# AMAZÔNIA 2030

BASES FOR SUSTAINABLE DEVELOPMENT

## ACKNOWLEDGMENTS

The Amazon 2030 Project is Brazilian-led research effort that aims to formulate a sustainable development plan for the Brazilian Amazon. Its objective is to understand how the region can achieve a higher level of economic and human development while ensuring the sustainable use of natural resources by 2030. This book represents the synthesis of 60 reports produced by more than 80 researchers from various institutions. The authors wish to thank the senior project collaborator, economist José Alexandre Scheinkman. Financial support for this work was provided by the Institute for Climate and Society (ICS) and Instituto Itaúsa. The data and opinions presented herein are the responsibility of the authors and do not necessarily reflect the views of the study's sponsors.

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## SUMMARY

# PREFACE

The Amazon is now the first thing that comes to mind when Brazil is mentioned abroad. It has become our postcard. However, it's not the postcard we once had with football or the beautiful and charming former capital, Rio de Janeiro. The forest, once inhabited by ancestral peoples and a natural reserve for the planet, has become an increasingly deforested space, partly occupied by illegal loggers and miners who leave behind a trail of mercury in the waters, degraded lands, and crimes. At a time when risks related to global warming are growing, what should be an asset for Brazil has turned into a shameful reputational and economic liability.

But now, after a period of darkness, the winds are turning for the Brazilian Amazon. I have been following the extraordinary Amazon 2030 project since its inception. It could not have come at a more opportune moment. The project presents a comprehensive and coherent strategy for regional development, without which there will be no chance of success.

The work is the result of the efforts of dozens of experts, organized according to the most relevant areas of social, economic, and environmental impact. This multidisciplinary emphasis is crucial. The challenges facing the Amazon go far beyond deforestation and affect the future of the 28 million inhabitants of the region. It is imperative to simultaneously improve the quality of life for people and reforest the region. Reforestation is part of the indispensable response to the challenge of climate change. Is it something achievable at a reasonable cost? Yes, as this report demonstrates, A key lesson is that there is still significant room to increase agricultural and livestock production in the region without cutting down a single tree.

It follows that the pursuit of more and better jobs necessarily involves creating urban opportunities or ones that respect the existential imperative of preservation. Clearly it has been difficult to find development paths for Brazil in areas that are connected to productive regions. Even harder is the same pursuit in spaces where the logistics are limited by preservation.

But do not despair. As presented in this report, good proposals and solutions abound.

Deforested lands offer the greatest opportunities, including sustainable forest management based on its products, restoration, productive livestock, and modern agriculture.

Deforestation has already reached the 20% mark, reversing a decade-long trend of decline and accelerating, especially in the last three years. Fortunately, ecological reforestation has already shown that it can be economically viable. Natural restoration is also occurring on a larger scale than imagined, reinforcing the idea that a growing forest has value, and a standing forest, too. Mechanisms for the economic and financial viability of these activities are being developed, alongside global efforts to reach the carbon emission reduction goals set for 2050.

However, there are numerous risks and points of contention associated with these initiatives. I am struck by the fact that 29% of the Brazilian Amazon remains without defined property rights. Another extremely complicated problem is the fast growing increase in violence and organized crime in the region. Homicide statistics already far surpass the national average, with a tendency to worsen. Clearly, reinforcing the state's presence in the region on all fronts of action will be necessary.

This report depicts the size of the challenge facing the Amazon's future, but also demonstrates that it is possible to turn the tide. Its publication aims to contribute to an informed debate about the region, based on a strategy that deserves consideration.

**Armínio Fraga**
September 2023

# PRESENTATION

The Amazon 2030 project aims to propose solutions for the economic, social, and environmental development of the Brazilian Amazon. In the first phase (2020-2022), the project – led by Brazilian researchers – engaged over 80 researchers from various regional, national, and international institutions. They published 60 technical reports on topics related to social policies (health, education, public safety, demography), the Amazonian economy (income and employment, public finance, bioeconomy, infrastructure, livestock, and others), environmental conservation (forest restoration, carbon market, anti-deforestation policies, etc.), as well as cross-cutting themes such as land tenure and cities.

The book "Amazon 2030" (Volume 1) is a synthesis of the studies published in the first phase of the project. It is structured into three chapters:

- **The Amazon Paradox;**
- **The Five Amazons: Foundations for the Sustainable Development of the Brazilian Amazon;**
- **Zero Deforestation and Land Use Planning: Pillars for the Sustainable Development of the Brazilian Amazon.**

The first chapter addresses the so-called Amazon paradox, in which three serious problems are recast as opportunities for the region.

Firstly, over the last decades, the Amazon has experienced extensive deforestation, amounting to around 84 million hectares. This has resulted in the creation of vast degraded areas, often abandoned or occupied by low productivity agriculture or cattle ranching. If productivity were improved, these deforested areas could accommodate all agricultural expansion in the region, creating a surplus of approximately 35 million hectares. This surplus could be utilized for forest restoration involving the planting native trees for carbon capture, or directed towards other land uses.

Secondly, despite facing excessive deforestation, the Brazilian Amazon retains a vast remaining forest cover that is gaining increasing strategic value and importance due to its environmental services, potential for the bioeconomy, and superlative biodiversity.

Thirdly, the Amazon has over 8 million working-age adults who are not in the workforce. This serious social crisis can represent an opportunity, heightened by the fact that the region is still benefiting from a demographic bonus. That is, the number of economically active adults is larger than the number of children and the elderly.

The second chapter discusses the heterogeneity that exists within the Brazilian Amazon. Covering 5 million km2, which is equivalent to 59% of Brazil, the region displays distinct patterns of human occupation and land use. Recognizing the different "Amazons" is a precondition for any feasible sustainable development plan for the region. In this chapter, the Brazilian Amazon is divided into five major zones: "The Forested Brazilian Amazon", "The Brazilian Amazon with Forest Under Pressure", "The Deforested Brazilian Amazon", "The Non-Forested Brazilian Amazon" (the vast majority of this area is covered by savanna-type vegetation and natural grasslands), and "The Urban Brazilian Amazon" (where about two-thirds of the population resides).

Policy suggestions vary depending on the zone. For example, intensifying agriculture and forest restoration are critical for the development of the Deforested Brazilian Amazon. In contrast, environmental enforcement carries greater weight in the Brazilian Amazon with Forest Under Pressure, where most deforestation has occurred. The bioeconomy should be encouraged throughout the region but it is key in the Forested Amazon. The carbon market is fundamental in all zones, but the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation) is even more critical in the Brazilian Amazon with Forest Under Pressure.

Ending deforestation is crucial for both the environment and climate, as well as for the economic and social development of the Brazilian Amazon. Continued deforestation keeps Amazonian society trapped in a vicious cycle of environmental destruction with low land productivity, high poverty rates, and slow social progress. Moreover, it has contributed in recent years to an explosion of environmental crimes and increased violence in the region.

In summary, deforestation deteriorates the economic environment and prevents good investments in the region. Land use planning is also imperative, as approximately 29% of the Brazilian Amazon territory remains with undefined land tenure, a significant portion of which consists of public forests not allocated.

The bases for allocating these lands are already present in current Brazilian legislation. Therefore, it is crucial that land use planning policy in the Brazilian Amazon aligns the procedures for allocating public lands according to the order of priorities identified in the Constitution and national legislation.

Increasing regional productivity, attracting good investors and entrepreneurs to the region, harnessing opportunities related to the bioeconomy and forest restoration, and ensuring the provision and remuneration of ecosystem services provided by the forest are all impossible without zero deforestation and land use planning.

# THE AMAZON PARADOX

The recent history of the Brazilian Amazon is marked by rapid population growth and an explosive increase in deforestation. In the last 50 years, deforestation has gone from a mere 0.5% in 1975 to 21% in 2021. Put together, the accumulated destruction of around 86 million hectares of forests is equivalent to the sum of the areas of Spain and Italy. In addition, extensive areas of remaining forests are degraded by fires and illegal logging.

Finally, the local population quadrupled in the same period, from about 7 million in 1970 to approximately 28 million people in 2021.

This process was accompanied by serious social conflicts and resulted in the worst of all possible scenarios: environmental destruction, low quality of life for the population, an economy with limited growth, and very high carbon emissions. In fact, in 2019, the Brazilian Amazon contributed less than 9% of the country's GDP and generated 48% of Brazil's Greenhouse Gas emissions. The majority of these were due to deforestation and fires.

The Amazon region is suffering from record deforestation rates, violence, and worsening social conditions. However, each of the factors that contribute to the current crisis presents elements that can serve as a foundation for sustainability in the region. This context constitutes the Amazon paradox, namely that it is possible that a new model of regional development, one based on the sustainable use of the forest's natural resources, may emerge from an apparently unsolvable situation.

## THE DISASTROUS OCCUPATION OF THE BRAZILIAN AMAZON CURRENTLY OFFERS US THE KEYS TO BUILDING ITS SUSTAINABLE FUTURE

The Amazon paradox is made up of three elements. The first of these, the most evident, is excessive deforestation over the last four decades. The vast expanses of deforested lands that resulted are now degraded and underused. These lands are available for development and are much larger than the area needed for all agricultural production in the region. Thus, the deforestation crisis provides an opportunity to take advantage of these degraded lands. Increasing their agricultural productivity would avoid opening new areas for this purpose. In this scenario, there would still be extensive areas for forest restoration (planting of native forests,) reforestation, and consequent opportunities in the carbon market.

The second element of the Amazon paradox is the forest remnant area, which contributes to climate balance. It contains the largest reserve of forest carbon in the world, estimated at 550 to 734 gigatons[1] of $CO_2$ equivalent, and is home to the greatest terrestrial biodiversity on the planet. Despite these irreplaceable qualities, the forest's destruction continues at an accelerated pace. Ending deforestation will create an opportunity for Brazil to become an environmental power, a green nation, and consequently a preferred destination in the world's immense carbon market.

Finally, the third element of the paradox – not so widely known as the first two – is the demographic profile of the Amazon, which is markedly different from the rest of Brazil. The region will experience a demographic bonus by mid-2030, meaning that it will have a higher proportion of economically active people (those between the ages of 18 and 64) compared to children and the elderly. However, in the current absence of employment opportunities, this bonus has become a burden. In fact, 40% of the population aged between 25 and 29 in the region has no part in the labor market.

As employment prospects for young people remain dim, violence has increased steadily in the region since the early 2000s. In 2019, the homicide rate was already 70% higher than in the rest of Brazil. This unusual level of violence contributes to the deteriorating economic environment. Lacking new opportunities, residents of the Amazon find themselves trapped in a cycle of poverty, violence, and low economic growth. In contrast, young people in the Amazon could become the driving force to develop and sustainably leverage the region's resources if they were provided with quality education, internet access, technologies, and job opportunities.

**Combined, these three factors – the underused deforested areas, the carbon stock available in the forest remnants, and the workforce of the young population – represent a great opportunity for the region's development. (Figure 1).**

The priority is, therefore, to quickly end harmful and unnecessary deforestation, as it represents the major obstacle to all three opportunities for development. In fact, forest destruction is associated with illegal activities such as wildcat gold mining, predatory logging, and forcible private appropriation of public forests, known as land grabbing. This degree of illegality deteriorates the business environment and inhibits investments in the Amazon.

(1) Refers to the Amazon Basin, which covers 9 countries and is estimated at 7 million square kilometers.

**Figure 1 • The Amazon Paradox**
The Brazilian Amazon's most difficult problems are also its greatest opportunities

**1**

DEFORESTATION

**PROBLEM**
In Brazil and the Brazilian Amazon, deforestation has been extensive and unregulated

**OPPORTUNITY**
It is possible to increase livestock and agricultural production within the areas already deforested

**2**

EMISSIONS

**PROBLEM**
The Amazon is the biggest source of greenhouse gases in Brazil and could destabilize the Earth's climate

**OPPORTUNITY**
Forest conservation is one of the cheapest and most efficient ways to offset carbon emissions

**3**

UNEMPLOYMENT

**PROBLEM**
There are 8 million unemployed people in the Amazon, including many young people

**OPPORTUNITY**
These people can generate income and wealth if provided with job opportunities and professional training

Deforestation and forest degradation (partial loss of vegetation) put the future of the forest remnants at risk. Scientists warn that fractions of the Amazon are already at risk and on the verge of losing their ability to regenerate. They are at a tipping point for irreversible degradation. These areas would then be occupied by species of smaller size, more resistant to fire and more well-adapted to the dry climate typical of the Cerrado biome. The consequences for the global and regional climate and for biodiversity would be catastrophic. Therefore, it is essential to drastically reduce deforestation in the short term and aim to bring it to zero before 2030.

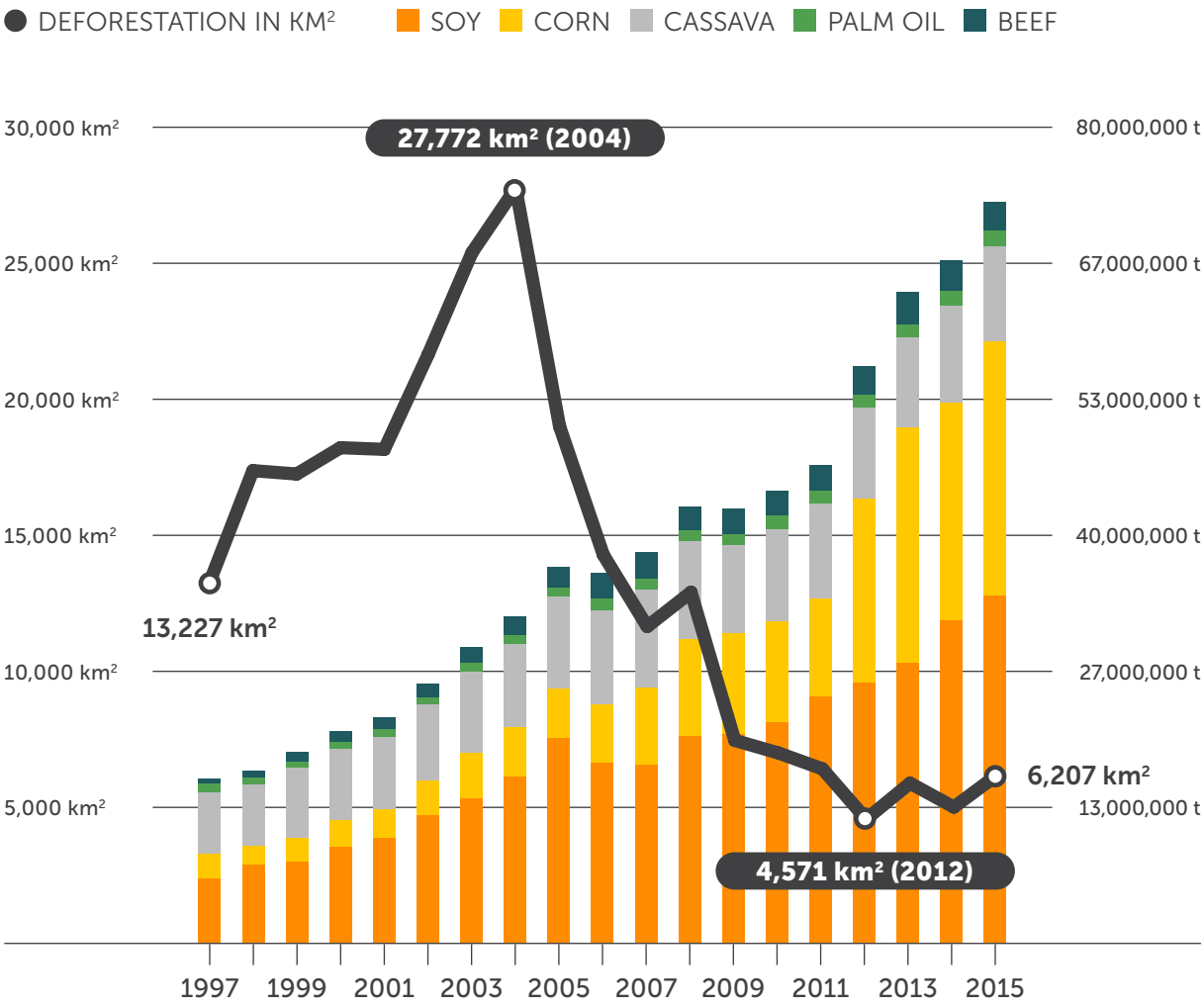
*Between 2004 and 2012, Brazil managed to reduce 84% of deforestation in the Amazon rainforest*

The good news is that Brazil already knows how to effectively control deforestation. For example, enforcement measures such as the rapid detection of deforested areas with satellite images ensured a drop of around 80% in deforestation between 2004 and 2012. Furthermore, the establishment of environmental reserves, or Conservation Units, protected more than 55 million hectares of forests in the Amazon (equivalent to the territory of Kenya).

This regulation was accompanied by an expansion of the agricultural GDP and, at the same time, an increase in production value in the region. (Figure 2)

**Figure 2 • Conservation and Production**

Brazil has already managed to reduce deforestation (in km2) while increasing agricultural production in the Amazon (in metric tons)




1. Between 2004 and 2012, deforestation in the Brazilian Amazon fell by more than 80%

2. During this period, Brazil implemented forest enforcement and command and control mechanisms

3. While deforestation was drastically reduced, the region's agricultural GDP practically doubled

Source: AMZ2030 with data from CPI/PUC-Rio, Prodes - Inpe and IBGE.

## FIVE KEY REASONS TO END DEFORESTATION IN THE AMAZON

Deforestation is bad business for Brazil. It is unnecessary and harmful to its society and economy. These are the main reasons to end deforestation in the Amazon:

1. Deforestation is inefficient and unnecessary. The total deforested area is more than sufficient for all agricultural and livestock production, with most deforested land being underutilized or degraded.

