth R$2,894,894 were imposed on violators.
Comparing the numbers with the 2022 edition of the operation, the report points to a reduction in the illegally deforested area. In 2023, 644 hectares of deforestation were identified, compared to 877 in the previous year.
Furthermore, I inform you that this Support Center remains available to provide the desired data, if there is future interest, by granting a period of time sufficient for the necessary investigations."

MPTO:
"In addition, we inform you that the Public Prosecution Service of Tocantins has made available a Deforestation Monitoring Panel in Tocantins, a public, geospatialized and updated database for collecting deforestation information, including the alerts already made available by Mapbiomas since 2019, with due identification of rural properties and the accumulated figure for each year. The panel is available at the following link: https://storymaps.arcgis.com/stories/ca3768747cdc4274bade5ed9179bed0d

The platform also contains information on more than 12 thousand alerts identified in Tocantins, more than 500 thousand hectares, the size classes of the alerts, the ranking of municipalities, and the identification of more than 8 thousand rural properties with deforestation, as shown in image below. (https://caomampto.maps.arcgis.com/apps/dashboards/0a3c08abc5e94bac983f2cfee0bd299d).

The MPTO has also organized a database of deforestation authorizations issued by the environmental agency. This base includes rural properties with authorizations and the polygons of effectively authorized areas. (https://caomampto.maps.arcgis.com/apps/dashboards/87db859459c34028b65522108f57a93f)
With this organized base, Tocantins now has the possibility of identifying which properties have authorized deforestation and which are potentially illegal. The Panel has a tool that allows the owner to report an authorization if their rural property has been identified without a license. "This allows the information to be corrected later."

MAPBIOMAS

http://alerta.mapbiomas.org