POLICY BRIEF

TARGETING DEFORESTATION, BOOSTING REGENERATION

EFFORTS TO COMBAT FOREST CLEARINGS IN THE AMAZON PROMOTE TROPICAL REGROWTH

INTRODUCTION

There is a pressing need for global action to reconcile mitigating the adverse effects of climate change with the pursuit of sustainable development goals. Restoring and protecting natural ecosystems — particularly tropical forests — play a fundamental role in this, as forest growth absorbs carbon and improves human well-being. Tropical conservation policies worldwide have, however, long focused on containing primary deforestation pressures, and have placed less emphasis on promoting and protecting regeneration.

Yet, even without targeted policy support, forest regrowth in the Brazilian Amazon expanded significantly in recent decades. From 2004 through 2014, the area covered by tropical secondary vegetation increased by more than 70%, rising from less than 10 million hectares to over 17 million hectares.[1] During this same period, deforestation rates in the Amazon fell by 80%, largely due to the adoption of conservation policies aimed at reducing primary deforestation.[2] The concomitant regeneration boost and deforestation slowdown raise a relevant question: did policy efforts designed to combat primary deforestation affect regeneration in the Amazon — even if unintentionally?

A study conducted by researchers from Climate Policy Initiative/ Pontifical Catholic University of Rio de Janeiro (CPI/PUC-Rio) shows that **environmental monitoring and law enforcement exclusively aimed at reducing primary deforestation also contributed to tropical forest regrowth from 2004 through 2014**.[3] The researchers interpret this as evidence that the presence of law enforcement targeting illegal primary deforestation inhibits illegal activities more broadly. As potential offenders operating in the targeted region perceive a higher risk of getting caught and punished, they abandon these regions and thereby allow a natural process of regeneration to occur. The study is the first to document spillovers from anti-deforestation policies on tropical regeneration in the Brazilian Amazon. Results suggest that environmental and socio-economic gains from conservation policies may be larger than initially presumed.

GLOSSARY

Primary vegetation
Vegetation that has never been deforested

Primary deforestation
Clearing of primary vegetation

Secondary vegetation (also referred to as **forest regrowth** and **regeneration**)
Vegetation growing in deforested areas

Secondary deforestation
Clearing of secondary vegetation

Spillover
Unintentional policy effects

1 INPE and Embrapa (2016). **TerraClass Amazônia.** Instituto Nacional de Pesquisas Espaciais/ Ministério da Ciência, Tecnologia e Inovação and Empresa Brasileira de Pesquisa Agropecuária/ Ministério da Agricultura, Pecuária e Abastecimento.

2 See the CPI/PUC-Rio Factsheet **Why Is Protecting the Amazon Important?** for a summary of conservation policy evaluations. The factsheet is available at <bit.ly/3dKDiHr>.

3 Assunção, Gandour and Souza-Rodrigues (2019). **The Forest Awakens: Amazon Regeneration and Policy Spillover.** CPI/PUC-Rio working paper.

RECOMMENDATIONS

Brazil must incorporate tropical regrowth into its conservation policy agenda. The country should start by tackling a key vulnerability of its forest monitoring systems, which currently do not detect the loss of secondary vegetation. To achieve this, the country should:

- Adapt already available remote-sensing technology to monitor secondary vegetation and thereby target secondary deforestation.
- Ensure law enforcement is legally and practically capable of both investigating and imposing binding penalties for illegal secondary deforestation.

The effect of monitoring and law enforcement on regeneration constitutes a spillover because tropical regrowth was virtually invisible to conservation policy efforts during the period analyzed. **Today, it would be both timely and strategic for Brazil to incorporate the promotion and protection of tropical regeneration into its conservation policy agenda**. Coupling the fight against forest loss with ecosystem restoration is a crucial next step to boost conservation and thereby enhance the provision of ecosystem services. Indeed, the restoration of 350 million hectares of degraded and deforested lands worldwide by 2030 has the potential to absorb 1.7 GtCO2 per year and yield approximately USD 170 billion in net annual benefits from watershed protection, improved agricultural yields, and forest products.[4] Brazil, which holds vast amounts of degraded and deforested lands in tropical regions, is uniquely positioned to contribute to this endeavor. Understanding how policy influences tropical regeneration — directly and indirectly — can catalyze regrowth and strengthen the protection of existing secondary vegetation. **This is an important step towards helping Brazil achieve its environmental commitments to reduce greenhouse gas emissions whilst improving human well-being at both local and global levels.**

4 IUCN and Winrock International (2017). **Global Emissions and Removals Databases.** International Union for Conservation of Nature and Winrock International.