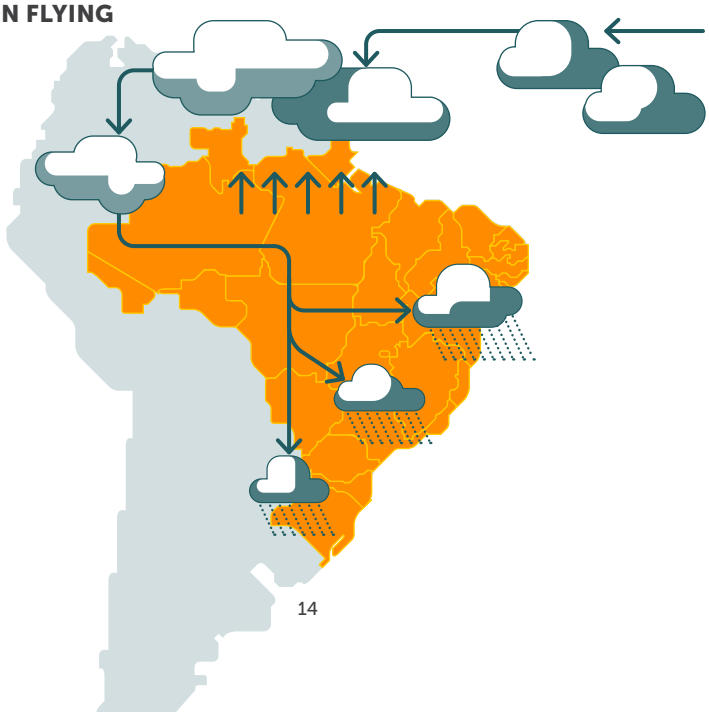
2. The standing forest has a growing value due to its significant carbon stock, the provision of environmental services, and biodiversity.

3. Deforestation constitutes losses for Brazilian society. Much of the current deforestation occurs in public forests, causing a substantial loss of public property.

4. Deforestation goes hand-in-hand with illegal activities and contributes to social conflicts and endemic violence in the region. This, in turn, deteriorates the economic environment and inhibits investment.

5. The destruction of the Amazon affects Brazil's international reputation, leading to reduced investments and harm to trade agreements, such as the European Union's treaty with Mercosur. Furthermore, the destruction of the Amazon poses an existential threat to the planet's climate stability and affects Brazil itself, which relies on the waters of the Amazon for its agricultural production and hydroelectric power generation.

**AMAZON FLYING RIVERS**



## FIVE ECONOMIC OPPORTUNITIES FOR THE AMAZON

Even though the Brazilian Amazon continues to suffer from continued deforestation, the region can take advantage of new economic opportunities for sustainable development. There are at least five opportunities:

1 CONSERVATION

2 FOREST RESTORATION

3 FOREST PRODUCTS

4 LIVESTOCK AND AGRICULTURAL PRODUCTION

5 CITIES

### 1

### CONSERVATION

The first pathway is to leverage the opportunities presented by carbon markets to preserve the forest. Among its numerous local, regional, national, and global benefits, a reduction in deforestation can attract new investment flows to the Amazon.

*Brazilian Amazon could generate up to US$ 18.2 billion by 2031 with forest carbon credits*

One example is the LEAF Coalition, which offers payment for reducing emissions from deforestation and forest degradation (REDD+) at national and subnational levels. According to LEAF, halting deforestation in the Brazilian Amazon by the end of this decade could generate up to US$ 18.2 billion (through carbon markets at a minimum price of US$ 10 per ton of $CO_2$).

**If prices rise to US$ 15 per ton of $CO_2$, revenue could reach US$ 26 billion. (Figure 3).**

## Figure 3 • Protecting the forest generates profit

how to make money from reducing deforestation (in millions of hectares)

**1 FUND**

There is an International Coalition* that pays for reducing deforestation of tropical forests

**2 REDUCTION**

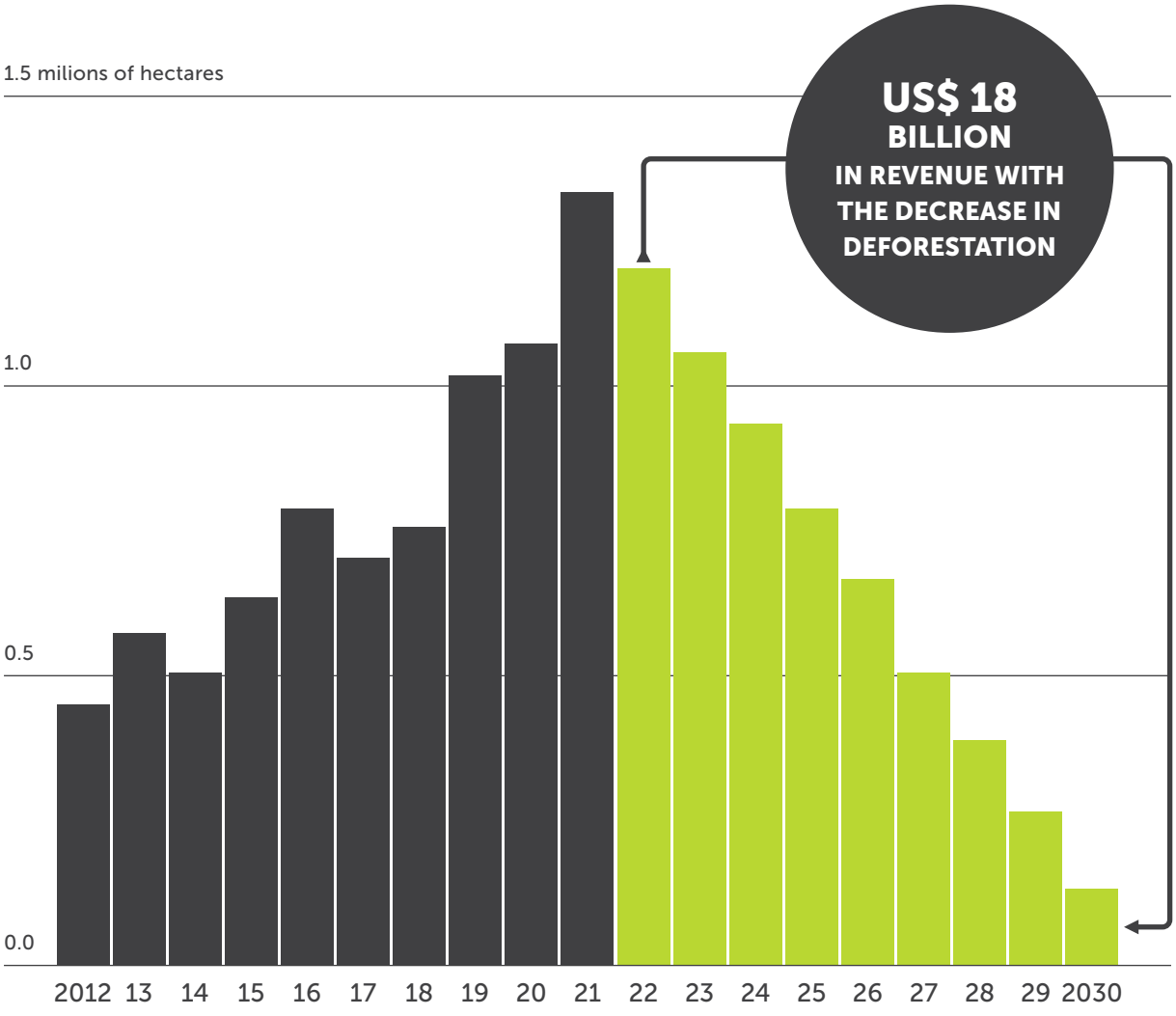
If Brazil reduces deforestation in the Amazon according to the pace projected in the graph, it will receive annual amounts through the Fund

**3 CARBON**

The Coalition will pay a minimum price of US$ 10 per ton of $CO_2$

**4 REVENUE**

Brazil could earn US$ 18 billion by 2031




* Leaf Coalition – (Lowering Emissions by Accelerating Forest Finance).
Source: AMZ2030 based on data from INPE (2022).

# 2

## FOREST RESTORATION

The second pathway is to invest in restoration with native species to rebuild the original forest. This approach is different from so-called reforestation, which consists of planting exotic species, such as eucalyptus.

There are two ways to carry out restoration: first, actively planting seedlings of trees of native species in deforested areas. Second, taking advantage of natural regeneration in abandoned deforested areas that are in a slow process of regeneration. Around 15 million hectares of the region are currently deforested and without active agricultural use. These areas, which are equivalent to the territory of Nepal, represent the main candidates for forest restoration.

**A recent study by the Amazon 2030 project revealed that, of this total, 7.2 million hectares have been naturally regenerating for over six years. This process of ecological succession is returning these areas to forestland. (Figure 4).**

Relatively modest investments could guarantee forest restoration and permit payment for carbon sequestration. On the demand side, there is also a lucrative and growing market for carbon capture through forest restoration.

According to *Time* magazine, the commitments to zero net emissions assumed by the 7,000 largest companies on the planet will require the worldwide restoration of almost 350 million hectares of forest by 2050. By prioritizing forest restoration, the Amazon – with its extensive deforested, abandoned, or underutilized areas – can seize this opportunity in the carbon capture market.

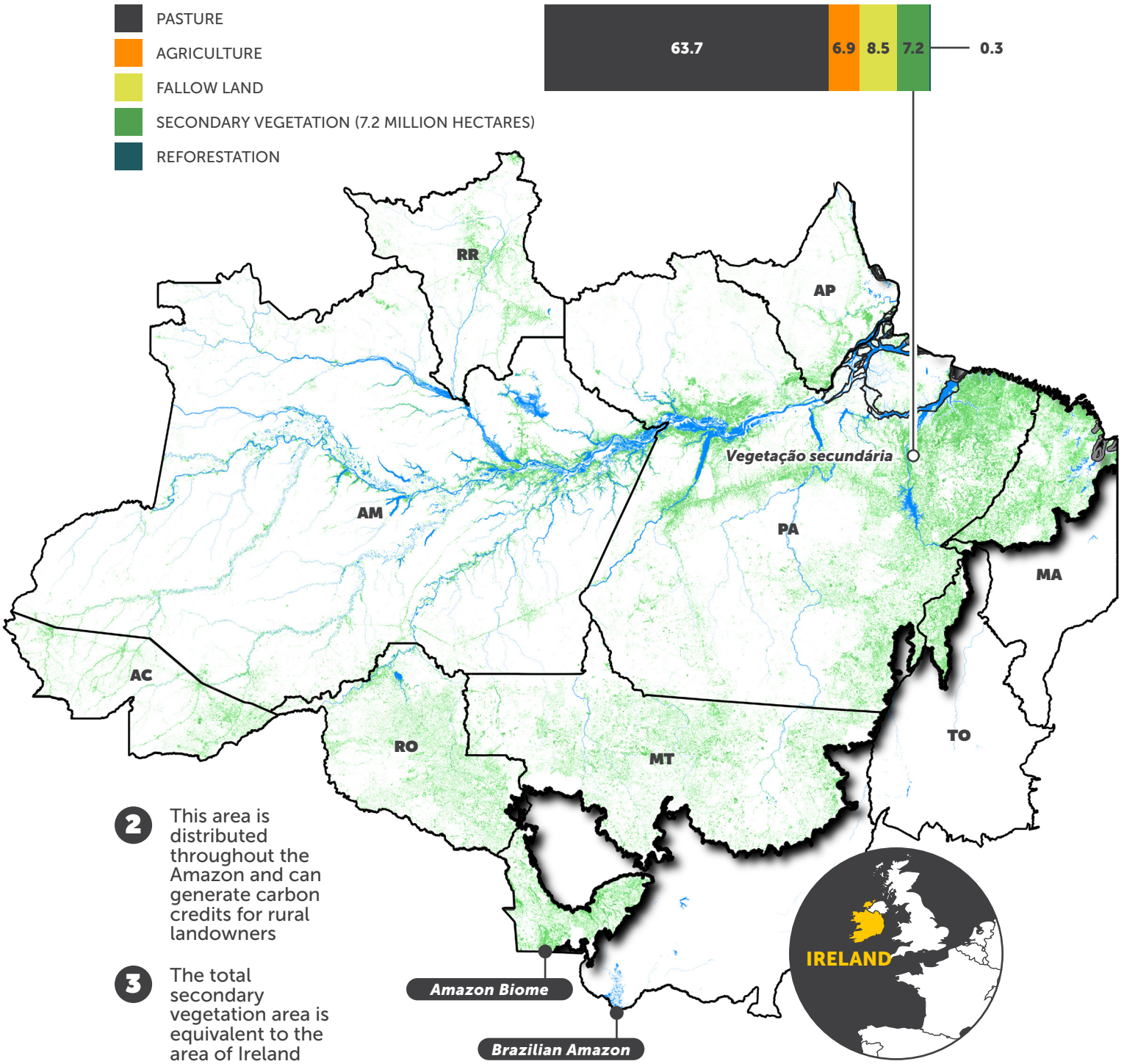
Brazil has assumed the goal of restoring 4.8 million hectares by 2030 in the Amazon biome. However, what was initially an obligation has become an opportunity thanks to the boom in the carbon capture market for forest restoration.

This boom means that future efforts can go far beyond the goals announced by the Government of Brazil in 2012.

## Figure 4 • A forest that regenerates itself

Opportunities with secondary vegetation (in millions of hectares)

**1** Out of the entire deforested area, about 7.2 million hectares have crossed the threshold of 6 years or more under regeneration




**2** This area is distributed throughout the Amazon and can generate carbon credits for rural landowners

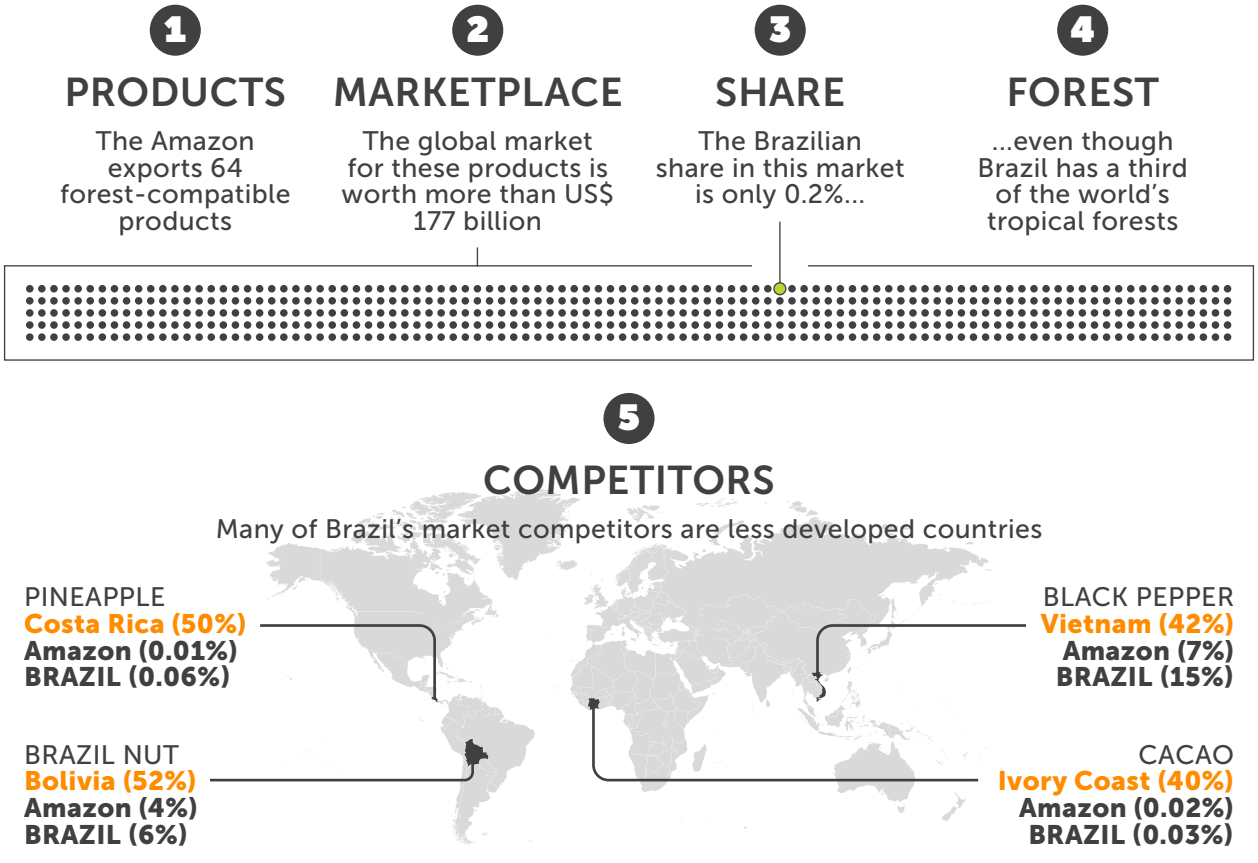
**3** The total secondary vegetation area is equivalent to the area of Ireland

# 3

## FOREST PRODUCTS

The third pathway is to increase exports of forest-compatible products (açai, tropical fruits, fish, Brazil nuts, etc.) and agroforestry products, such as cacao and black pepper. The Brazilian Amazon contributes only 0.2% of the global market for tropical products. These products are practically exclusive to tropical zones. The Brazilian Amazon, which represents one third of the world's tropical forests, ought to have a significant share of this market. However, currently, the participation of the Brazilian Amazon is negligible (0.2%, or US$ 300 million/year) in a huge global market worth more than US$ 177 billion a year and is in rapid expansion. (Figure 5).

**Figure 5 • Forest products**
Brazil should earn more money from exporting forest products



# 4

## LIVESTOCK AND AGRICULTURAL PRODUCTION

There are still opportunities to make better use of previously deforested areas. This immense area of 84 to 86 million hectares that has already been deforested[2] can supply the entire demand projected by the Brazilian government for agricultural production until 2030. And there would still be areas left for other uses, especially for the promising forest restoration market (planting native trees in deforested areas to recover the original forest).

**Brazil must focus efforts to make better use of these areas by increasing productivity through the adoption of the best agricultural practices. (Box 1) (Figure 6).**

Of the total 86 million deforested hectares, livestock occupy 63 million hectares (73%) of the total. The second-largest portion of the deforested areas (15 million hectares total) is occupied by secondary vegetation that grows after these areas are abandoned.

