POLICY BRIEF

BRAZIL KNOWS WHAT TO DO TO FIGHT DEFORESTATION IN THE AMAZON

MONITORING AND LAW ENFORCEMENT WORK AND MUST BE STRENGTHENED

INPUT
Iniciativa para o Uso da Terra

CLIMATE POLICY INITIATIVE

INTRODUCTION

The Brazilian Amazon is a vital environmental asset. It provides many critical ecosystem services whose benefits extend well beyond Brazil's national borders. At roughly half the size of continental Europe, the Brazilian Amazon serves as a major carbon sink and, thus, plays a central role in the global effort to fight climate change. A healthy Amazon is also key to conserving biodiversity and water resources, which, in turn, help maintain biophysical conditions needed for agricultural production. Moreover, considering Brazil's unique capacity to reconcile environmental conservation and agricultural production, protecting the Amazon also serves as a strategic means of moving the country towards a position of leadership in international commodity markets.

Yet, the Brazilian Amazon is currently under threat. Data from 2019 suggest forest clearing has accelerated sharply over the past few months.[1] Recent news coverage showing alarming images of fires raging across vast forest areas may have led many to think Brazil lacks sufficient policy tools to control Amazon deforestation – this conclusion is a mistake. The country holds unique expertise in using policy to fight tropical clearings, largely due to the implementation of an action plan in the early 2000s.[2] The plan proposed novel policy measures that helped reduce deforestation rates by more than 80% over the course of a decade. Despite the plan's initial success, fifteen years after its inauguration, Brazil finds itself at a crossroads. It must draw on what it has learned from the past to strengthen Amazon conservation today. This document offers evidence-based policy recommendations to help move the country in this direction.

Starting in 2004, through a combination of technological development and policy innovation, Brazil set up an innovative monitoring system for targeting law enforcement action to fight tropical forest clearing. **Analysis conducted by researchers at Climate Policy Initiative/ Núcleo de Avaliação de Políticas Climáticas da PUC-Rio (CPI/ NAPC PUC-Rio) indicates that this system works.**[3] Drawing on statistical tools to estimate the impact of monitoring and law enforcement efforts on deforestation, they find that, **from 2007 through 2016, these efforts avoided the clearing of an average of 27,000 km² of Amazon forest per year**. Furthermore, the effectiveness of this monitoring and law enforcement strategy in combating deforestation did not impose a high cost burden. Results suggest that **forest protection did not interfere with local agricultural production, and that its expected benefits outweighed the associated policy costs.**

These findings are particularly timely, as the Brazilian Federal Government currently plans to cut back on resources that support environmental enforcement. This will likely lead to escalating deforestation. **The 50% reduction in the budget for environmental monitoring and law enforcement proposed for 2020 could increase Amazon deforestation by an estimated 45%. Brazil must act quickly and decisively to prevent this from happening.**

1 INPE (2019). Sistema DETER [database]. Coordenação-Geral de Observação da Terra, Instituto Nacional de Pesquisas Espaciais, Ministério da Ciência, Tecnologia e Inovação. Retrieved from http://terrabrasilis.dpi.inpe.br/file-delivery/download/deter-amz/shape on Oct. 2019.

2 Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm).

3 Assunção, Gandour and Rocha (2019). **DETERring Deforestation in the Amazon: Environmental Monitoring and Law Enforcement**. CPI/ PUC-Rio working paper, available at http://www.inputbrasil.org/publicacoes/o-brasil-sabe-como-deter-o-desmatamento-na-amazonia/

RECOMMENDATIONS

Effective action against Amazon deforestation requires close collaboration between monitoring and law enforcement capacities. To achieve this, Brazil must:

- Resume and strengthen the federal government's institutional and financial support for monitoring and law enforcement action.
- Increase law enforcement's capacity to impose binding sanctions on environmental offenders by enhancing its ability to catch deforesters red-handed and respond quickly.
- Promote frequent reassessment and improvement of existing monitoring systems.
- Build strategic partnerships that bolster monitoring and law enforcement capacities.