INSTITUTIONAL CONTEXT

In 2004, the Brazilian federal government launched an ambitious action plan to conserve the Amazon. The plan proposed several novel policy measures to combat primary deforestation, which had recently peaked at over 27,000 square kilometers per year. Because deforestation in the Brazilian Amazon was largely illegal, the action plan's key policy was the adoption of satellite-based forest monitoring to strengthen law enforcement. The System for Real-time Detection of Deforestation (DETER) introduced the near-real-time monitoring of forest loss and the issuing of georeferenced deforestation alerts. Brazil's federal environmental police authority used these alerts to target law enforcement action. Previous work from CPI/PUC-Rio shows that enhanced monitoring and law enforcement effectively contained Amazon deforestation.[5] Satellite-based monitoring allowed forest loss to be detected and acted upon in a timelier manner, which sharply increased law enforcement's capacity to apply binding sanctions to environmental offenders. As the perceived risk of getting caught and punished by the environmental police authority increased, so did the expected cost of engaging in illegal deforestation.

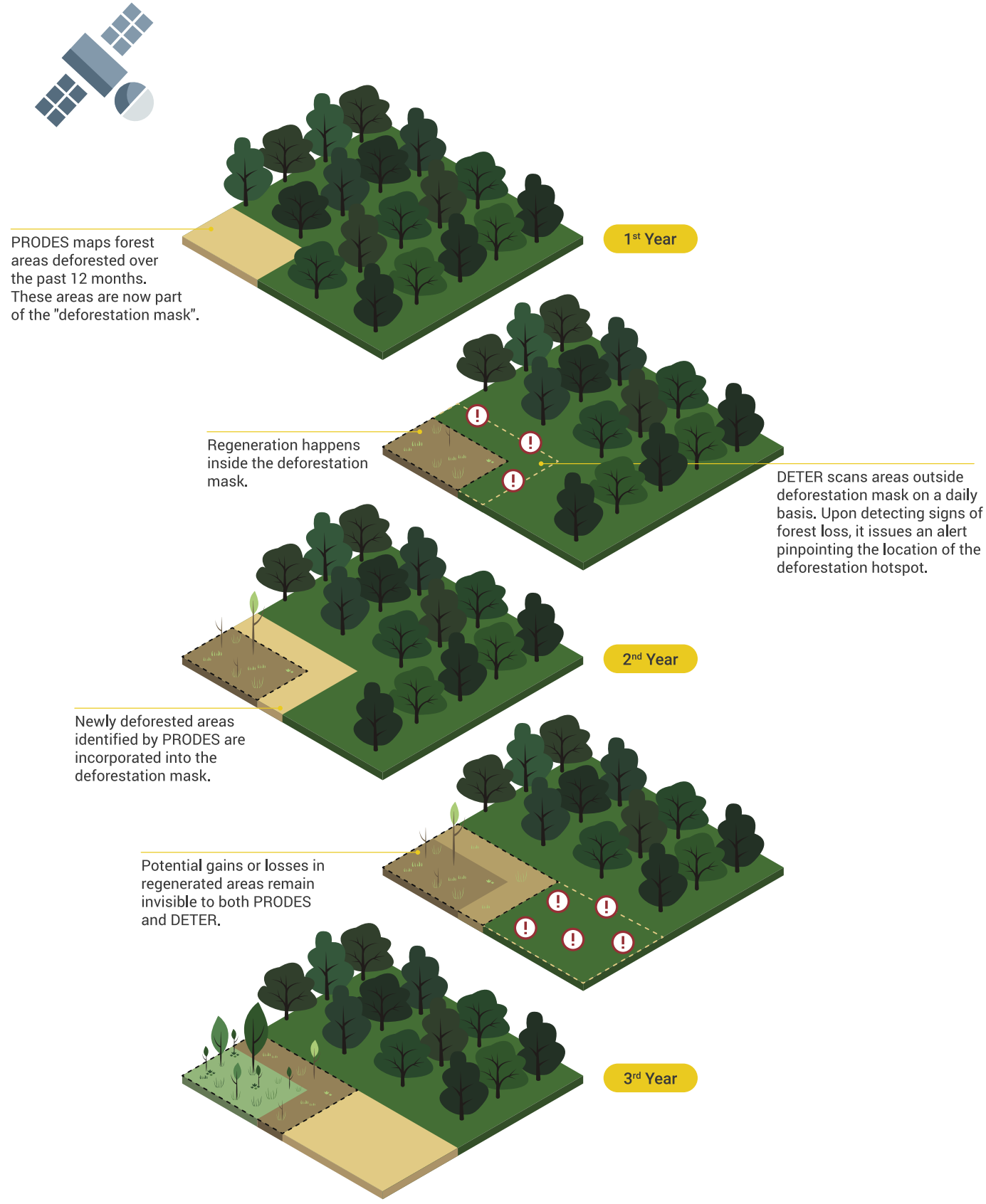
An important technical feature of DETER is that it was designed to exclusively detect the loss of primary vegetation. This is aligned with how Brazil has measured Amazon deforestation since the late 1980s using another satellite-based system known as the Project for Monitoring Deforestation in the Legal Amazon (PRODES). This system is not used to monitor deforestation and issue alerts in near-real-time, but rather to map and measure in detail the forest area that was cleared over the course of one year. Once an area is identified as deforested in PRODES, it is not revisited in future satellite imagery and becomes part of what is known as the deforestation mask. The mask is therefore an accumulation of all areas deforested over time. DETER builds on this deforestation mask, looking for signs of forest loss strictly outside the mask. Forest regrowth occurs, by definition, in areas that have been previously deforested – precisely inside the deforestation mask. Because the mask is a blind spot to PRODES and DETER, **changes to secondary vegetation in the Amazon remain invisible to both systems and, consequently, to Brazil's environmental authorities**. Figure 1 illustrates how PRODES, DETER, and regeneration are related.