Agriculture[3] and reforestation (commercial planting of exotic species such as eucalyptus) occupy smaller areas, 7 million hectares and 300 thousand, respectively. We must decide now what to do with the immense deforested area that is currently occupied by low-productivity pastures. Without an increase in livestock productivity, the additional demand for meat and agricultural products could increase deforestation by around 13 million hectares, which would further exacerbate climate and socioeconomic risks for Brazil.

*The area that has already been deforested in the Amazon can support the entire agricultural expansion expected and much more*

That being said, it is feasible to increase livestock productivity to meet the projected demands for agricultural products by 2030. There would still remain 37 million hectares that have already been deforested. (Box 1).

(2) According to Inpe/Prodes, this area adds up to approximately 84 million hectares, while MapBiomas calculates it at 86 million hectares.
(3) Refers only to areas used for agriculture that resulted from the conversion of forest to deforested areas. Agricultural areas that were converted from the original Cerrado (savannah) vegetation are not included.

This surplus area could be used to increase the production of forest-compatible products (e.g., cacao in agroforestry systems) and for forest restoration, thus supplying credits to the growing market for carbon credits (which provides compensation for planting carbon-absorbing trees).

## Box 1 • How can brazil increase agricultural production in the amazon without deforestation

**Brazil is faced with a fork in the road**

This decision will determine the future of the Amazon. The first, unsustainable path would allow the expansion of low-productivity livestock areas to meet the growing demand for meat projected for 2030. The second, sustainable path is to invest in improving livestock productivity in the Amazon, using well-known and successfully tested techniques. This approach would not only eliminate the need for further deforestation but would also allow us to supply the entire demand for meat by 2030, using a much smaller area of pasture than we use today and leaving deforested areas free for other economic uses. To project the magnitude of land use changes in these scenarios, we considered how the region would respond to growth in demand projected for 2030. According to the Brazilian government, leading up to the 2030 harvest, the demand for agricultural production will increase by 27%, and demand for beef will increase by 17% in the country. Our assumption is that production in the Amazon will grow following the same national projection, based on the 2020 baseline.

**Scenario of increase in production without gain in livestock productivity**

If the region fails to implement new techniques for increasing livestock productivity, then the demand for expanding production will cause almost 13 million hectares to be deforested by 2030. An average of 1.6 million hectares would be deforested each year (a level similar to recent years). The demand for beef expansion (17% increase) in particular would require the deforestation of 10.8 million hectares. The current tendency is for agriculture (especially grains) to replace pasturing in lands with better infrastructure. Pasturing then moves to more distant borders. Thus, without productivity gains, cattle ranchers would clear another 1.8 million hectares to compensate for the pasturing land that becomes occupied by crops.

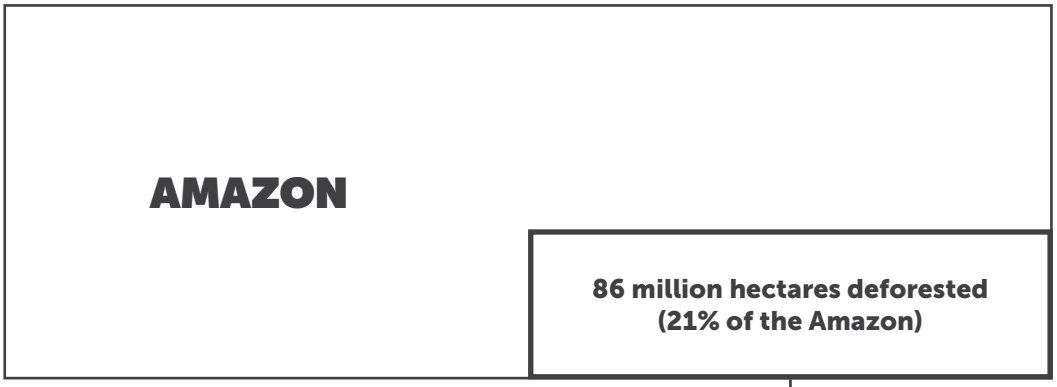
**Scenario of livestock productivity gain**

If farmers adopted the efficient techniques of pasture management and animal welfare already available in the region today, it would be possible to triple the average productivity of livestock production. This increase would allow the pasture area in 2020 (63.7 million hectares) to be reduced to approximately 25 million hectares, while still maintaining current production. In total, these techniques would free up approximately 37 million deforested hectares.

## Figure 6 • What fits in the deforested area

How can we make better use of what has already been cleared in the Amazon (in millions of hectares)

1 Nearly 21% of the Amazon has already been deforested, equivalent to 86 million hectares*

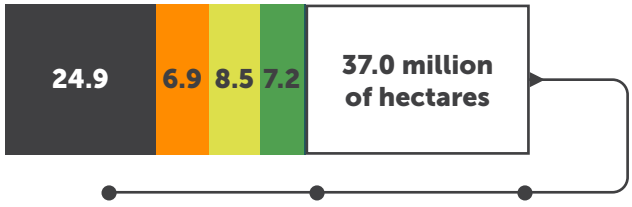



2 Currently, this cleared area is being used for the following activities:

- PASTURE
- AGRICULTURE
- FALLOW LAND
- SECONDARY VEGETATION (OVER 6 YEARS OLD)
- REFORESTATION


3 If demand for meat keeps growing at its current pace and cattle-ranching productivity does not increase, deforestation will increase by 2030


4 With an increase in livestock productivity, it will be possible to meet this demand with less pasture area, freeing up a total of 37 million hectares




5 This area is so big it would fit the entire worldwide production of...

| COFFEE | CACAO | LATEX |
|---|---|---|
| 11.0 | 12.3 | 12.8 |

* According to Inpe/Prodes, this area adds up to approximately 84 million hectares, while MapBiomas calculates it at 86 million hectares.

# 5

## CITIES

Finally, the primary demand of people living in the Amazon is employment. Many Amazonians are leaving the region in search of job opportunities. Hence, new investments must accelerate the growth of job openings within the region.

**Research indicates that, instead of agricultural activity, sectors within cities generate the highest quality jobs and offer improved standards of living. Therefore, urban infrastructure and vocational education should be priorities for public funding. (Figure 7).**

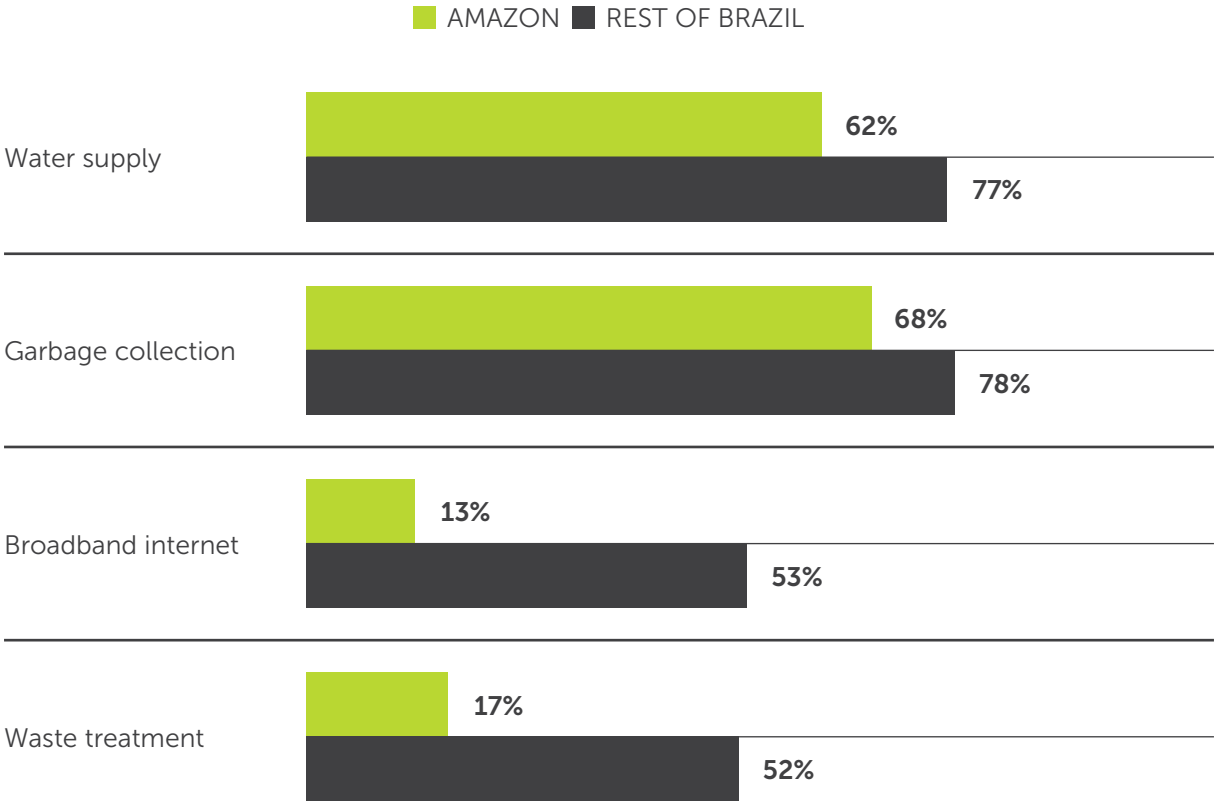
## *The Brazilian Amazon is more economically isolated than the rest of Brazil*

In our strategy to enhance job prospects in the Amazon, it's crucial to minimize this gap and fortify economic ties between the region and the rest of the world. These connections would bolster the economy, creating jobs and income for the local population. Traditionally, investments in infrastructure, especially highways, have been seen as the most secure approach to improve accessibility in isolated regions. However, the environmental, social, and economic costs make this strategy impractical in the Amazon. An alternative solution to enhance accessibility is to invest in the region's broadband internet infrastructure.

Strategically expanding telecommunications access, including high-speed internet, in the Amazon provides two significant advantages. Firstly, it allows for expanded communication without the socio-environmental risks associated with traditional infrastructure expansion like roadways. Secondly, broadband infrastructure has the potential to increase income and employment opportunities for local workers and entrepreneurs, as demonstrated in other regions.

**Figure 7 • Urban amazon**
Most of the region's population lives in cities...


...and suffers from worse services than the rest of Brazil




Source: AMZ2030 with data from CadÚnico (2022), Anatel (2022) and PNAD-C IBGE (2021).

# THE FIVE AMAZONS: BASIS FOR THE SUSTAINABLE DEVELOPMENT OF THE BRAZILIAN AMAZON

The Brazilian Amazon covers approximately 5 million square kilometers, constituting 59% of Brazil's territory, characterized by significant socioeconomic and natural variances across its expanse. Despite its complexity and heterogeneity, the Brazilian Amazon can be segmented into five primary zones based on the remaining vegetation cover, each requiring specific tailored public policies for sustainable development.

We adopted the methodology initially developed by Imazon in 2007[4] to delineate these zones, classifying each of the 772 municipalities in the Brazilian Amazon based on their vegetation cover and deforestation.

This analysis identified four major zones initially: Zone 1, named 'The Forested Brazilian Amazon'; Zone 2, termed 'The Brazilian Amazon with Forest Under Pressure'; Zone 3, labeled 'The Deforested Brazilian Amazon' (originally forested but having lost a substantial part of its forest); and Zone 4, titled 'The Non-Forested Brazilian Amazon' (predominantly covered by savanna-type vegetation and natural grasslands).

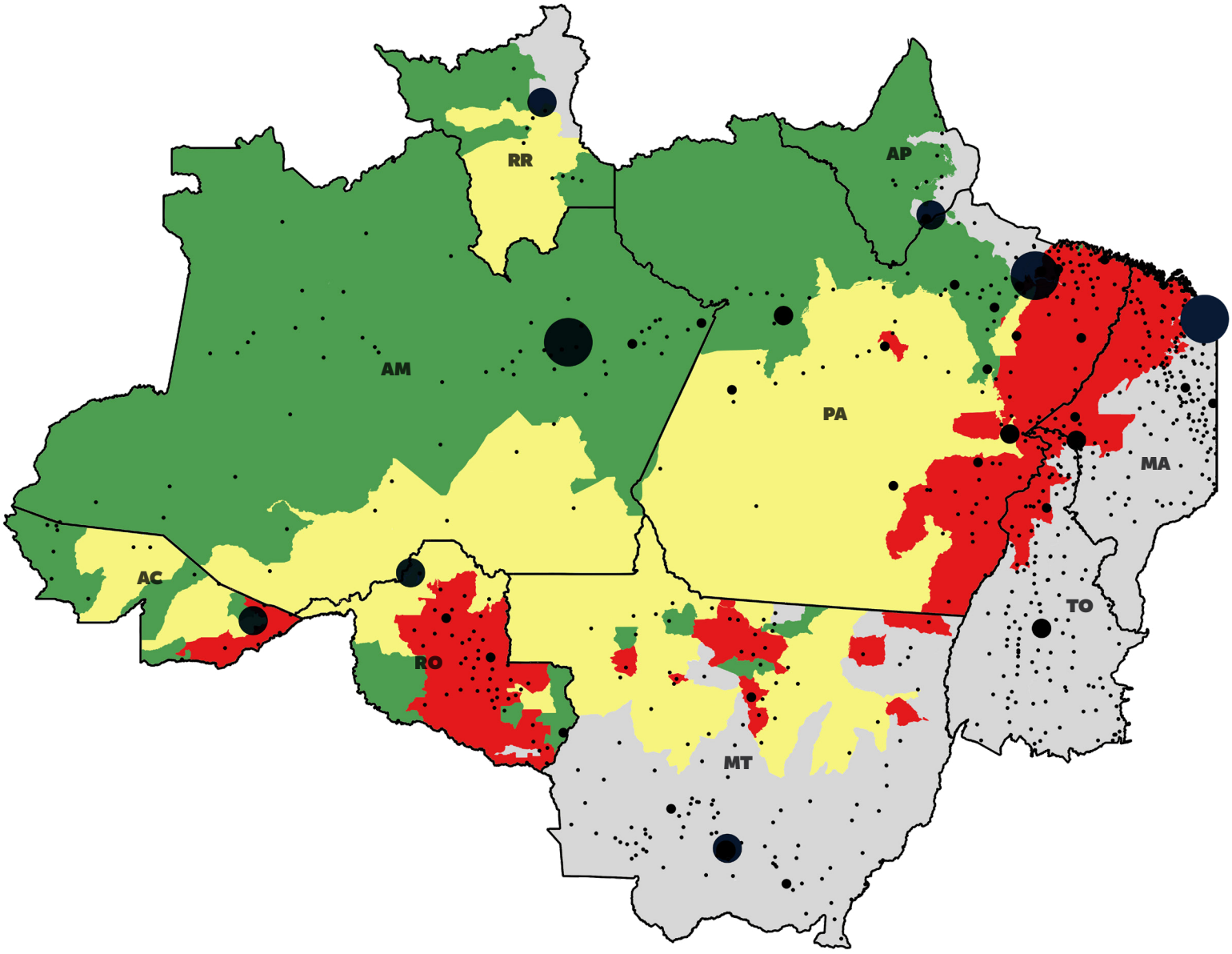
**Recently, this analysis was updated to integrate new deforestation data from the National Institute for Space Research's (INPE) Prodes Project[5], introducing a fifth major zone: Zone 5, known as 'The Urban Brazilian Amazon' (Figure 8).**

Zone 4, 'The Non-Forested Brazilian Amazon,' consists of municipalities primarily characterized by savannas in their original vegetation cover. Conversely, the other four zones encompass municipalities that originally possessed over 50% of forest cover. Zone 3, 'The Deforested Brazilian Amazon,' pertains to municipalities that have lost more than 70% of their original forest cover, excluding Protected Areas (Conservation Units and/or Indigenous Lands). In contrast, Zone 1, 'The Forested Brazilian Amazon,' comprises municipalities that have experienced less than a 5% loss of their original forest cover.

Municipalities falling within Zone 2, 'The Brazilian Amazon with Forest Under Pressure,' maintain substantial forest cover (>75% of their territory), yet have encountered recent accelerated deforestation. The demarcation of areas within Zone 5, 'The Urban Brazilian Amazon,' is based on criteria established by the Brazilian Institute of Geography and Statistics (IBGE), utilizing the positioning of urban centers and the resident population in these regions[6].

(4) https://imazon.org.br/publicacoes/o-avanco-da-fronteira-na-amazonia-do-boom-ao-colapso/.
(5) http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes.
(6) https://sidra.ibge.gov.br/pesquisa/pnadca/tabelas.

## Figure 8 • The five zones of the Brazilian Amazon




Source: Adapted from Celentano & Veríssimo (2007) based on data from IBGE (territorial area and population) and INPE (vegetation cover and deforestation).

**The public policy recommendations for each zone are not mutually exclusive. Several proposals can be applicable across zones, such as participation in the forest carbon market through the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation) and the establishment and reinforcement of Protected Areas. (Figure 9).**

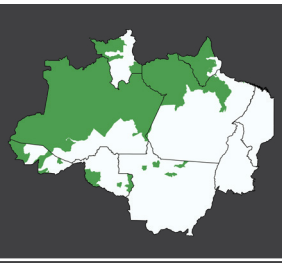
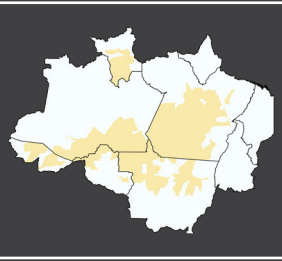
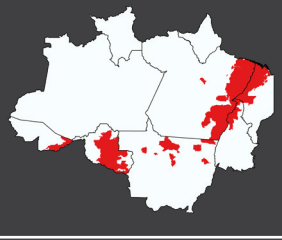
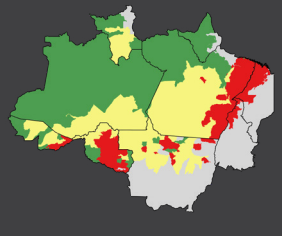
Additionally, forest restoration (native tree planting) finds greater suitability in the deforested and forested under pressure zones. Enhancing agricultural productivity is a crucial measure across the entire Brazilian Amazon, with heightened priority in the deforested zone.

