



COMBATING ILLEGAL DEFORESTATION STRENGTHENING COMMAND AND CONTROL IS FUNDAMENTAL

JULIANO ASSUNÇÃO AND CLARISSA GANDOUR

The Challenge

Protecting native vegetation is not merely a critical and urgent environmental responsibility for Brazil. It is also a key to **promoting the country's position in global markets** and a major theme as it builds its international reputation. Controlling deforestation also means **confronting the crime and corruption** so deeply ingrained in the illegal practices of land occupation and conversion of vegetation that currently spread throughout the country. The fight against illegal deforestation is therefore a matter of national concern and a strategic objective that permeates many branches of government.

Monitoring and law enforcement are fundamental to controlling deforestation. Throughout the last decade, Brazil has seen significant progress in this area, especially in combating deforestation in the Amazon. Yet, the country must still face important technological and political challenges to reinforce its capacity for environmental command and control.

This white paper proposes actions to solidify and improve monitoring and law enforcement in the fight against illegal deforestation. These proposals draw on empirical evidence on the effectiveness and limitations of Brazilian public policy.

Recommendations for Public Policy

1. Promote and support technological development that enables the identification and control of small-scale deforestation and forest degradation.
2. Monitor areas of forest regeneration to measure and combat illegal clearing of secondary vegetation.
3. Expand the coverage of remote sensing-based environmental monitoring to the entire country.
4. Develop complementary strategies to combat illegal deforestation in agrarian reform settlements and undesignated public lands.



WHAT IS THE ISSUE?

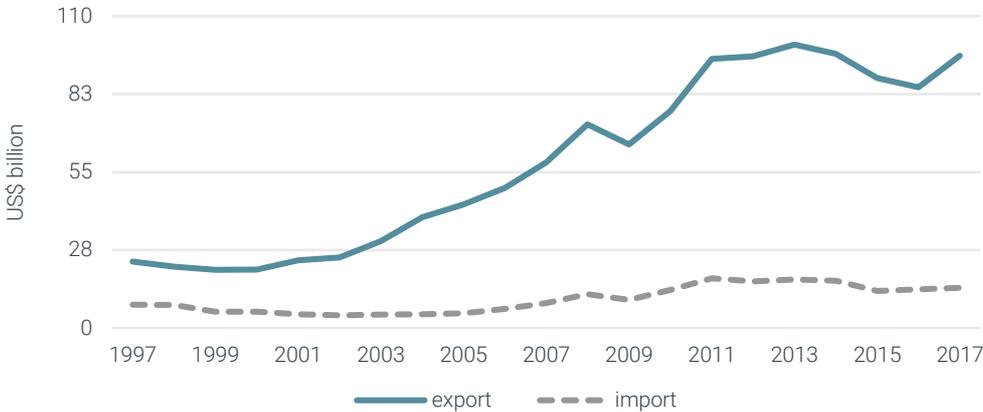
What challenge would we like to meet? Why is it important?

Brazil currently has close to 530 million hectares of native vegetation: 349 million hectares of Amazon rainforest, and 92 million hectares of savanna formations in the *Cerrado* region (Project Mapbiomas, 2018). Protecting this vegetation is a tremendous challenge. In addition to the country’s vast expanse of land, it holds significant ecological diversity and a complex legal framework for land use. In this context, effective action against illegal deforestation depends on cutting-edge technological development, specific personnel training, and deep institutional knowledge. Moreover, its success will crucially depend on firm political will to steer and orchestrate efforts.

Facing the challenge is worth the trouble. Protecting native vegetation brings many environmental benefits, including the conservation of biodiversity, preservation of water resources, and reduction of greenhouse gas emissions. But there is potential for even further gains. While protection of its vast natural patrimony today figures nearly exclusively on environmental agendas in Brazil, it is, in fact, a matter of strategic importance on a national scale, and cuts across diverse sectors and government agencies.

Two areas in particular are closely tied to environmental issues. First, **the development of Brazilian agribusiness depends in part on the country’s capacity to protect its natural resources.** Biophysical factors, which are key determinants of agricultural production, are directly linked to the conservation of native vegetation and ecosystem services, such as the preservation of water resources. Additionally, environmental results can also be used as tools for building an international reputation. The steady growth of exports in Brazil’s trade balance (see Figure 1) points towards the increasing dependence of Brazilian agribusiness on global markets. These external markets are more demanding in terms of compliance with environmental norms and agreements throughout the production chain. For Brazilian products to be competitive in international markets, Brazil must ensure that its agricultural production fully conforms to environmental regulations.