In addition to being invisible to the country's satellite-based deforestation monitoring systems, secondary vegetation was also mostly missing from Brazil's tropical conservation policy agenda.[6] Within its first decade, the Amazon action plan neither promoted forest regrowth, nor explicitly sought to protect existing regenerated areas. Thus, **if policy efforts aimed at combating primary deforestation somehow influenced secondary vegetation, this would constitute a spillover – an unintended and indirect consequence of a given policy measure**.

5 Assunção, Gandour and Rocha (2019). **DETERring Deforestation in the Amazon: Environmental Monitoring and Law Enforcement.** CPI/PUC-Rio working paper. See the CPI/PUC-Rio Policy Brief **Brazil Knows What To Do To Fight Deforestation in the Amazon: Monitoring and Law Enforcement Work and Must Be Strengthened** for a summary of the technical paper. The policy brief is available at <bit.ly/3dHpPQg>.

6 See the CPI/PUC-Rio Report **Ensuring Greener Economic Growth for Brazil: Opportunities for Meeting Brazil's Nationally Determined Contribution and Stimulating Growth for a Low-carbon Economy** for an overview of Brazil's conservation policies over recent decades. The report is available at <bit.ly/3aCGWB7>.

Figure 1: Why is Amazon regeneration invisible to forest monitoring systems?