In the zone under forest pressure, the primary focus should be on combatting illegal land encroachments in public forests.[7]

While the enforcement of laws against deforestation and forest degradation (including predatory logging, forest fires, etc.) is imperative throughout the Brazilian Amazon, it holds heightened significance[8] in the forest under pressure and deforested zones.

(7) https://amazonia2030.org.br/propostas-para-um-ordenamento-territorial-na-amazonia-que-reduza-o-desmatamento/.
(8) https://oeco.org.br/salada-verde/governo-atualiza-lista-de-municipios-que-mais-desmatam-a-amazonia/.

## Figure 9 • Profile of the Brazilian Amazon zones

| | ZONES AND TERRITORIAL AREA | POPULATION (2021) | FOREST AREA COMPARED TO ORIGINAL FOREST COVER | | NON-FORESTED AREA COMPARED TO ORIGINAL SAVANNAS COVER | |
|---|---|---|---|---|---|---|
| | | | Forest in 2021 (%) | Deforestation up to 2021 (%) | Non-forest in 2021 (%) | Deforestation up to 2021 (%) |
|  | THE FORESTED BRAZILIAN AMAZON 1,996,540 km² **39%** | 6,281,683 | 96 | 4 | 99 | 1 |
|  | THE BRAZILIAN AMAZON WITH FOREST UNDER PRESSURE 1,483,100 km² **29%** | 3,282,561 | 81 | 19 | 93 | 7 |
|  | THE DEFORESTED BRAZILIAN AMAZON 547,262 km² **11%** | 9,052,133 | 34 | 66 | 76 | 24 |
|  | THE NON-FORESTED BRAZILIAN AMAZON 1,041,146 km² **21%** | 9,803,335 | 44 | 56 | 72 | 28 |
|  | TOTAL BRAZILIAN AMAZON 5,068,048 km² **100%** | 28,419,712 | 79 | 21 | 76 | 24 |

Source: Based on data from IBGE (territorial area and population) and INPE (vegetation cover and deforestation).
*Zone 5, The Urban Amazon , is included in the four others zones.

1

## THE FORESTED BRAZILIAN AMAZON

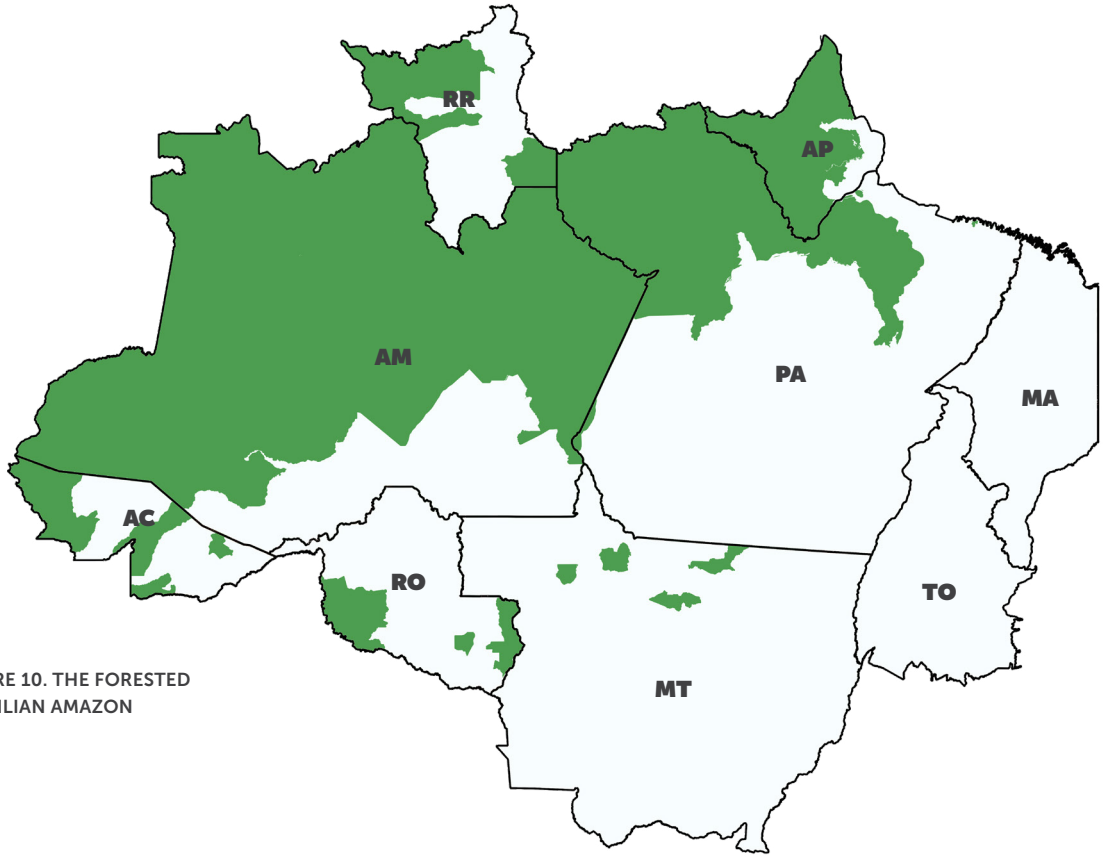



FIGURE 10. THE FORESTED BRAZILIAN AMAZON

**THE FORESTED BRAZILIAN AMAZON (Figure 10) encompasses 39% of the entire Brazilian Amazon and comprises extensive tracts of preserved areas.**

In this zone, the primary focus should be on forest conservation efforts that also yield social and economic benefits. This strategy involves promoting the bioeconomy and investing in environmental services payments, particularly emphasizing REDD+[9]. Additionally, there exists the potential to boost exports of forest-friendly products like açai, tropical fruits, Brazil nuts, agroforestry goods (such as cacao and black pepper), and tropical fish (Figure 5).

(9) https://amazonia2030.org.br/oportunidades-financeiras-para-obrasil-com-a-reducao-dodesmatamento-na-amazonia/.

Despite the Brazilian Amazon representing one-third of the world's tropical forests, its current share in the global market for these products is minimal (less than 0.2%). This market generates worldwide revenues exceeding USD 170 billion annually and is expanding.(10) In enhancing infrastructure within 'The Forested Brazilian Amazon,' it's crucial to avoid the establishment of new major roads, as roads can lead to disorderly occupation, social conflicts, and increased deforestation. Overcoming the challenges linked to access and logistics can be achieved through enhancements in the extensive network of navigable rivers in the region. Additionally, investments in renewable energy are necessary to improve the energy supply in this area, considering that a segment of the forested Amazon relies solely on fossil fuels for energy generation.(11) Lastly, inadequate internet quality is an issue within this zone. Hence, there's a critical need to invest in broadband internet infrastructure not only within this zone but also across the entire Brazilian Amazon (Box 2 & 3).

## Box 2 • Benefits of the internet in the brazilian amazon

| POTENTIAL FOR INCREASING | INCREASING ACCESSIBILITY | IMPROVING AND EXPANDING |
|---|---|---|
| income and employment opportunities via remote work and entrepreneurship (digital business) even in more remote regions | for the region without the socio-environmental risks associated with opening new roads in forest regions | education, health services (telemedicine), technical assistance for rural extension, public social |

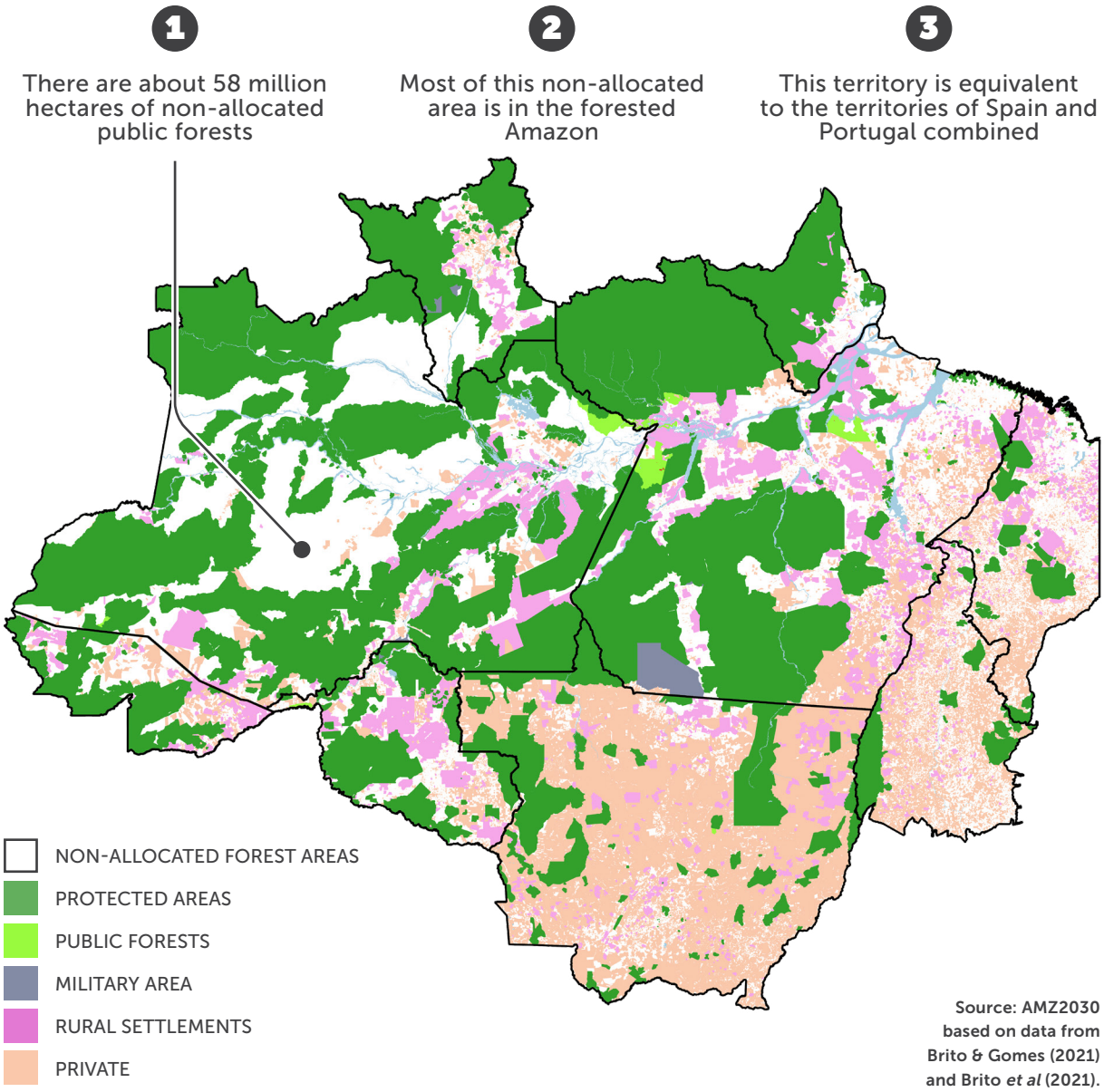
## Box 3 • Protected areas

Protected areas are composed of conservation units (national parks, biological reserves, national forests, extractivist reserves, etc.) And indigenous lands. The national strategic plan for protected areas (PNAP) recognizes that indigenous lands contribute to environmental conservation and must be protected. The strengthening of protected areas requires enforcement, improved management, and ensuring funds to implement programs. It is also essential to strengthen the national foundation for indigenous peoples (Funai) to protect indigenous peoples, as well as strengthen and implement the National Policy for Territorial and Environmental Management of Indigenous Lands (PNGATI).

(10) https://amazonia2030.org.br/oportunidades-para-exportacao-de-produtos-compativeis-com-a-floresta-na-amazonia-brasileira/.
(11) https://amazonia2030.org.br/a-atuacao-do-bndes-na-amazonia-legal/.

The Forested Brazilian Amazon encompasses the majority of non-allocated Brazilian public forests, totaling over 580 thousand square kilometers, equivalent to the combined territories of Spain and Portugal. These forests, primarily situated in the western part of the Brazilian Amazon, require legal protection against land encroachments and deforestation (Figure 11).[12]

**Figure 11 • Create and strengthen Protected Areas in non-allocated public forests**




Source: AMZ2030 based on data from Brito & Gomes (2021) and Brito *et al* (2021).

(12) https://amazonia2030.org.br/oportunidades-financeiras-para-obrasil-com-a-reducao-dodesmatamento-na-amazonia/.

Establishing Protected Areas means giving purpose to non-allocated public forests

| | | |
|---|---|---|
| **STRENGTHEN** | ▶ | Conservation Units through the expansion of the Program Protected Areas in the Amazon (ARPA) and other similar initiatives |
| **EXPAND** | ▶ | The FUNAI's budget and scope of work in Indigenous Lands |
| **PRIORITIZE** | ▶ | The implementation of the National Policy for Territorial and Environmental Management of Indigenous Lands (PNGATI) |
| **CREATE** | ▶ | New Indigenous Lands or Conservation Units |

The solution lies in the establishment of Protected Areas. Establishing these zones will facilitate forest preservation while simultaneously generating income through environmental service payments and forest-related enterprises (such as timber forest products managed sustainably and non-timber forest products).

## RECOMMENDATIONS FOR THE FORESTED BRAZILIAN AMAZON

**The forest-based economy and biodiversity conservation are the main avenues for sustainable development in this region**

- Prioritize the bioeconomy
- Promote REDD+ credits
- Maintain existing Protected Areas
- Create Protected Areas in non-allocated public forests
- Evaluate the impact of new infrastructure
- Strengthen river transport network
- Invest in renewable energy
- Expand broadband internet access

# 2

## THE BRAZILIAN AMAZON WITH FOREST UNDER PRESSURE

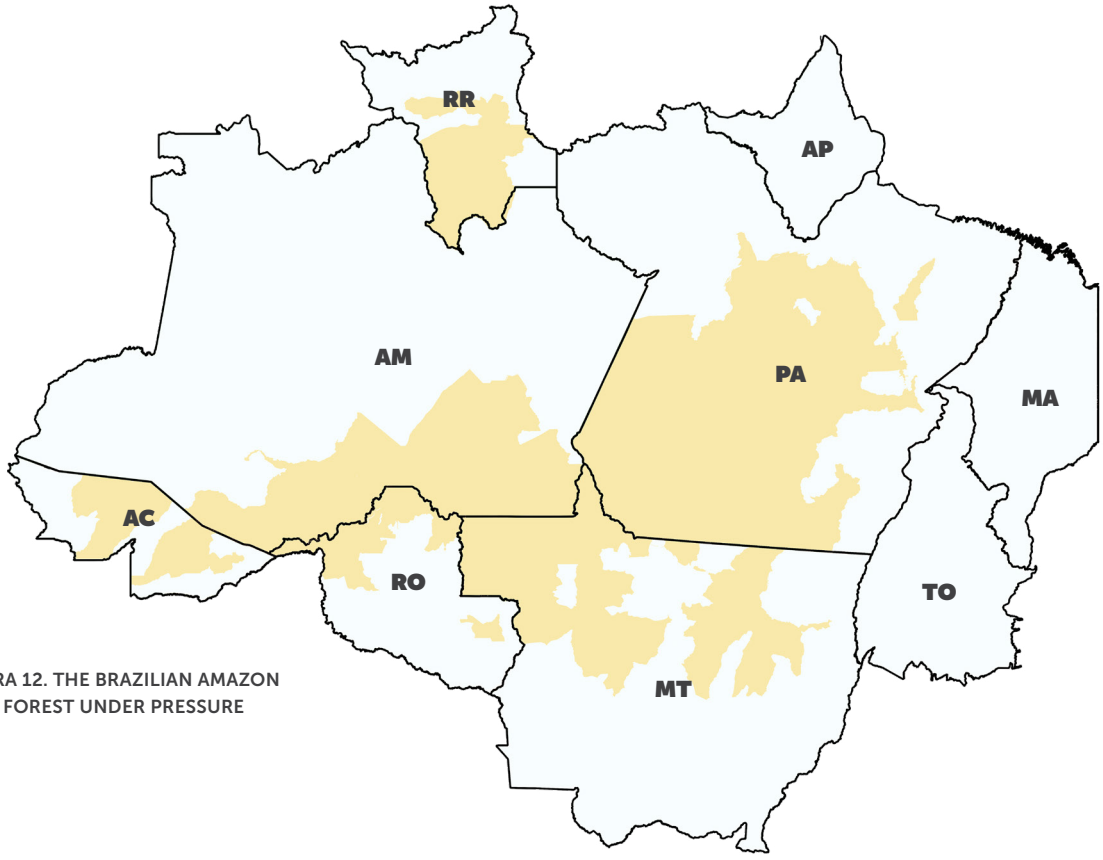



FIGURA 12. THE BRAZILIAN AMAZON WITH FOREST UNDER PRESSURE

**This zone (Figure 12) covers 29% of the Brazilian Amazon and corresponds to municipalities with extensive forest coverage suffering from increasing deforestation, illegal logging, and land grabbing.**

There are three fundamental priorities for this zone.

First, coordinated command and control efforts should curb deforestation and forest degradation through illegal logging and forest fires. Second, it is essential for territorial regulation to advance on two fronts: firstly, by avoiding changes in the land-use legal framework that could encourage the illegal occupation of public forests; secondly, transforming public forests into Protected Areas to ensure their integrity.

The zone's third priority is to offer technical assistance and loans, especially to small-scale farmers, to promote better land use in already deforested areas.

There are good opportunities in the region for both the intensification of agriculture and for the improvement and expansion of agroforestry systems for the cultivation of crops such as cacao[13] (Box 4 & 5).