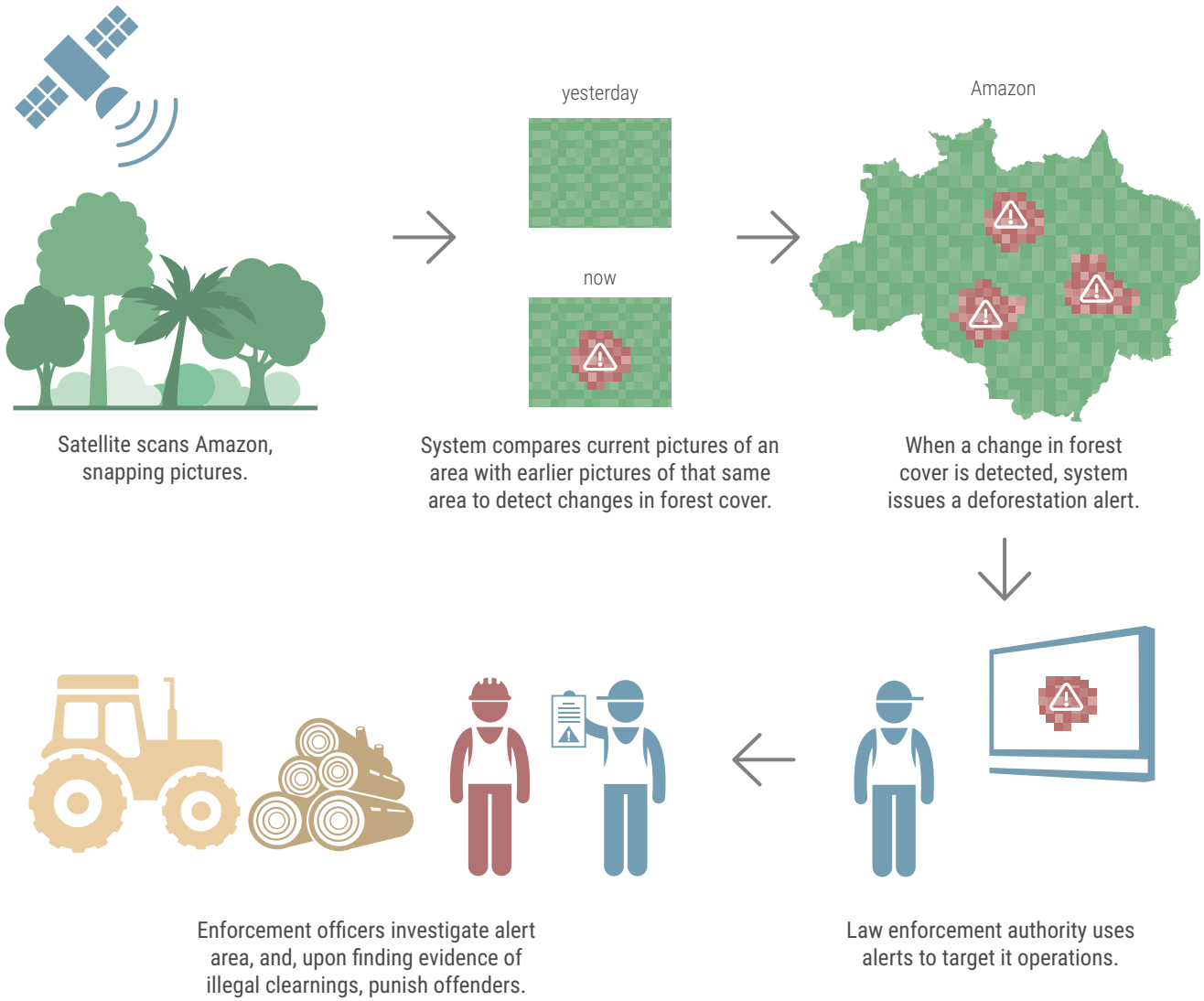
THE AMAZON MONITORING AND LAW ENFORCEMENT SYSTEM

Law enforcement plays a critical role in combating deforestation, because the vast majority of clearings that occur in the Amazon are illegal. In the early 2000s, Brazil had a limited capacity to detect these illegal practices. Law enforcement efforts depended largely on strategic intelligence collected by the environmental police, as well as anonymous reports of forest clearing activity received via a hot line. In the absence of remote monitoring technology capable of placing large forest areas under regular surveillance, law enforcement officers depended heavily on air vehicles, such as helicopters, which offered only a relatively short range of action, and still put law enforcement officers at great personal risk. In this setting of acute lawlessness and limited enforcement capacity, strengthening command and control was a priority for Brazil's policy action plan to combat Amazon deforestation.