Figure 1: Brazilian Agribusiness Trade Balance, 1997 – 2017



Source: Climate Policy Initiative with data from Agrostat Brasil (MAPA) and SECEX (ME).

Second, **combating illegal deforestation means combating crime and corruption in Brazil.** The country is host to a wide variety of illegal activities in rural areas, including irregular occupation of public lands, falsified property-rights documents, unauthorized removal of vegetation, failure to comply with legally established environmental requirements, among others. All of these constitute an attack on public patrimony, since Brazil's native vegetation is a national asset of enormous environmental, social, and economic value. Protecting vegetation requires direct confrontation of the criminal and corrupt practices that are so entwined in rural occupation and land use in the country.

WHAT IS THE CONTEXT?

What is the history behind this issue?

In 2004, when total forest cleared in the Brazilian Amazon had reached more than 62 million hectares, deforestation was advancing at a record rate of 2.7 million hectares per year (Inpe, 2019). This scale of forest loss meant that the land use sector was responsible for approximately 70% of the country's greenhouse gas emissions (MCTI, 2013). At the same time, the world paid increasingly close attention to Amazon, as Brazil emerge as the global leader in tropical forest loss in both absolute and relative terms (Hansen et al., 2008). In the face of growing awareness of the role tropical forests play in global efforts to take on climate change, combating deforestation has become a priority on the international political agenda (Stern, 2008; Burgess et al., 2012).

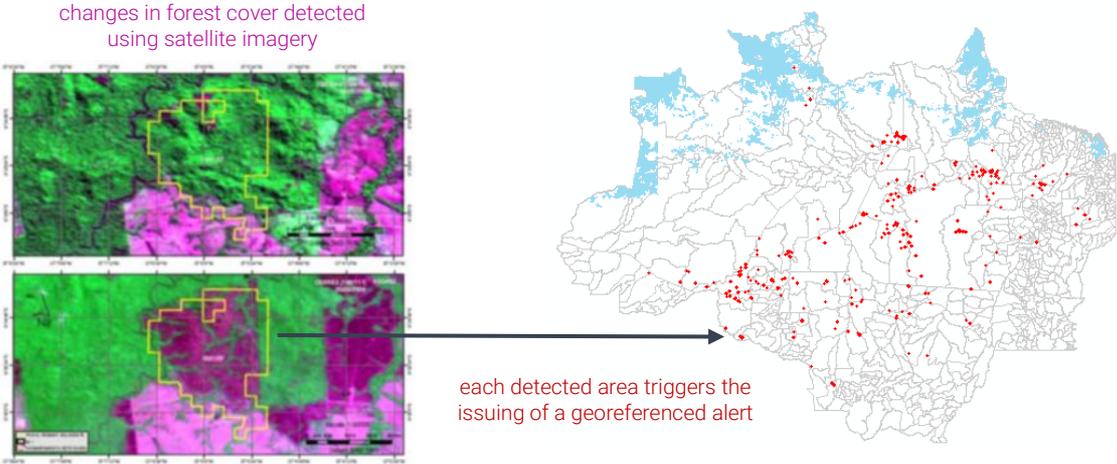
In this context, under increasing pressure to control its high rates of forest loss, Brazil launched the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm). This marked the country's new approach to dealing with illegal tropical deforestation. **Combining cutting-edge technology and innovative public policy, the action plan helped reduce the annual rate of forest loss by more than 80%** (Hargrave and Kis-Katos, 2013; Assunção et al., 2015; Burgess et al., 2018).

How effective is existing public policy?

Brazil implemented several conservation measures under the PPCDAm, but **the strengthening of monitoring and law enforcement stands out as the factor that most contributed to the reduction of deforestation in the first decade of the action plan** (Assunção et al., 2017b). This strengthening benefited from important institutional changes that brought better regulatory stability to the process of investigating and punishing environmental infractions. However, with the implementation of a modern satellite-based system to target environmental enforcement, technological innovation was the true driver of Brazil's enormous leap in forest monitoring capacity.

Developed by the National Institute for Space Research (Inpe), the System for Real-time Detection of Deforestation (DETER) uses high-frequency satellite imagery to monitor recent changes in forest cover. By comparing daily images from a same region, DETER identifies areas that have seen recent loss in forest cover. Each of these areas is classified as a deforestation hotspot and is associated with a georeferenced alert, which flags the location of the potential infraction (see Figure 2). Alerts are then forwarded to the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama), which uses them to target monitoring and law enforcement efforts. DETER covers the full extent of the Brazilian Legal Amazon and generates daily information about areas under risk. The system therefore offers near-real-time surveillance of a region extending over more than 500 million hectares.