## Box 4 • Fight deforestation and forest degradation: The PPCDAm program[14]

Brazil has the know-how to fight deforestation and environmental crimes in the amazon. It will be key to restore the Action Plan for the Prevention and Control of Deforestation in the Amazon (known as PPCDAm) and to incorporate new approaches, including traceability and the monitoring of forest degradation. Moreover, the National Environmental System (Sisnama) must be strengthened.

**The new plan to combat deforestation must restore the PPCDAm program and include new technologies and approaches**

| RESTRUCTURE AND STRENGTHEN | EXPLORE AND INNOVATE |
|---|---|
| Restore environmental control and the ground enforcement | Combat organized crime |
| Conduct regular inspections in the field | Fight forest degradation |
| Combat illegal occupation | Strengthen the Sisnama |
| Create financial incentives for compliance with environmental standards | Develop specific strategies for agrarian reform settlements |
| Monitor secondary vegetation | Track supply chains |

(13) https://amazonia2030.org.br/cacau-fino-ou-commodity-opcoes-para-a-amazonia/.
(14) https://amazonia2030.org.br/politicas-publicas-para-protecao-da-floresta-amazonica-o-que-funciona-e-como-melhorar/.

### Box 5 • Land reform settlements in the Brazilian Amazon

The land reform settlements add up to an area of 370 thousand square kilometers (an area equivalent to japan). These settlements are home to about 526,000 families. [15] There are settlements originating from the agricultural colonization projects of the 1970s that are in the deforested Amazon zone, as well as settlements created more recently which are located in the Forested Amazon zone. Therefore, solutions for settlements must consider these differences. For example, in settlements located in the deforested Amazon, it is recommended to prioritize the improvement of agricultural productivity and agroforestry systems. Moreover, there are opportunities for forest restoration. Payments for forest conservation via REDD+ would help families in predominantly forested settlements.

## RECOMMENDATIONS FOR THE BRAZILIAN AMAZON WITH FOREST UNDER PRESSURE

### Brazil needs to resume defense of the Amazon forests under pressure

- Fight deforestation and forest degradation
- Create Protected Areas in non-allocated public forests
- Prevent illegal grabbing of public forests
- Support the implementation of Conservation Units
- Support the protection of Indigenous Lands
- Halt illegal gold mining
- Combat illegal logging
- Support sustainable forest management
- Support low-carbon agriculture
- Promote the expansion of agroforestry systems

(15) https://amazonia2030.org.br/assentamentos-rurais-da-amazonia-diretrizes-para-a-sustentabilidade/.

# 3

## THE DEFORESTED AMAZON

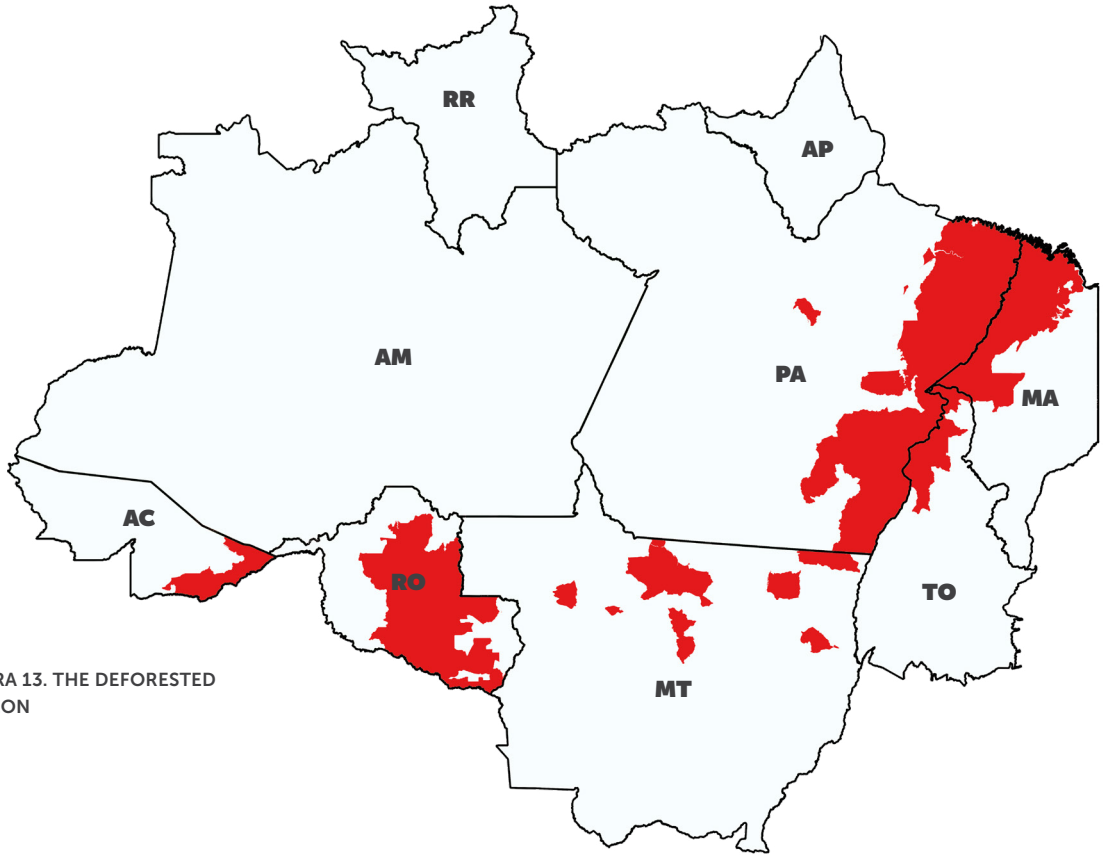



FIGURA 13. THE DEFORESTED AMAZON

**Municipalities located in zone "The Deforested Amazon" account for about 11% of the total area of the Brazilian Amazon (figure 13). For the most part, deforested areas in this zone have been subsequently abandoned or remain underused.**

Despite the high rate of deforestation characterizing the zone "The Deforested Amazon," this area still holds a substantial remnant of forest, although some areas have suffered degradation due to predatory logging. The regions within "The Deforested Amazon" have been occupied since the 1970s and possess a more extensive network of roads compared to the rest of the region. There are four main priorities for this zone. First, emphasizing land tenure regularization, following Brazilian law, to create a foundation for improving the business and investment environment in rural areas.

Second, improving infrastructure quality (roads and internet) and enhancing education and healthcare services, especially in municipalities with low social development indicators.[16]

Third, there's a significant potential to expand agricultural production without additional deforestation. Over 84 million hectares[17] have already been deforested in the Amazon, with more than 70% comprised of areas with low livestock productivity or abandonment. (Figure 6).[18]

Fourth, there are promising opportunities for forest restoration (regeneration of secondary vegetation and planting native trees) in deforested areas[19], as well as reforestation (planting fast-growing trees) linked to the paper and pulp sector (Figure 3, 4 e 6 e Box 6 e 7).

### Box 6 • Forest restoration

There are two general ways of carrying out restoration: active planting of seedlings of native tree species in deforested areas or allowing for natural regeneration of deforested areas that have been abandoned. With relatively modest investments, it is possible to restore the forest and receive payment for carbon capture. The Brazilian Amazon, with its abundance of abandoned and/or underutilized deforested areas, can take advantage of this opportunity in the carbon capture market via forest restoration.

(16) https://amazonia2030.org.br/indice-de-progresso-social-na-amazonia-brasileira-ips-amazonia-2021/.
(17) Projeto Mapbiomas. https://mapbiomas.org/.
(18) https://amazonia2030.org.br/o-paradoxo-amazonico/.
(19) https://amazonia2030.org.br/identificando-areas-prioritarias-para-restauracao-bioma-amazonia/.

### Box 7 • REDD+

Reducing deforestation can attract new flows of investment for the Brazilian Amazon. one example is the LEAF coalition[20], which provides payment for redd+ at the national and subnational levels. According to Lowering Emissions by Accelerating Forest Finance (LEAF), drastically reducing deforestation in the Brazilian Amazon by 2030 could generate up to USD 18.2 billion (through carbon markets at a minimum price of USD 10 per ton of $CO_2$). If prices rise to USD 15 per ton of $CO_2$, this value could reach USD 26 billion.

## RECOMMENDATIONS FOR THE DEFORESTED AMAZON

**The country can meet the entire demand for agricultural products in the Brazilian Amazon by 2030 without cutting down a single tree**

- Prioritize land tenure regularization
- Improve the quality of the road network
- Increase livestock productivity
- Promote the expansion of agroforestry systems
- Encourage low-carbon agriculture
- Encourage forest restoration
- Promote reforestation
- Promote REDD+ credits

(20) https://amazonia2030.org.br/oportunidades-financeiras-para-obrasil-com-a-reducao-dodesmatamento-na-amazonia/.

# 4

## THE NON-FORESTED AMAZON (SAVANNAS)

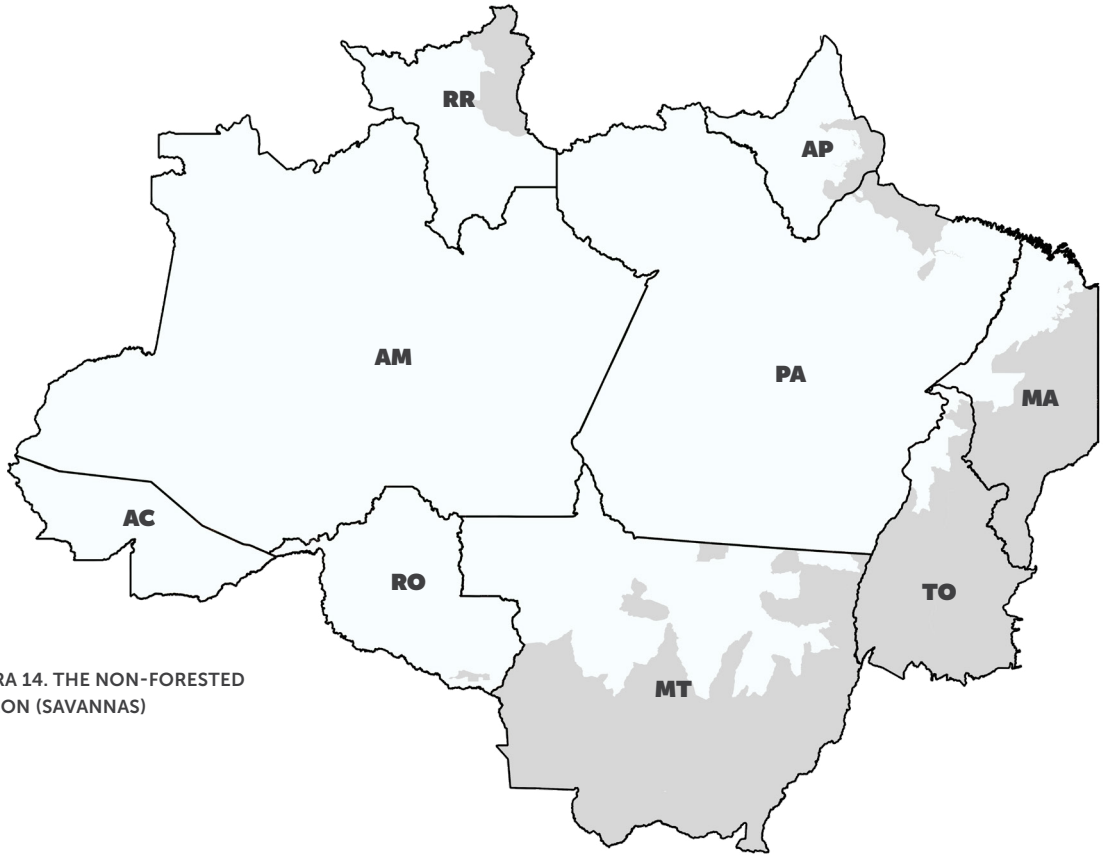


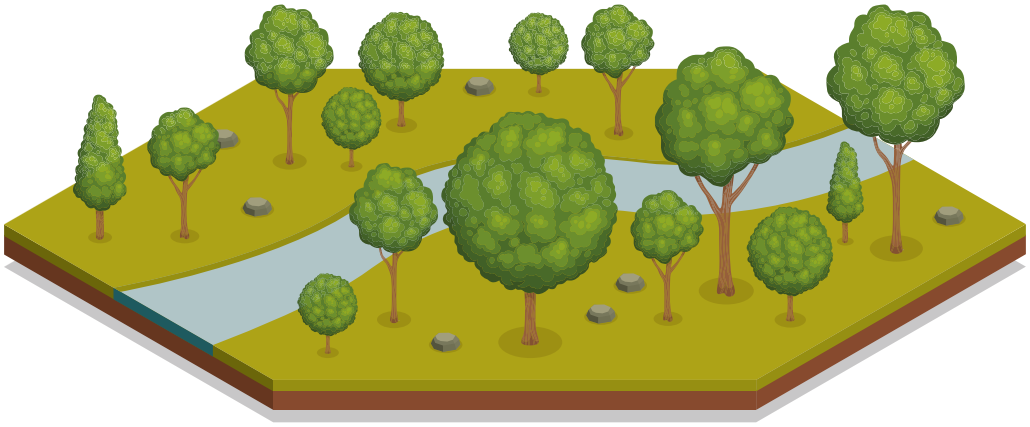

FIGURA 14. THE NON-FORESTED AMAZON (SAVANNAS)

**The "Non-forested Amazon" (figure 14) constitutes 21% of the brazilian amazon and is covered mainly by cerrados, a savanna-type vegetation[21], while the forest cover is less than 50%. The savannas are concentrated in Mato Grosso, Tocantins, and Roraima. Moreover, there are extensive campinaranas in the north of the amazonas state and natural fields in the Island of Marajó (PA).**

This zone has a better road network, better infrastructure, and better internet access when compared to the rest of the Amazon. It is predominantly occupied by soy plantations. It shares the problems of and recommendations for the deforested Amazon.

(21) Also includes campinaranas and native grasslands

The implementation of the Brazilian Forest Code[22] is essential to conserve biodiversity and protect water sources. In this zone, there are good economic opportunities for forest restoration, reforestation, agroforestry systems, and prospects for low-carbon agriculture.



**RECOMMENDATIONS FOR THE NON-FORESTED AMAZON (SAVANNAS)**
**There are great economic opportunities for forest restoration, reforestation, and agroforestry systems market, with good prospects for the development of low-carbon agriculture**

- Fully adopt the Brazilian Forest Code
- Promote forest restoration
- Promote reforestation
- Combat the illegal conversion of the Cerrado/Savannas into farmland
- Fight wildfires and illegal burns
- Practice low-carbon agriculture
- Conserve biodiversity through the expansion of Protected Areas
- Regularize land ownership

(22) https://observatorioflorestal.org.br/en/o-codigo-florestal/.