The major leap forward in law enforcement capacity happened with the adoption of near-real-time satellite-based monitoring of forest clearing activity. Developed by the Brazilian Institute for Space Research (INPE), the Real-Time System for Detection of Deforestation (DETER) uses satellite imagery to regularly scan the full extent of the Brazilian Amazon, looking for signs of recent forest disturbance. By comparing pictures from different dates for a same location, the system detects areas that exhibit a change in tropical forest cover. For each of these areas, DETER issues an alert that carries geographic information pinpointing its exact location. Alerts flag areas in need of immediate attention, and help target and deploy environmental law enforcement operations (see Figure 1).

DETER was developed as a means of supporting law enforcement operations carried out by the Brazilian Institute for the Environment and Natural Resources (IBAMA), which operates as the federal environmental police. During these operations, offenders who engaged in illegal deforestation are punished with administrative sanctions, including fines, embargoes (which obstruct access to rural credit), seizure of illegal products and equipment used in the infraction, and destruction of seized products and equipment. Administrative sanctions therefore impose a high financial burden on offenders both directly (e.g., fine payment, loss of product/equipment) and indirectly (e.g., restricted access to credit, legal fees). Offenders may also face civil and criminal charges, in addition to administrative ones.

Figure 1: How Satellite Monitoring and Law Enforcement Work Together to Fight Deforestation in the Amazon



Elaboration: *CPI/ NAPC PUC-Rio*

WHY THE MONITORING AND LAW ENFORCEMENT SYSTEM MATTERED

The implementation of DETER was game changing. The system was the first of its kind to be used for monitoring vegetation over such a vast geographical area and in near-real-time. It not only allowed the environmental police to spot illegal activity throughout the entire Amazon, but it did so with unprecedented speed and speed was the key to boosting law enforcement's potential for impact. Prior to the activation of DETER, it was extremely difficult for law enforcement officers to locate and reach new deforestation activity in a timely manner. By the time officers reached areas where a clearing had happened, it was often too late to effectively punish offenders. Even if officers were able to correctly identify and locate the responsible parties, which is not a trivial task in a setting rife with insecure property rights,[4] they could only apply truly costly penalties when catching offenders red-handed.

Consider, as an example, the seizure and destruction of equipment used for clearing. If law enforcement officers found heavy machinery, like tractors, on-site in a deforestation hot spot, they could inflict an immediate and severe financial loss on the offender by seizing and destroying it. Expensive equipment, however, was not usually left unused in deforested areas once clearing was completed, so officers could only seize and destroy when they interrupted offenders mid-clearing. DETER essentially increased the probability of such caught-in-the-act operations.