Figure 2: DETER System – Satellite-Based Monitoring of Forest Loss



Source: Climate Policy Initiative with data from Ibama (MMA) and DETER / Inpe (MCTIC).

Prior to the development of the satellite-based monitoring system, knowledge about new deforestation hotspots depended largely on voluntary anonymous tips on recent clearing activity. It was difficult for law enforcement personnel to reach affected areas in time to identify those responsible for environmental damage. Since the adoption of DETER, law enforcers are routinely armed with up-to-date information, thus improving their chances of catching and punishing offenders. The system therefore represented a significant improvement in the capacity to enforce environmental law. With DETER, environmental authorities closely monitor an enormous area of the country, identifying forest loss with greater agility and acting more precisely to combat illegal deforestation. DETER serves as the main environmental monitoring tool in the Amazon.

Studies show that environmental monitoring and law enforcement have effectively reduced deforestation in the Amazon (Hargrave and Kis-Katos, 2013; Assunção et al., 2017b). Estimates suggest that in the first five years since DETER’s implementation, environmental command and control efforts helped prevent the loss of more than 2 million hectares of Amazon rainforest per year (Assunção et al., 2017b). It is important to emphasize that this protection has not been to the detriment of agricultural production. The study presents evidence that monitoring and enforcement did not interfere with production. Conservative estimates also indicate that the command and control efforts in the Amazon have a relatively

low cost as compared to their potential benefits (Assunção et al., 2017b). Thus, **in addition to its effectiveness in combating deforestation, the command and control strategy adopted in the Amazon did not impose a high cost burden – in neither financial nor productive terms.**

HOW CAN BRAZIL RESOLVE THIS ISSUE?

Discussion and Recommendations

Brazil has developed and implemented a system for monitoring and law enforcement that has been effective in combating deforestation in the Amazon. The following proposals build on this experience. In light of the empirical evidence on the efficacy and limitations of the current system and context, the proposals aim at determining areas for priority policy action to solidify and strengthen Brazil's environmental command and control strategy.

1. Promote and support technological development that enables the identification and control of small-scale deforestation and forest degradation.

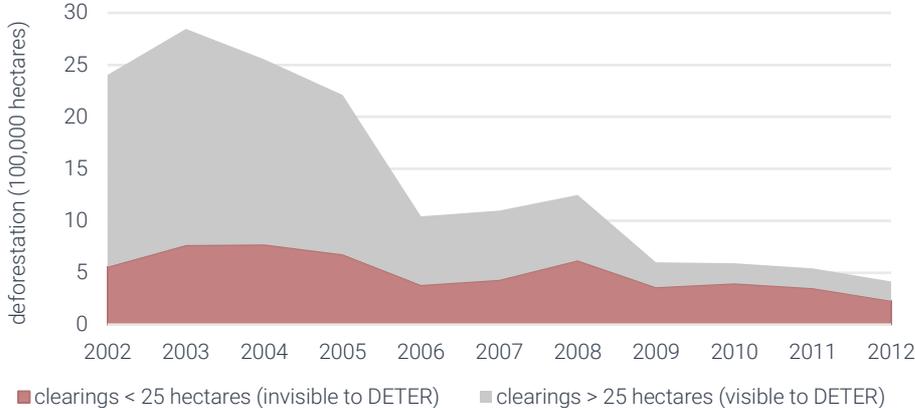
Despite representing an enormous leap forward in Brazil's environmental monitoring and law enforcement capacity, the DETER system exhibited a key technical limitation. Due to the resolution of the satellite imagery used by DETER, forest loss in contiguous areas covering less than 25 hectares remained invisible to the system. In practice, if the system does not detect a clearing, it is not associated with an alert and is thereby less likely to be visited by law enforcement personnel. Before DETER was implemented, small-scale clearings represented one quarter of annual deforestation; by the beginning of this decade, it accounted for more than half of cleared forests (see Figure 3). Studies suggest that this change in the makeup of deforested lands indicates a possible strategic response on the part of offenders looking to escape detection (Rosa et al., 2012; Godar et al., 2012, 2014; Assunção et al., 2017a).

Furthermore, forest degradation in Brazil has also increased in relation to clearcutting (Souza Jr. et al., 2013; Rappaport et al., 2018). Since it occurs gradually, this phenomenon is more difficult to detect via satellite imagery than clearcutting. The original DETER system detected degradation, but it did so in low resolution and therefore lacked precision. The sooner forest degradation is detected by the monitoring system, the better. This allows for the interruption of environmental deterioration at its earlier stages, increasing the potential for preservation.