# 5

## THE URBAN AMAZON

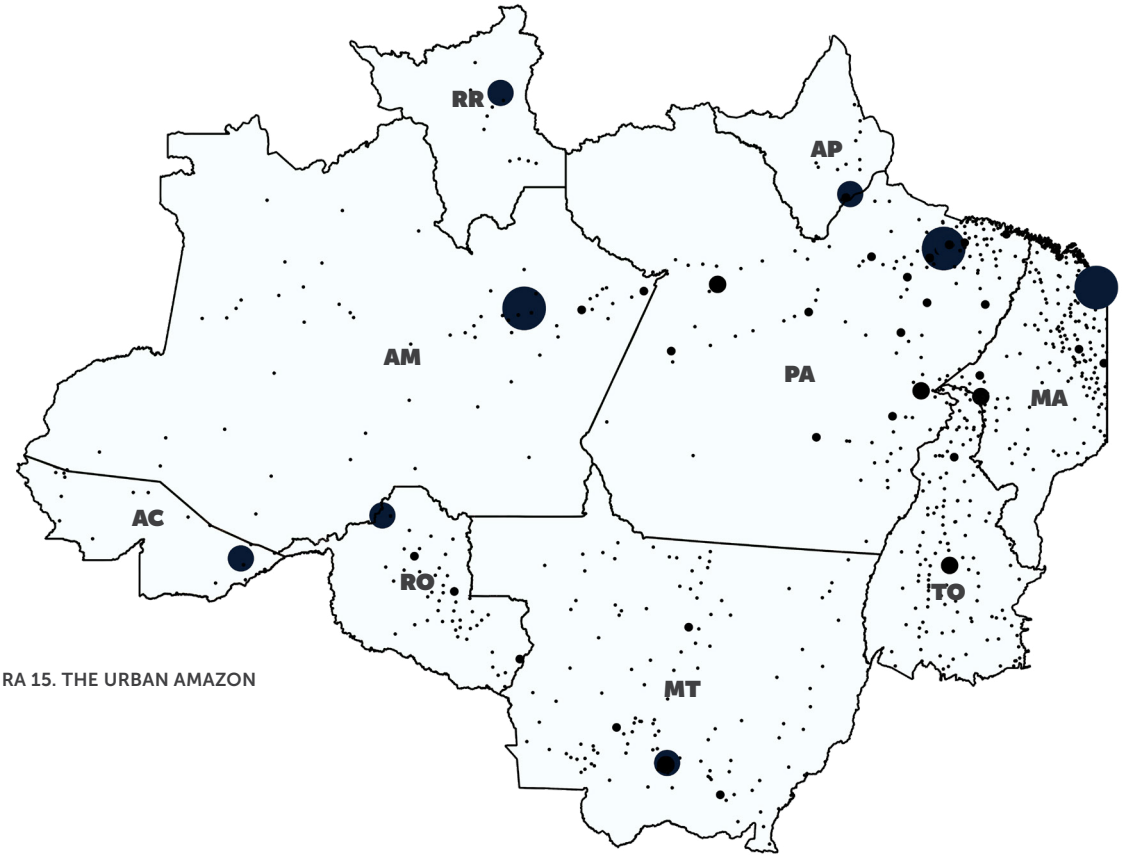


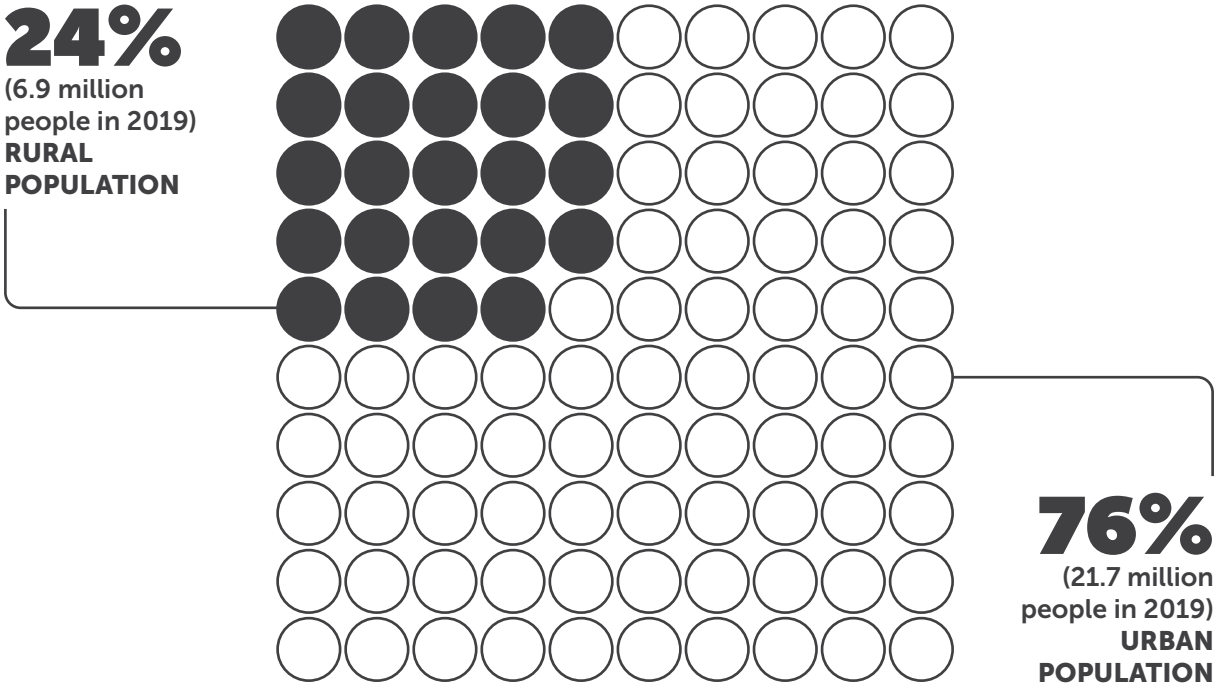

FIGURA 15. THE URBAN AMAZON

**The majority (76%) of the population in the brazilian amazon lives in urban areas (figure 15).[23] However, the brazilian amazon cities have poor infrastructure and poor public services compared to urban areas in the rest of Brazil. These cities have severe sanitation deficits, and a third of urban households do not have waste collection service(figure 16).[24] Despite the Brazilian Amazon's hot and humid tropical climate, urban afforestation occurs at lower rates than cities in the rest of the country.[25]**

(23) https://sidra.ibge.gov.br/pesquisa/pnadca/tabelas.
(24) https://amazonia2030.org.br/o-paradoxo-amazonico/.
(25) https://amazonia2030.org.br/as-cidades-na-amazonia-legal-diagnostico-desafios-e-oportunidades-para-urbanizacao-sustentavel/.

The majority (80%) of jobs are in cities. For this reason, it will be important to significantly expand the availability of vocational education, especially to youth and young adults in these urban areas.

**Figure 16 • The majority of the population in the brazilian amazon is urban**
Most of the population of the region lives in cities

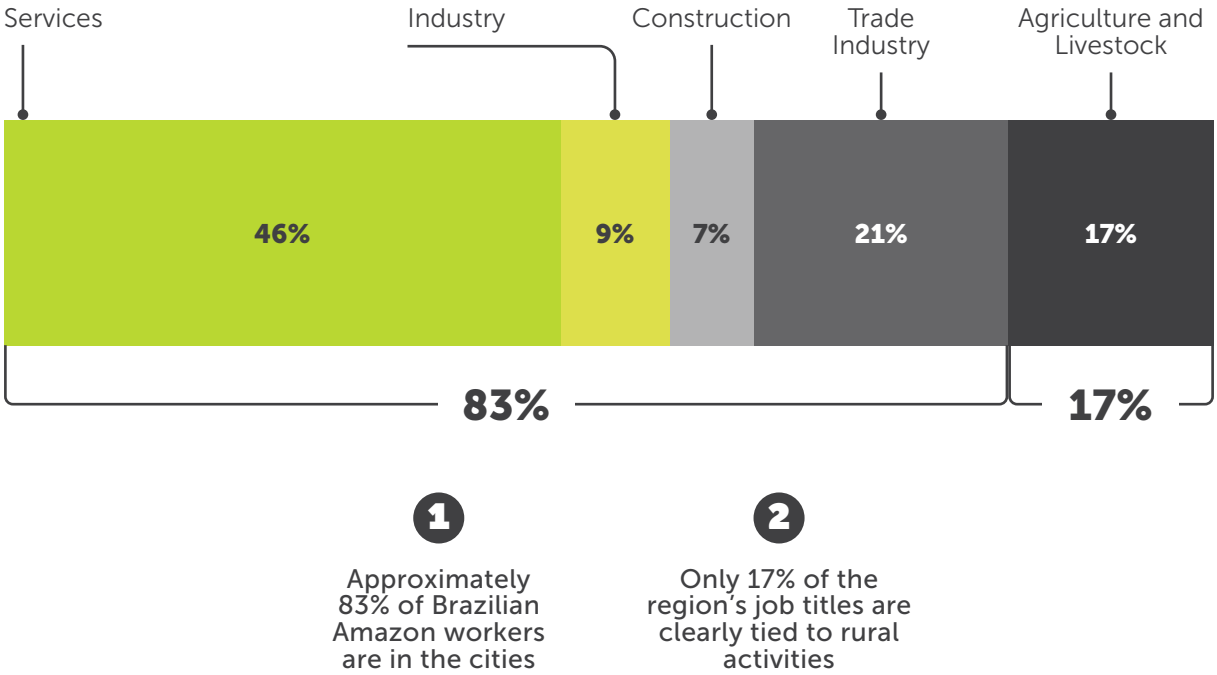



1. In 1960, less than one third of the Brazilian Amazon population was urban
2. As of 2019, about 76% of the population of the Brazilian Amazon was living in cities

Source: AMZ2030, with data from the IBGE Demographic Census (2010) and the IBGE Continuous National Household Sample Survey (PNAD-C, 2022).

This training will allow youth and young adults to take advantage of emerging employment and entrepreneurship opportunities in areas such as software and information technology, the creative economy including film-making, design, cultural production, gastronomy, tourism, etc. (Figures 17 and 18 an Box 8).

**Figura 17 • Job distribution by type In the Brazilian Amazon**
More than 80% of job opportunities are in the urban area




Source: AMZ 2020, with data from the IBGE Continuous National Household Sample Survey (PNAD-C, 2022).

### Box 8 • Manaus Free Trade Zone (ZFM)

The ZFM has the potential to provide a greater contribution to the generation of income and employment. Although the objective of industrial policy is regional development and employment generation, the majority of its workers are not well paid. In 2019, the majority (59%) of employees at the Industrial Hub of Manaus ZFM earned less than twice the Brazilian minimum wage. In order to fulfill its role and contribute to the region, the ZFM should prioritize the training and hiring of local labor, reinvest in the improvement of urban infrastructure, and support entrepreneurship and innovation with an emphasis on the effective use of natural resources in the Brazilian Amazon.[26]

(26) https://amazonia2030.org.br/aprimorando-zona-franca-manaus/.

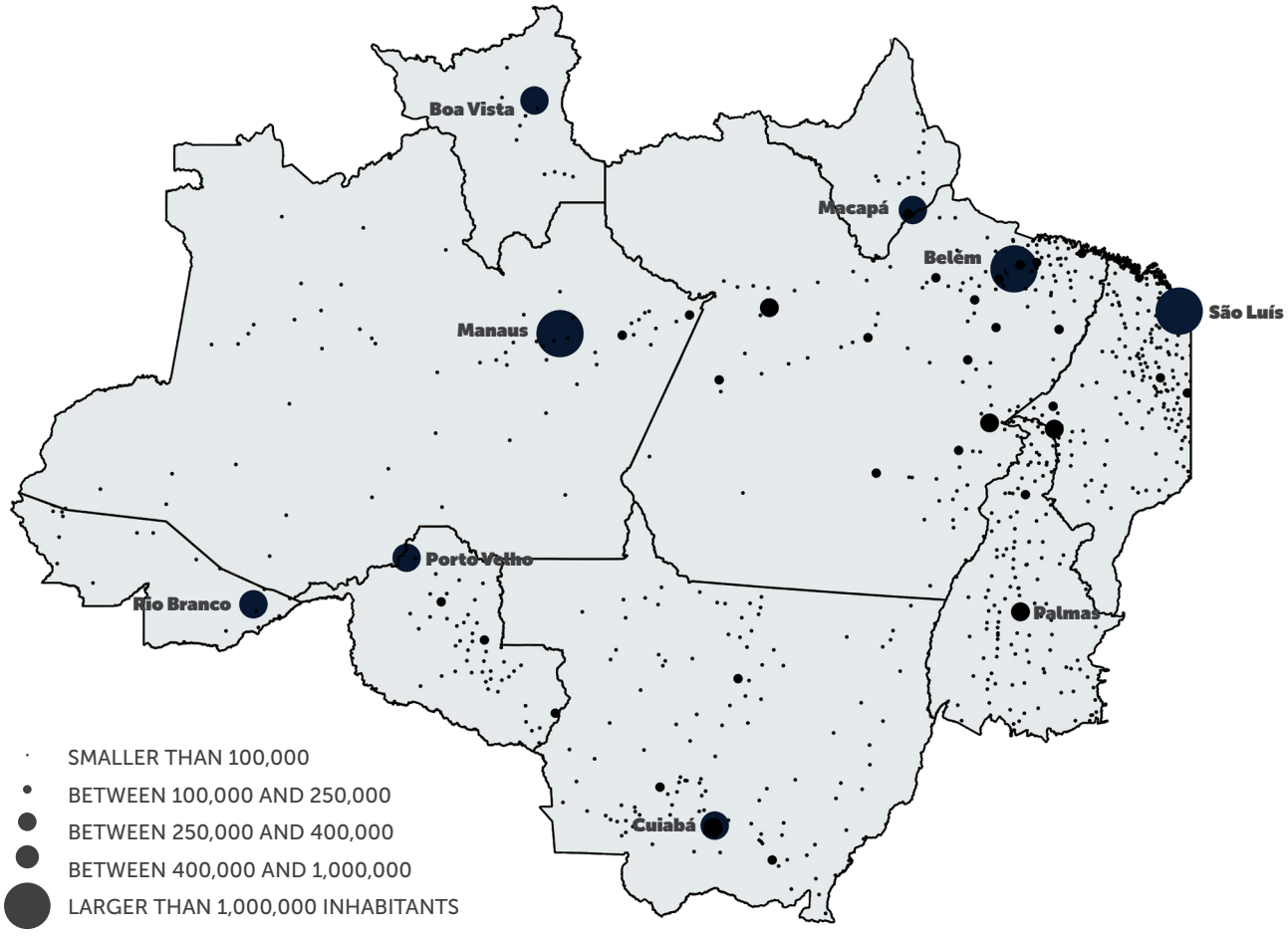
## Figure 18 • Investing in small and medium cities in the Brazilian Amazon

Most residents live in small towns and away from large centers

**1** In the Brazilian Amazon, 58% of the population lives in small municipalities, but the percentage is 43% in the remainder of Brazil

**2** The Brazilian Amazon lacks the kind of medium-sized cities that offer health care, education, justice, and other public services

**3** Small municipalities are defined as having populations lower than 100,000 inhabitants (2021 data)





Source: AMZ 2030, with data from the IBGE Municipal Population Estimate (2021).

Finally, it is necessary to invest in expanding and improving internet access in small and medium-sized cities and on the outskirts of large cities. This infrastructure will be essential to opening up new employment and income opportunities for which young people must be trained. Quality internet access strengthens the connection network between Amazonian cities and promotes improvements in public services and in the urban economy (Figure 19).

**Figure 19 • The infrastructure of the Brazilian Amazon**

The Amazon's urban infrastructure is also worse than the rest of the country's. To improve the quality of life of the population and encourage people to remain in the region, it is necessary to invest in essential services

| | BRAZILIAN AMAZON | REST OF BRAZIL |
|---|---|---|
| Water supply | **62%** | **77%** |
| Waste collection | **68%** | **78%** |
| Broadband internet | **13%** | **53%** |
| Sewage system | **17%** | **52%** |

**Source: AMZ2030 with data from the Ministry of Citizenship (2022), Anatel (2022), and IBGE (2022)**

## RECOMMENDATIONS FOR THE URBAN AMAZON

**Since urban areas contain most of the population, it is important to invest in cities' infrastructure to improve people's quality of life**

- Improve the quality of urban life
- Promote urban and river mobility
- Promote tree planting in cities
- Ensure access to basic sanitation, garbage collection, and water supply
- Promote areas of leisure and culture
- Expand broadband internet access
- Reinforce urban infrastructure
- Invest in professional training

## METHODOLOGY

To separate the Brazilian Amazon into five zones, the authors first classified each municipality as forested or non-forested. Municipalities with original forest cover greater than 50%, according to the map of vegetation physiognomies (IBGE 1997), were classified as 'forested'. In turn, municipalities with less than 50% forest were classified as 'non-forested' and constitute Zone 4, 'Non-Forested Brazilian Amazon'.

Next, forested municipalities were divided into three groups according to deforestation pressure: deforested, under pressure, and forested. These groupings were created through a statistical K-means cluster analysis, which creates groups as statistically distinct as possible through a set of response variables (Hardigan 1975; Härdle & Simar 2015). Deforestation in the Brazilian Amazon is mapped annually by the INPE through the analysis of Landsat satellite images. We used the INPE's deforestation map and the map of municipal boundaries from the IBGE in this analysis.

Data on the total, urban, rural, and migrant population and population composition are collected by the IBGE through demographic censuses, surveys of household samples, and published on the internet, on the IBGE, Institute for Applied Economic Research (Instituto de Pesquisa Econômica Aplicada – Ipea), or United Nations Development Programme (UNDP) websites.

For the analyses and definition of zones, we adopted the municipal scale. However, there are 29 municipalities in the Brazilian Amazon whose territorial extension is equal to or greater than 30,000 square kilometers (an area greater than Belgium). A few municipalities cover areas even greater than 100,000 square kilometers. For example, Altamira, in the Eastern Amazon, encompasses 159.5 thousand square kilometers and thus it is larger than Austria, Switzerland, and Belgium combined.

For large municipalities with territories of this magnitude, municipal data cannot fully capture the internal differences in the dynamics of human occupation and the pattern of deforestation. In order to have a more accurate picture of the spatial patterns of frontier occupation and deforestation, the solution would be to use census data (the IBGE collection and unit of analysis). Unfortunately, due to the unavailability and time lag of these data, we were unable to adopt this approach.

# ZERO DEFORESTATION AND LAND USE PLANNING: FOUNDATIONS FOR THE SUSTAINABLE DEVELOPMENT OF THE BRAZILIAN AMAZON

The Brazilian Amazon deserves a new economic model that enables conservation and sustainable use of its natural resources while contributing to an improved quality of life for its 28 million inhabitants. To this end, Brazil must commit to zero deforestation by 2030 and implement a land use plan in the region. These two pillars are essential for addressing the main factors that are deteriorating the economic environment of the Brazilian Amazon: criminality, violence, and inefficient land use.

Driven by destructive practices, the predominant land uses in the region have replaced a valuable and strategic natural asset – the forest – with unproductive activities. As a result, the Brazilian Amazon has become the largest contributor to greenhouse gas emissions in the country.[27] Furthermore, these practices have led to precarious living conditions for a large part of the population.[28]

Our article "The Amazon Paradox"[29] argues that this context of environmental destruction and socioeconomic vulnerability paradoxically presents three opportunities to establish a new pattern of regional development.

First, it is imperative to optimize the use of vast deforested areas that are largely underutilized. This entails increasing the productivity of traditional agriculture and cattle ranching while promoting agroforestry systems, reforestation, and forest restoration. Second, it is crucial to unlock the socioeconomic potential of the forest through the development of the bioeconomy and to create mechanisms for receiving compensation for its environmental services, particularly carbon capture and storage. Thirdly, it is essential to take advantage of the region's demographic dividend and the productive capacity of its available labor force, especially the 8 million adults who are currently not participating in the labor market.

Zero deforestation and land use planning are necessary conditions for the Brazilian Amazon to seize these three opportunities. Otherwise, the country will fail to enhance regional productivity or attract significant investments to the region. It will also be impossible to capitalize on opportunities related to the bioeconomy and forest restoration or to ensure the responsible stewardship and profitability of the forest's ecosystem services.

(27) plataforma.seeg.eco.br/total_emission.
(28) https://amazonia2030.org.br/wp-content/uploads/2023/01/FatosdaAmazonia_Socioeconomia.pdf
(29) https://amazonia2030.org.br/wp-content/uploads/2022/10/ParadoxoAmazonia_AMZ2030.pdf

In the Brazilian Amazon, there are still 143.6 million hectares of public lands without legally registered owners. The region's land use regularization plan – which is the basis for the allocation of these lands – is currently governed by Brazilian legislation and must be conducted in compliance with the procedures outlined in the Constitution and national laws for the allocation of public lands:

- **recognition of Indigenous Territories;**[30]
- **recognition of African-Brazilian (Quilombola) Territories;**[31]
- **recognition of Traditional Community Territories (Law No. 11284/2006, Article 6), often achieved through the establishment of Extractive Reserves and Sustainable Development Reserves;**[32]
- **areas designated for environmental conservation through the creation of Protected Areas or forest concessions (which can be located within or outside a Protected Area);**[33]
- **access to land for family agriculture, either through the establishment of agrarian reform Settlement Projects or through land title regularization for properties of up to four fiscal modules (maximum of 400 hectares in the Brazilian Amazon);**[34]
- **titling of medium and large private occupations (up to 2,500 hectares) without the need for public bidding, provided there is no overlap with previous claims and all requirements for receiving the land title are satisfied (Federal Law 11.952/2009, Art. 4).**

It is therefore the obligation of the Brazilian State (Union and states) to lead the agenda of zero deforestation and land use planning.