MEASURING SUCCESS OF MONITORING AND LAW ENFORCEMENT IN COMBATING DEFORESTATION

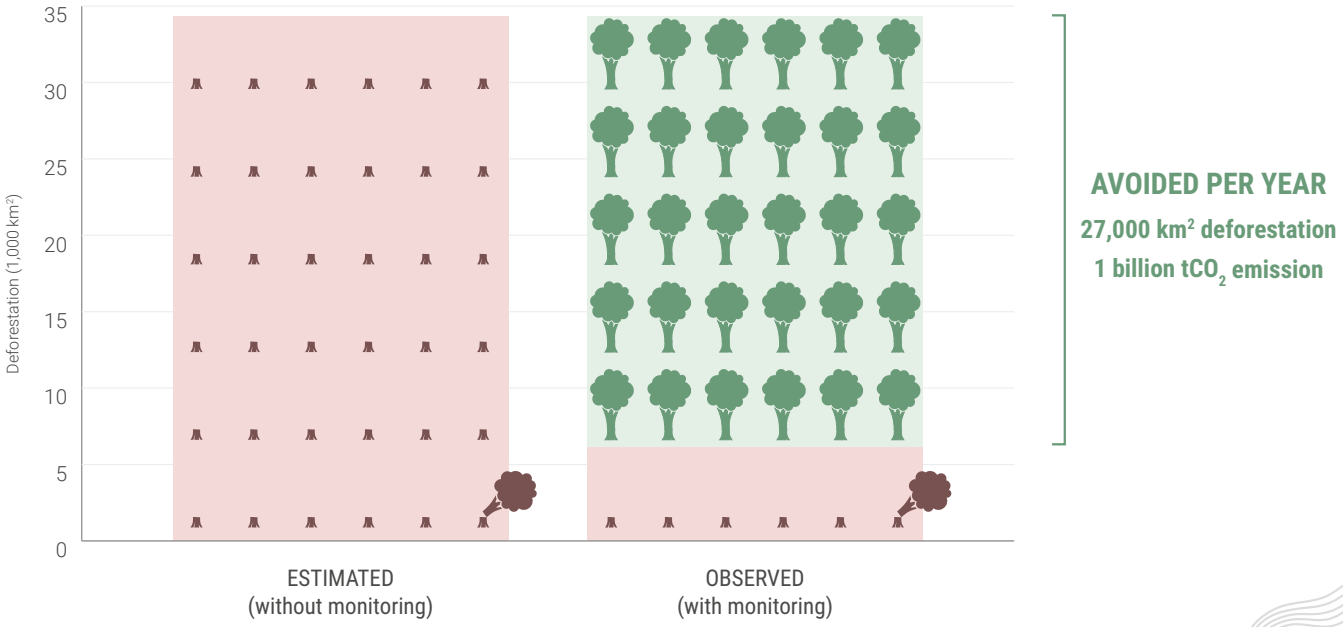
Monitoring and law enforcement made a very sizable contribution to forest protection. These combined strategies effectively curbed deforestation in the Amazon forest clearing slowed down in places that had been targeted by law enforcement the year before. CPI/ PUC-Rio estimates that, **without monitoring and law enforcement efforts, an additional 270,000 km² of Amazon forest would have been lost from 2007 to 2016**. This is more than four times greater than what was actually observed during this period. Monitoring and law enforcement efforts therefore helped avoid the loss of 27,000 km² — nearly 4 million soccer fields — of tropical forest per year (see Figure 2).

Having shown that the monitoring and law enforcement strategy met its primary goal of curbing deforestation, the researchers also investigate the potential unintended consequences of the strategy. They start by testing whether the presence of law enforcement reduced deforestation in one place while increasing it in another nearby place. Results indicate that the reduction

4 Chiavari, J., Lopes, C. L., Marques, D., Antonaccio, L., and Braga, N. (2016). **Panorama dos direitos de propriedade no brasil rural: Legislação, gestão fundiária e código florestal.** Technical report, Climate Policy Initiative. Available at https://www.inputbrasil.org/publicacoes/panorama-dos-direitos-de-propriedade-no-brasil-rural-legislacao-gestao-fundiaria-e-codigo-florestal/?lang=en

of deforestation in a specific area was not the result of displacement of illegal clearings to neighboring areas, so law enforcement contributed by reducing forest clearing in general. Next, the researchers look into the alleged tension between environmental protection and agricultural production by investigating whether forest protection occurred at the expense of agricultural outcomes. Findings suggest the contrary: places that experienced an increased presence of law enforcement in a given year typically exhibit not only reduced clearings, but also increased agricultural production the following year. This reinforces that **combating Amazon deforestation does not harm local agricultural production**.