Partially in response to these limitations, Inpe developed the DETER-B system. With the capacity to detect forest loss in areas larger than one hectare, the new system is also better at detecting forest degradation, since it can distinguish between degradation, forest fire damage, and selective logging. DETER-B's higher resolution comes with a practical cost: lower time

frequency. Therefore, the new system works as a complement to the previous one, not as a substitute. It is crucial that DETER-B and analogous complementary systems not only be maintained and strengthened, but also evaluated in order to identify room for improvement.

Figure 3: Amazon Deforestation by Cleared Patch Size, 2002 – 2012



Source: Climate Policy Initiative with data from PRODES / Inpe (MCTIC).

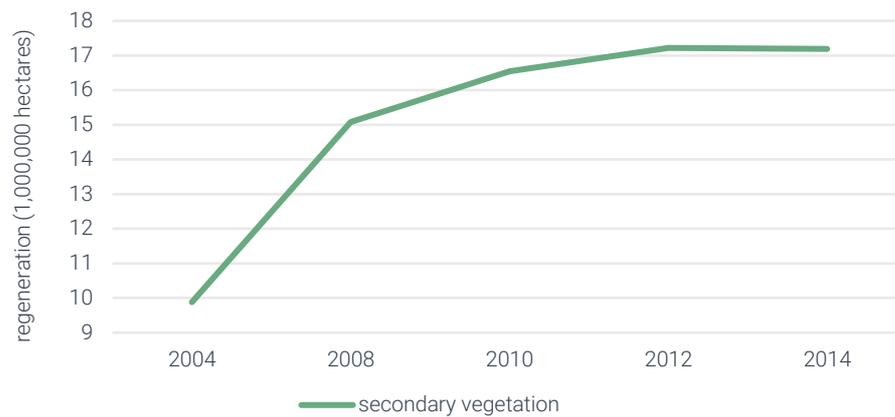
2. Monitor areas of forest regeneration to measure and combat illegal clearing of secondary vegetation.

Brazilian satellite-based monitoring systems were designed to detect loss of primary vegetation. As such, once an area has been cleared, the systems do not revisit it. Whatever happens inside that area thus becomes invisible to the systems. Since regeneration, by definition, occurs in areas that have been deforested, the country has no monitoring whatsoever of secondary vegetation. Regeneration is therefore completely vulnerable.

This affects a significant amount of land. In the Amazon, the only biome for which official data exist on regeneration, there were more than 17 million hectares of secondary vegetation in 2014 (Inpe and Embrapa, 2016). The amount of regeneration in the Amazon – equivalent to nearly a quarter of all deforested land – suggests that a large part of cleared areas were abandoned. This represents a tremendous waste of resources, aggravated by the fact that the country continues to advance on its primary forests at a rate of nearly 800 thousand hectares per year (Inpe, 2019).

Tracking forest regeneration is central to compliance with the Forest Code and the goals established in the Paris Agreement. The increase of 7 million hectares of secondary vegetation in the Amazon in one decade (see Figure 4) indicates that the reforestation commitment signed by Brazil (12 million hectares for the entire country) is feasible. It is critical, then, that the country monitor secondary vegetation throughout its territory, to measure the progress of regeneration as well as to guarantee its protection.

Figure 4: Amazon Regeneration, 2004 – 2014



Source: Climate Policy Initiative with data from TerraClassAmazonia / Inpe (MCTIC) and Embrapa (MAPA).

3. Expand the coverage of remote sensing-based environmental monitoring to the entire country.

Remote sensing systems for monitoring land cover and land use play two crucial roles. First, they facilitate the regular and systematic collection of data, making them an important and reliable source of information about the country's territory. Second, they are fundamental to guaranteeing effective law enforcement in a country as vast as Brazil. Remote sensing optimizes the authorities' monitoring capacity by allowing them to see the entire country without having to be physically present in any one place.