(30) Art. 231 of the Constitution of the Federative Republic of Brazil of 1988.
(31) Art. 68 of the Transitory Constitutional Dispositions Act.
(32) On federal lands, Decree No. 9.311/2018 (Art. 10) indicates three types of environmentally differentiated settlements: the Agroextraction Settlement Project (PAE), the Sustainable Development Project (PDS), and the Forest Settlement Project (PAF).
(33) Art. 225, §5 of the Constitution of the Federative Republic of Brazil of 1988 and Federal Law 9.985/2000.
(34) Art. 188 of the Constitution of the Federative Republic of Brazil of 1988, Law 8.629/1193 and Art. 2, §2 and §3 of Federal Law 4.504/1964.

## ZERO DEFORESTATION

Over the last four decades, the Brazilian Amazon has been subjected to excessive deforestation. The destruction of the forest has caused a significant loss of biodiversity, excessive greenhouse gas emissions, and disturbances in regional rainfall patterns, which have had detrimental effects on agriculture. Moreover, deforestation has contributed to the explosion of environmental crime and violence, inhibiting favorable investments in the region.

These disruptions, particularly criminal activities, have eroded the economic environment of the Brazilian Amazon. Criminality in the region, with its extensive and consolidated networks, contributes to the frequent trend of labor going unreported and unregulated. For this reason, law-abiding businesses – ones that prioritize good corporate governance practices and are well integrated into national and global markets – avoid making investments in the Brazilian Amazon, as they are reluctant to compete within a context of rampant criminality and environmental degradation. Additionally, the prevailing pattern of land use is highly inefficient and wasteful, with nearly one-fifth of the deforested area already degraded and abandoned instead of being used productively.[33]

Zero deforestation is not only desirable from an environmental standpoint but also justified from a socioeconomic perspective. In fact, the continued occurrence of deforestation perpetuates a detrimental cycle of environmental degradation, leading to low productivity and poor social indicators such as high poverty rates.[34] Therefore, it is crucial to strive for zero deforestation in the Brazilian Amazon by 2030.

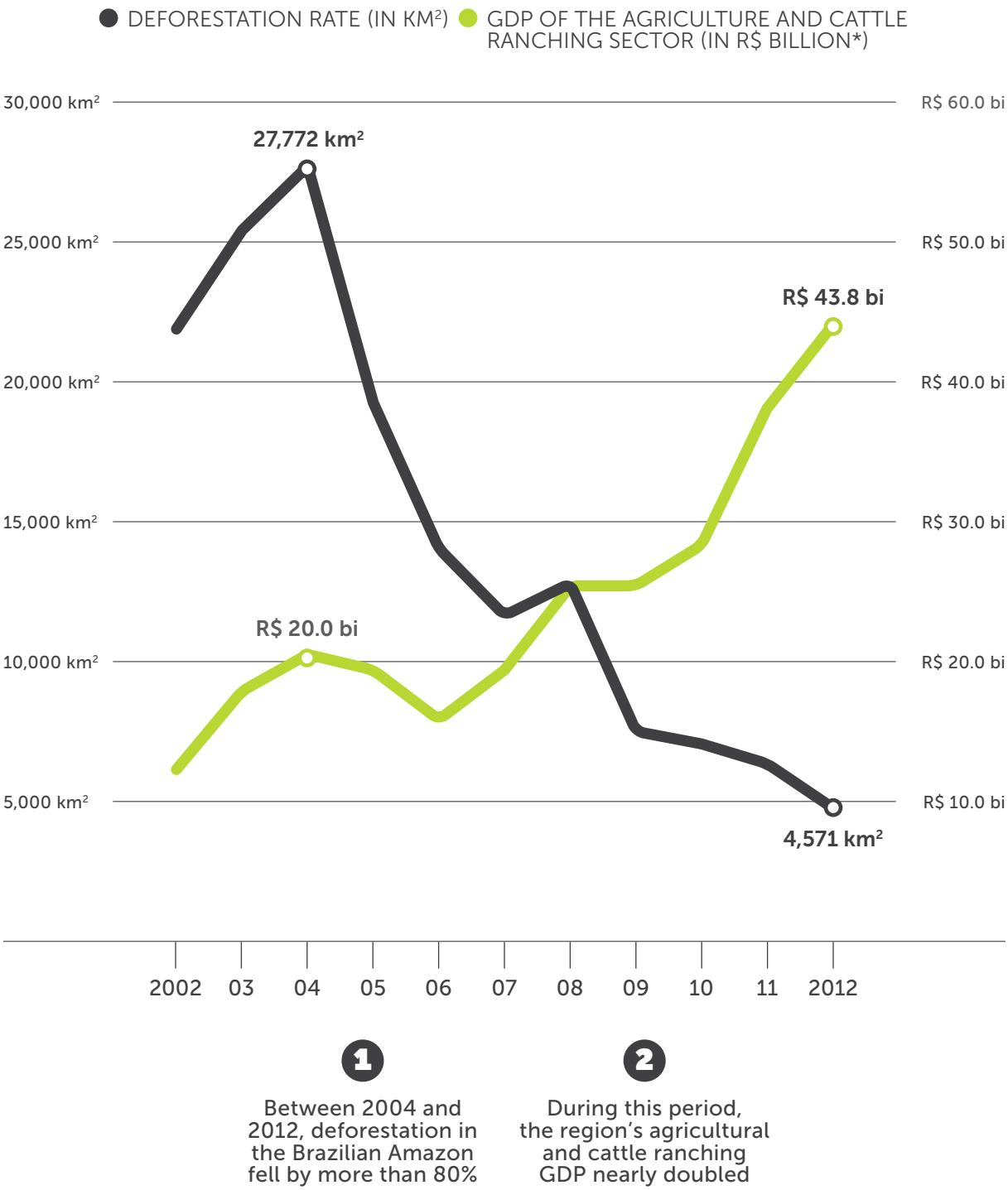
### Reducing deforestation does not have a negative impact on economic growth

It is possible to combat deforestation in the Brazilian Amazon without harming the economy. This is because most of the deforested area is occupied by lowproductivity cattle ranching, which generates few jobs and little income. Combating deforestation stimulates the intensification of farming and ranching activities in these already deforested areas, thereby contributing to increasing the value of production without requiring new deforestation.[35] In fact, between 2004 and 2012, the period during which the deforestation rate in the Brazilian Amazon fell by 84%, the inflation-adjusted GDP of the agricultural and cattle ranching sector in the region increased by 45%.

(33) amazonia2030.org.br/wp-content/uploads/2021/07/REL-AMZ2030-Protecao-Florestal-3.pdf.
(34) https://imazon.org.br/publicacoes/ips-amazonia-2021/.
(35) amazonia2030.org.br/wp-content/uploads/2021/09/pecuaria-extrativa_final_Paulo-Barreto-1.pdf.

## Figure 20 • Deforestation is not necessary for the region's development

Deforestation rate X GDP of the agriculture and cattle ranching sector in R$ billion



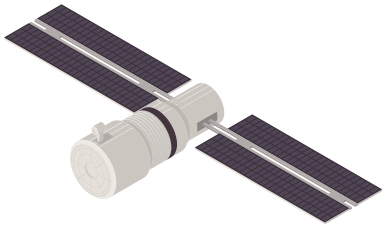

1 Between 2004 and 2012, deforestation in the Brazilian Amazon fell by more than 80%

2 During this period, the region's agricultural and cattle ranching GDP nearly doubled

* Deflated values

Source: AMZ2030 with data Prodes-Inpe and IBGE

Public policy played a crucial role in reducing forest loss in the Brazilian Amazon[36]. The Action Plan for the Prevention and Control of Deforestation in the Brazilian Amazon (PPCDAm), launched by the federal government in 2004, was the key driving force behind the decline in the deforestation rate. Over this period, deforestation decreased from 27,800 square kilometers in 2004 to 4,600 square kilometers in 2012. The PPCDAm encompassed various policy initiatives, with three highlights:

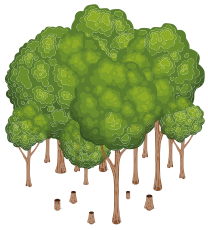


**Strengthening environmental monitoring and law enforcement**

The ability to detect forest loss in near-real time – the result of the development of a pioneering satellite image monitoring system

**Making access to rural credit conditional upon compliance with environmental and land titling requirements**

This was an innovative move towards using financial mechanisms to combat illegal deforestation in the region[37]



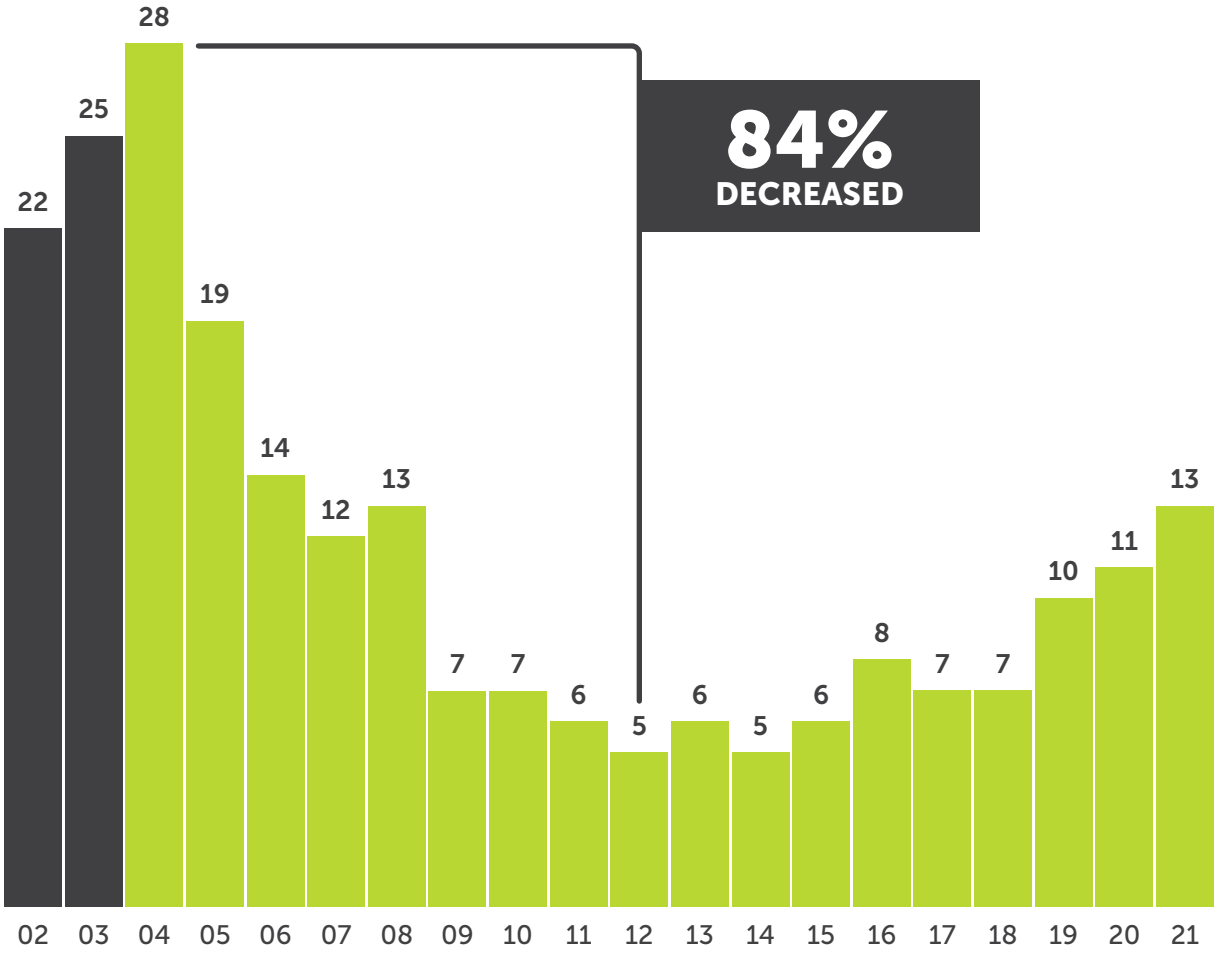
**The establishment of Protected Areas in regions with a high risk of deforestation**

Taking this step was decisive in mitigating the illegal occupation of public forests and the consequent deforestation

These initiatives were implemented within a new environmental governance structure. Through an inter-ministerial arrangement led by the Civil House, the PPCDAm was pioneering in its recognition of the cross-cutting nature of the forest protection agenda in the Brazilian Amazon. Starting in the mid-2010s, government policies and actions aimed at combating deforestation lost momentum. This situation further deteriorated from 2019 onwards, with the suspension of creating new Protected Areas, a sharp decline in enforcement efforts, and a significant increase in land grabbing, illegal logging, and illicit gold mining in the region. As a result, deforestation has continued at the highest rates of the past decade. Achieving zero deforestation by 2030 will require simultaneous action on two fronts: first, restructuring and strengthening the PPCDAm, and second, incorporating innovative approaches to address the region's new challenges, such as the substantial increase in crime.

(36) https://amazonia2030.org.br/wp-content/uploads/2021/07/REL-AMZ2030-Protecao-Florestal-3.pdf.
(37) https://www.bcb.gov.br/pre/normativos/res/2008/pdf/res_3545_v1_O.pdf.

**Figure 21 • Brazil knows how to reduce deforestation**
In thousands of km² per year




1. After record destruction rates in 2004, the country implemented a strategic policy plan that proved to be very effective in combating deforestation

2. From 2004 to 2012, the country successfully achieved an 84% reduction in the deforestation rate

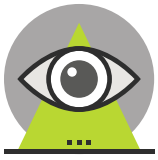
3. The PPCDAm was cost-effective and did not negatively impact regional economic activity

Source: AMZ2030with data of Prodes/Inpe (2021).

Zero deforestation involves the elimination of both illegal and legal deforestation. However, it is important to acknowledge that certain activities, such as industrial mining or essential infrastructure development, may involve some unavoidable residual deforestation. In such cases, it is crucial to offset the necessary deforestation through effective forest restoration measures.

## Restructure and strengthen what works

The public policy framework for forest protection has suffered from inaction and dismantling, particularly after 2019. It is therefore essential to restructure and strengthen policy instruments that are capable of effectively combating deforestation. These instruments include:



### ENFORCEMENT AND PROTECTION

The destruction of the Brazilian Amazon Forest is associated with the illegal extraction of natural resources and illegal occupation of the land to extensive deforestation for alternative uses. From 2019 to 2022, there was a significant decline in enforcement and a notable increase in deforestation. It is crucial to restore the response capacity of environmental protection and, in doing so, enforce the law. The Brazilian Amazon already has an effective satellite imagery system for monitoring forest loss[38]. The priority is to reinstate effective enforcement and the application of sanctions capable of imposing binding penalties on environmental offenders, such as economic embargoes of deforested areas[39], seizure and destruction of machinery, and cancellation and suspension of producers in the Rural Environmental Registry (CAR) if they act illegally in public areas.

### FINANCIAL INSTRUMENTS

These can promote the adoption of sustainable practices and drive compliance with environmental standards. The Brazilian banking system has made progress in this regard by implementing measures such as: i) increasing the credit limit by up to 10% for producers who provide a validated CAR, and ii) establishing the Green Bureau by the Central Bank to integrate data on sustainable practices of rural producers into the rural credit information system. Brazil should expand the utilization of financial instruments linked to sustainable practices[40]. This measure encourages enhanced agricultural and cattle ranching productivity while ensuring environmental conservation and compliance with environmental regulations, particularly the Forestry Code. Moreover, the financial sector should cease financing companies and entities involved in the processing of products derived from illegal deforestation.

### PROTECTED AREAS

The recognition of Indigenous Territories and the expansion of Protected Areas are essential to conserving biodiversity and safeguarding the livelihoods of forest communities. Moreover, these areas are key instruments for territorial planning in the Brazilian Amazon, especially in terms of allocating public forests. It is also important to ensure the preservation of the existing Protected Areas and to thoroughly investigate and effectively punish environmental crimes (such as deforestation, illegal logging, and gold mining) committed within these territories.

(38) The National Institute for Space Research's (INPE) Deforestation Detection in Real Time (DETER) system and Imazon's Deforestation Alert System (SAD) (https://imazon.org.br/en/imprensa/understanding-the-imazon-monitoring-system/).
(39) As municipalities listed in the federal list of municipalities for priority action in combating deforestation.
(40) https://www.climatepolicyinitiative.org/wp-content/uploads/2020/12/REL-Politica-de-Credito-Rural-no-Brasil.pdf.

## Innovating to meet new challenges

Reestablishing the PPCDAm is necessary to achieve zero deforestation, but it will not be enough. It is also necessary to tackle issues that were not fully addressed by previous public policies. For example, by enhancing economic incentives and ensuring the traceability of production chains operating in the region. Furthermore, it is crucial to take on new challenges, such as the growth and spread of organized crime, and to actively combat forest degradation.

### 1 Increase transparency and traceability in production chains

Lack of transparency regarding activities that contribute to deforestation interferes with fighting environmental crimes and limits market access for agricultural and cattle ranching products. Examples of inadequate transparency include the low percentage of validated rural property registrations in the CAR and the limited availability of Animal Transit Documents (GTA). Both the government and companies must provide accessible information that enables the traceability of agricultural, cattle ranching, and forest products across the entire production chain. Traceability is essential because it allows:

- Holding environmental criminals and their direct and indirect beneficiaries accountable;
- Encouraging and expanding markets for sustainable products;
- and Promoting products that are produced in an environmentally sustainable manner.