Figure 2: Impact of Monitoring and Law Enforcement Efforts on Deforestation in the Amazon



Note: *For full results, see technical paper, available at http://www.inputbrasil.org/publicacoes/o-brasil-sabe-como-deter-o-desmatamento-na-amazonia/*

Elaboration: *CPI/ NAPC PUC-Rio*

A COST-EFFECTIVE SOLUTION FOR MEETING EMISSION REDUCTION GOALS

The success of monitoring and law enforcement action highlights an effective means to slow deforestation — but at what cost? To answer this question, the researchers conduct a simple cost-benefit assessment that draws on the estimates for the impact of monitoring and law enforcement on deforestation. Avoiding a loss of 27,000 km^2 of tropical forest per year results in avoided emissions of nearly 1 billion tCO_2 per year.[5] This is equivalent to about half of Brazil's total emissions in 2017,[6] but it is certainly an underestimate of the benefits of protecting the forest, as it only considers the emissions aspect of tropical forest conservation. The analysis then estimates the cost of the monitoring and law enforcement policy at approximately $685 million per year, which represents total annual budgets for INPE and IBAMA combined. This is certainly an overestimate of the cost, as these organizations are not exclusively dedicated to fighting Amazon deforestation.

Comparing the estimated benefit and cost of monitoring and enforcement efforts yields a break-even price of $0.69/$tCO_2$. Carbon prices are currently rising, with about half of emissions now covered by carbon pricing initiatives worldwide priced at over $10/$tCO_2e$ — well above the break-even price calculated for avoided Amazon emissions.[7] Hence, **the benefits of protecting the forest more than compensate the costs of implementing Amazon monitoring and law enforcement efforts**.

These findings are particularly striking considering that this analysis only captures a lower bound for this potential gain since costs are overestimated and benefits are underestimated. Overall, results suggest that monitoring and law enforcement are a cost-effective approach to combatting deforestation in the Amazon.

5 Conversion based on a factor of 10,000 tC/km^2 (36,700 tCO_2/km^2), as determined by the Brazilian Ministry of the Environment (2011). Nota Técnica n.22/ 2011/ DPCD/ SECEX, Departamento de Políticas para o Combate ao Desmatamento, Ministério do Meio Ambiente..

6 SEEG (2019). Sistema de Estimativa de Emissões de Gases de Efeito Estufa [database]. Retrieved from http://plataforma.seeg.eco.br/total_emission on Oct. 2019.

7 World Bank, Ecofys, and Vivid Economics (2017). State and Trends of Carbon Pricing 2017. Technical report, World Bank, Washington, DC, USA.

CONCLUSION

Brazil's use of satellite technology to monitor Amazon forest loss and target law enforcement efforts was a pioneering move. It allowed the environmental police authority to better identify, monitor, and act upon areas of illegal deforestation. This was instrumental in reducing deforestation and protecting tropical forests. Although technological development was an important part of this strategy, none of it would have been possible without governmental buy-in. The Brazilian federal government played a central role in directing and supporting monitoring and law enforcement efforts. Today, Brazil must again strengthen its monitoring and law enforcement strategy along both technological and policy dimensions. The benefits of doing so — for Brazil and the world — far outweigh the costs.

NOTES

DATA SOURCES

The analysis uses a municipality-by-year panel dataset (2006 – 2016) for 521 municipalities constructed from publicly available data. The sample includes all municipalities that are either partially or entirely located in the Amazon biome, that exhibited variation in forest cover during this period, and for which deforestation data were available. The key variables and their corresponding sources include: municipal deforestation increments from INPE's Project for Monitoring Deforestation in the Legal Amazon (PRODES); municipal total count of deforestation-related fines from IBAMA; and monthly DETER cloud coverage from INPE. The technical paper provides additional details.

METHODOLOGY

The relationship between law enforcement and deforestation is characterized by reverse causality — the presence of enforcement officers is expected to affect forest-clearing practices, but clearing patterns determine the allocation of enforcement. Isolating the impact of law enforcement on deforestation therefore requires using statistical methods that adequately tackle this endogeneity. The analysis uses one such method, two-stage least squares estimation, and introduces DETER cloud coverage as a novel instrument for law enforcement. The technical paper provides methodological details.

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The Land Use Initiative (INPUT – Iniciativa para o Uso da Terra) *is a dedicated team of specialists who work at the forefront of how to increase environmental protection and food production. INPUT engages stakeholders in Brazil's public and private sectors and maps the challenges for a better management of its natural resources. Research conducted under INPUT is generously supported by the Norway's International Climate and Forest Initiative (NICFI), Children's Investment Fund Foundation (CIFF) and Instituto Clima e Sociedade (iCS) through grants to Climate Policy Initiative.*