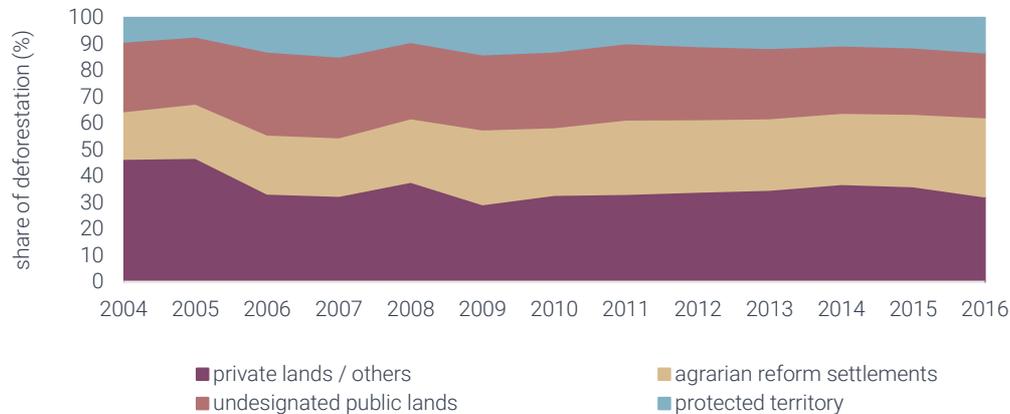
Until mid-2018, Brazil's federal systems for measuring and monitoring forest loss via satellite could only be used for tropical vegetation in the Legal Amazon. The systems were recently expanded to the *Cerrado* biome and adapted to its specific vegetation. Brazil now monitors loss of native vegetation, in near-real-time, in 73% of the country. Coverage of the two largest Brazilian biomes should be maintained and refined, but monitoring should also be extended and adapted to the rest of the country's biomes.

4. Develop complementary strategies to combat illegal deforestation in agrarian reform settlements and undesignated public lands.

Since 2010, an estimated two-thirds of the Amazon's deforested area lies within public lands, primarily in agrarian reform settlements (30%) and in undesignated areas (25%) (see Figure 5). Combating illegal deforestation should therefore be aligned with the development and implementation of other public policies, especially those that promote land regularization. This is particularly relevant to the Brazilian Amazon, due to its long history of irregular occupation,

squatting, land conflicts, and uncertainty regarding property rights (Mueller et al., 1994; Alston et al., 2000; Pacheco, 2009; Chiavari et al., 2016; Fetzer e Marden, 2017).

Figure 5: Amazon Deforestation by Land Tenure Category, 2004 – 2016



Source: Climate Policy Initiative with data from the DPCD (MMA).

CONCLUSION

Brazil has a unique opportunity to align the interests of diverse segments of the government around a common action. **When it strengthens the protection of its native vegetation, the country not only protects a precious environmental asset, but also moves toward a position of leadership in multilateral forums, becomes more competitive in global commodities markets, and makes progress toward the national goals of combating crime and corruption.**

The country's recent experience in the Amazon is evidence that monitoring and law enforcement are key elements in controlling deforestation. Building on that experience, the proposals presented in this white paper aim to solidify and strengthen the protection of native vegetation on a national scale. The implementation of these proposals depends on technological development, personnel training, and coordinated efforts between different spheres and segments of government.

Finally, but no less importantly, effective control of illegal deforestation requires unwavering political will. **There must be public commitment to maintaining approaches that have already proven effective, as well as to facing the necessary challenges in order to strengthen monitoring and law enforcement.** The protection of native vegetation in Brazil should be treated as a national priority. The future of the country – its environmental balance, international reputation, agribusiness, and fight against crime – depends on it.

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ABOUT CPI AND INPUT

With deep expertise in policy and finance, **Climate Policy Initiative (CPI)** works to improve the most important energy and land use practices around the world. Our mission is to help governments, businesses, and financial institutions drive growth while addressing climate risk. Our Brazil office is affiliated with the Pontifical Catholic University of Rio de Janeiro (PUC-Rio) and has close collaborations with prominent research universities around the world.

The **Land Use Initiative (INPUT - Iniciativa para o Uso da Terra)** counts on a dedicated multidisciplinary team of experts who work at the forefront of how to increase environmental protection and food production. INPUT aims at analyzing and influencing the creation of a next generation of low-carbon economy policies in Brazil. CPI's work for the initiative is currently supported by Norway's International Climate and Forest Initiative (NICFI), Children's Investment Fund Foundation (CIFF) and Instituto Clima e Sociedade (iCS).

AUTHORS

Juliano Assunção

Climate Policy Initiative (CPI)

Núcleo de Avaliação de Políticas Climáticas da PUC-Rio (NAPC/PUC-Rio)

juliano.assuncao@cpirio.org

Clarissa Gandour

Climate Policy Initiative (CPI)

Núcleo de Avaliação de Políticas Climáticas da PUC-Rio (NAPC/PUC-Rio)

clarissa.gandour@cpirio.org

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