### 2 Promote strategic coordination among all levels of government (national, state, and local)

In a context of limited resources for implementing public policies, it is necessary to prioritize areas with the highest potential impact. This constraint leads to distinct priorities for different levels of government:[41]

- The federal government should prioritize combating deforestation in rural settlements, which account for 20% of the deforested area in the Brazilian Amazon over the past decade, with more than half of it occurring in federal areas. It is important to emphasize that this deforestation is concentrated in a few specific rural settlements.

- State governments bear the primary responsibility for enforcing environmental laws in private areas, which account for nearly 30% of deforestation in the last decade. Therefore, implementing the Forest Code – the main policy instrument for ensuring environmental protection in these areas – must be a priority for subnational governments. This state-level effort must be supported by the federal government

(41) https://www.climatepolicyinitiative.org/wp-content/uploads/2022/12/INS_Coordenacao-Estrategica-para-o-Combate-ao-Desmatamento.pdf .

- The federal government and state governments must work together in a complementary and coordinated manner to promote land use regularization in the Brazilian Amazon. Undesignated public areas and areas without land title information have become targets of illegal occupations associated with forest destruction. It is essential for the authorities to survey, register, and allocate these areas, adhering to legal priorities such as recognizing Indigenous Lands, African Brazilian (Quilombola) Territories and other Traditional Communities, establishing Protected Areas, allocating areas for family agriculture, and granting land titles once legal requirements are met.

### 3 Strengthen the environmental governance structure

The dismantling of forest protection policies between 2019 and 2022 and its resulting consequences have exposed the vulnerability of the institutional framework for conservation. Brazil must explore methods to safeguard forest protection efforts from political interference. To this end, it is crucial to strengthen the environmental governance structure, especially the National Environmental System (SISNAMA). The protection of the Amazon Rainforest depends fundamentally on cooperation among government sectors and levels, as well as on the active and representative involvement of civil society.

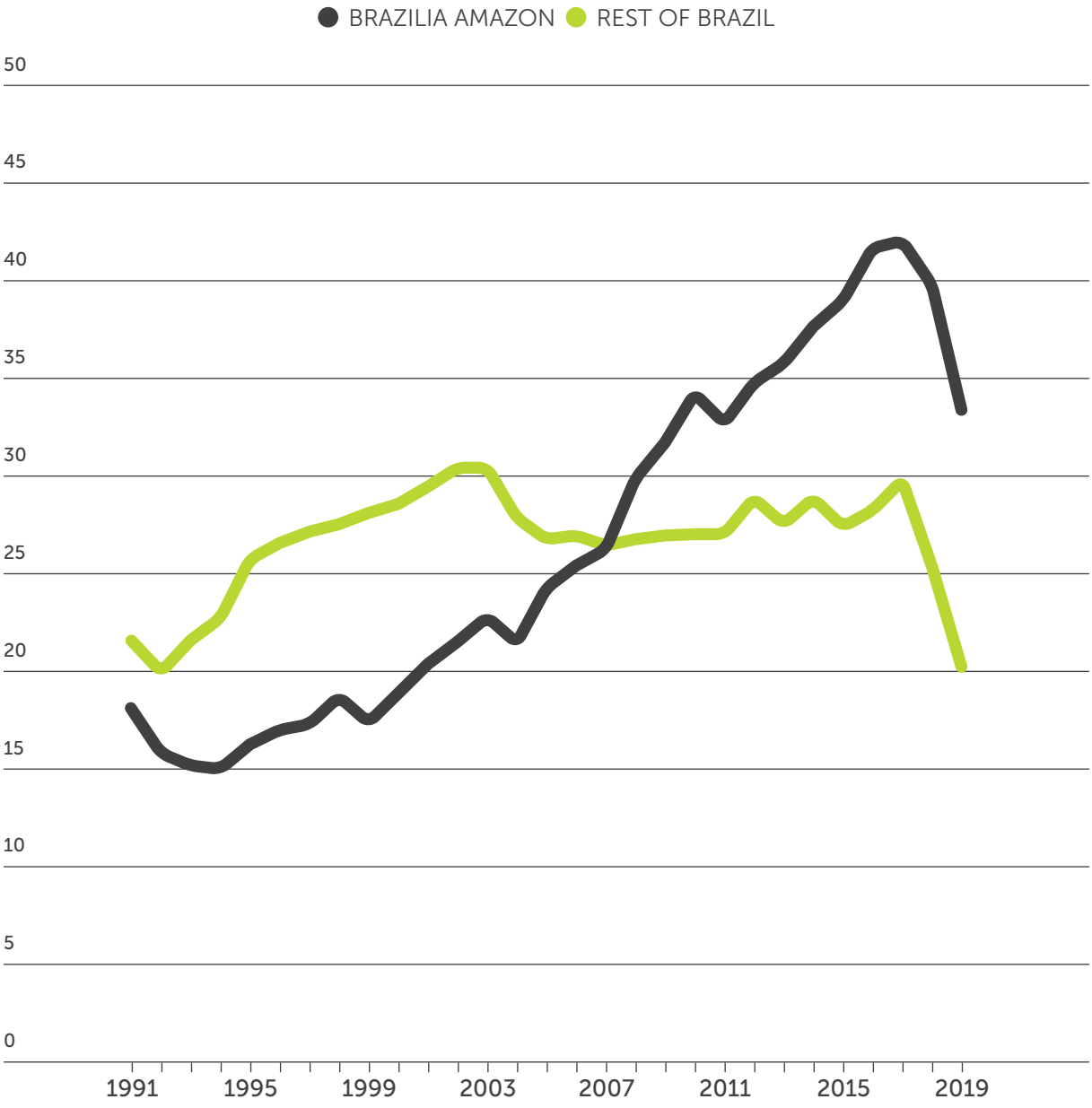
### 4 Strengthen the fight against organized crime

In recent years, the Brazilian Amazon has experienced a surge in violence and the spread of organized crime. While the region was relatively safe compared to the rest of the country until the mid-2000s, it has now become the most violent region in Brazil, hosting 23 of the country's 100 most violent municipalities[42]. This poses enormous risks to individuals in the region, leading to a significant decline in their quality of life. Moreover, the price paid collectively is very high. The lack of public safety deteriorates the economic environment and discourages law-abiding people from entering the region, while the failure to prosecute offenders attracts criminals and contributes to the expansion and consolidation of criminal networks. To dismantle these networks, it is crucial to investigate and penalize those who finance and support environmental crimes, both inside and outside the Brazilian Amazon.

**In general, deforestation in the Brazilian Amazon is not associated with social and economic benefits in the region. It neither leads to better employment conditions nor generates income for the local population. Moreover, due to its association with illicit activities, the effectiveness of long-term efforts to combat deforestation in the Brazilian Amazon hinges on simultaneously strengthening sustainable and legal economic alternatives in the region.**

(42) http://amazonia2030.org.br/wp-content/uploads/2021/12/Soares-Pereira-Pucci-Relato%CC%81rio-AMZ-2030-26.pdf.

**Figure 23 • The region has become one of the most violent in Brazil**
Homicide rates – per 100,000 inhabitants – in the Amazon and in the rest of Brazil




1. Until the early 2000s, the Brazilian Amazon had one of the country's lowest regional homicide rates
2. Today, if the Brazilian Amazon were a country, it would be the fourth most violent in the world, behind only El Salvador, Venezuela, and Honduras
3. The lack of economic opportunities and growth in criminality create space for violence

Source: AMZ2030 with data of DATASUS (1991-2019.

## 5 Combat forest degradation (logging and forest fires)

Approximately 21% of the Brazilian Amazon has already been deforested and the remaining forest areas are not fully intact. According to the Science Panel for the Amazon, around 17% of the remaining forest has experienced degradation of its vegetation cover[43]. The forest area affected by degradation in the Brazilian Amazon is estimated to be at least as large as that which is deforested each year. Despite having the capacity to monitor forest degradation in the Brazilian Amazon, Brazil has failed to take effective action against degradation[44]. Environmental performance metrics largely ignore degraded forest, focusing only on deforestation. This is also true for emissions associated with forest degradation, which are not computed in the Brazilian inventories of greenhouse gas emissions[45]. It is necessary to implement targeted measures to combat forest degradation, including programs aimed at preventing unsustainable logging practices and forest fires.

## 6 Protect secondary vegetation

The Brazilian Amazon holds vast amounts of underutilized deforested areas. This offers a unique opportunity to contribute to global ecosystem restoration efforts and establish the country as a leader in the restoration and carbon capture market. The region is home to 7.2 million hectares of secondary vegetation that is at least six years old, and another 6 million hectares of regenerated and potentially fallow areas[46]. However, secondary vegetation remains vulnerable. Currently, Brazil still has no official system for monitoring these areas. As a result, the country is unable to monitor and prove compliance with international targets for ecosystem recovery and restoration requirements established in its Forest Code. Furthermore, it does not detect the loss of secondary vegetation rapidly, limiting the capacity of environmental authorities to effectively protect forest regrowth. Systematic and frequent monitoring of secondary vegetation is vital for strengthening its protection and catalyzing the restoration process[47]. Brazil already has access to the technology and technical knowledge necessary to implement such monitoring but requires political support. Strengthening public policy efforts to promote landscape restoration, particularly the restoration of native forests, is essential.

(43) heamazonwewant.org/spa_publication/amazon-assessment-report-2021/.
(44) https://climatepolicyinitiative.org/wp-content/uploads/2022/08/Precisamos-Falar-Sobre-Degradacao-Florestal-na-Amazonia.pdf.
(45) https://nature.com/articles/s41561-021-00823-z.
(46) https://amazonia2030.org.br/wp-content/uploads/2021/04/Restauracao-Florestal-AMZ-2030.pdf.
(47) inputbrasil.org/wp-content/uploads/2020/07/whitepaper-O-Brasil-precisa-monitorar-sua-regeneracao-tropical.pdf.

## LAND TENURE

Poorly defined property rights are a critical issue in the Brazilian Amazon. They affect nearly 30% of its territory, totaling 143.6 million hectares of public areas that lack well-established land tenure information.[48]

Without clear land titles, these areas become targets for invasions, illegal occupation, and deforestation. Together, they account for 41% of the region's forest loss over the past decade.

Undefined land tenure also creates detrimental incentives that interfere with the region's economic development. This uncertainty poses a major obstacle, for instance, for the development of forest restoration and carbon capture initiatives, which constitute potentially huge and rapidly growing markets. Furthermore, the lack of guaranteed property rights discourages investments, while land insecurity fosters illegal land invasion and land grabbing.

The problem of undefined land rights entails significant costs for the region, making land use planning another necessary condition for the sustainable development of the Brazilian Amazon.

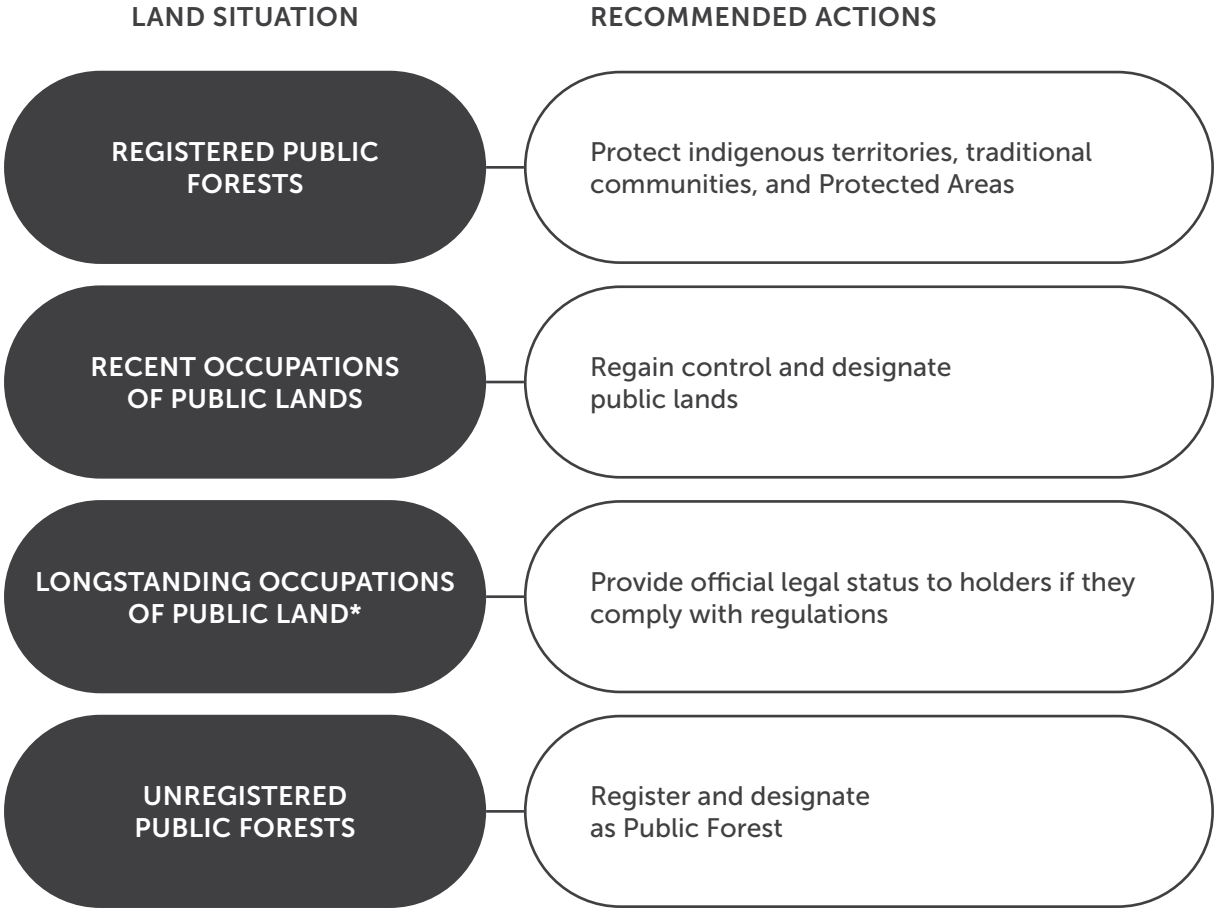
The Brazilian National Registry of Public Forests (CNFP) shows that there are 57.9 million hectares of undesignated public forests in the region. In addition, it is estimated that another 29.2 million hectares may be undesignated public forests that are not registered in the CNFP. These areas may hold various types of occupation – including Indigenous Territories, African-Brazilian (Quilombola) Territories, and Traditional Communities – but have not yet undergone the necessary titling process.

There is also an area totaling 7.2 million hectares of forests in Environmental Protection Areas (APA) and, despite appearing in the CNFP as assigned areas, they may be titled to private landowners if the legal requirements for land regularization are met. However, requirements vary across federal and state regulations, with some allowing for the legalization of occupations that occurred at any point in time, without a specific cut-off date (Brito et al. 2022).

(48) https://amazonia2030.org.br/wp-content/uploads/2022/06/AMZ-2030-46-1.pdf.

## Figure 23 • Recommended actions

Approximately 29% of the Brazilian Amazon has poorly defined land rights




*** Longstanding occupations in public lands include areas that were not titled by the National Institute for Colonization and Agrarian Reform (INCRA), areas in undesignated lands that are registered in the CAR and APA. Although they are included in the CNFP, APAs can be titled to private landholders if they are regarded as longstanding occupations that meet the legal requirements for land regularization. Landholders in properties with more than 80% of forest cover should be prohibited from deforesting as a condition for remaining on the property.**

The appropriate treatment of undesignated areas in the Brazilian Amazon depends on their status in terms of registration and occupation:

- **Registered and undesignated public forests**
  The designation of public forests should only include categories compatible with sustainable use and conservation, as outlined in the Public Forest Management Law. This includes Indigenous Territories, African Brazilian (Quilombola) Territories, territories of Traditional Communities, Protected Areas, and forest concessions.

- **Unregistered public forests and APAs**
  These areas should be included in the CNFP and designated according to the recommendations made for registered and unregistered public forests.

- **Longstanding occupations of public land**
  These areas are subject to land title regularization. The current legislation allows the issuance of land titles to longstanding occupations that meet the legal requirements, such as the federal cutoff date of December 2011, and do not overlap with priority demands for territorial recognition. However, to proceed with land title regularization in these areas while maintaining socio-environmental safeguards, it is necessary to strengthen the operational capacity of the land agencies and establish mechanisms for monitoring and transparency in the associated processes.

- **Recent occupations of public land**
  These areas are not eligible for land title regularization. Requests for regularization of recent occupations should be rejected, and the areas should be reclaimed and designated for other purposes. It is also essential to prevent changes in laws that would extend the deadlines for titling in public lands. Otherwise, there will always be an incentive for continued occupation and potential deforestation of public land.

The existing laws are already sufficient to allocate public forests in line with sustainable use and conservation. However, adjustments to the procedures outlined in the decree can increase the transparency in land regularization actions. It is also necessary to improve coordination among different federal entities that are responsible for solving the problem.

The time frame for land title regularization determines the cut-off date for defining what is a longstanding or recent occupation. Currently, the federal law sets December 2011 as the cut-off date, while state laws adopt more flexible dates or, in some cases, no cut-off date at all. It is crucial for all states to adopt a cut-off date for occupancy that is at least as restrictive as the federal one. Otherwise, it creates a harmful incentive for more illegal occupation of public areas, counting on the relaxation of the rules and eventual titling. The planning of the Brazilian Amazon territory must occur on the basis of transparent and consistent criteria.

The fight against deforestation and the regularization of land tenure are crucial for the Brazilian Amazon. This agenda must prioritize the protection of the forest and create the conditions that will enable sustainable development in the region. While primarily a public agenda, it has profound implications for quality of life and private investment. Uncontrolled deforestation and unregulated land use hinder the urgent economic renewal of the Brazilian Amazon.

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The AMAZONIA 2030 project is an initiative by Brazilian researchers to develop a sustainable development plan for the Brazilian Amazon. Our goal is to provide conditions for the region to achieve higher levels of economic and human development and attain sustainable use of natural resources by 2030.