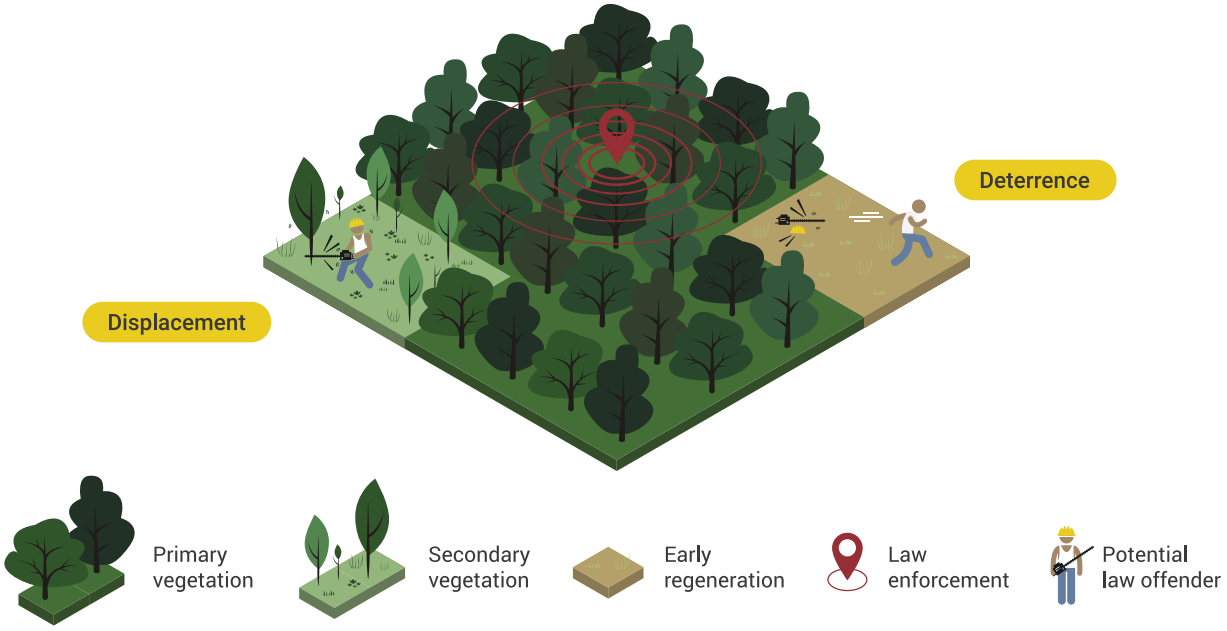
Source: *Climate Policy Initiative/ PUC-Rio (2020).*

REGENERATION AS AN ADDITIONAL BENEFIT OF LAW ENFORCEMENT

To empirically test for policy spillovers, researchers from CPI/PUC-Rio explored rich spatial data on Amazon deforestation, deforestation alerts, and regeneration from 2004 through 2014. In particular, they assessed how local forest regrowth responded to regional law enforcement. Empirical results point towards positive spillovers. **On average, regions with a greater presence of law enforcement targeting primary deforestation were more likely to exhibit an expansion in local forest regrowth.**

But why would law enforcement efforts aimed at reducing primary deforestation in the Brazilian Amazon indirectly affect a process of tropical regeneration? The analysis discusses two possible channels for this and explains why they are expected to have opposite effects on forest regrowth. Figure 2 illustrates these channels.

Figure 2: How could law enforcement targeting primary deforestation affect regeneration?



Source: *Climate Policy Initiative/ PUC-Rio (2020).*

Displacement Deforestation in the Brazilian Amazon occurs primarily as a means of obtaining land for use in other activities, most notably cattle ranching.[7] In light of stricter monitoring and law enforcement focused on primary deforestation, potential offenders might have reasonably chosen to shift their activities to areas that were less likely to be targeted by enforcement. In practice, this would have displaced the demand for land areas towards those covered by secondary vegetation. After all, instead of clearing primary vegetation and risk getting caught by the monitoring system, offenders could cut secondary vegetation and thereby try to evade law enforcement action. In this scenario, law enforcement aimed at combating primary deforestation would lead to the loss of secondary vegetation – a negative unintended policy impact.

7 From 2004 through 2014, pasturelands occupied about two-thirds of the area historically cleared in the Amazon (INPE and Embrapa, 2016. **TerraClass Amazônia.** Instituto Nacional de Pesquisas Espaciais/ Ministério da Ciência, Tecnologia e Inovação and Empresa Brasileira de Pesquisa Agropecuária/ Ministério da Agricultura, Pecuária e Abastecimento.).

Deterrence Satellite monitoring of primary deforestation makes it easier for law enforcement to locate where environmental offenders act, increasing the presence of enforcement personnel in primary deforestation hotspots. Although monitoring does not cover previously deforested areas, using land that was illegally deforested in the Brazilian Amazon is, in and of itself, illegal. Moreover, impeding or interfering with natural regeneration is an environmental crime. So, from the perspective of a potential offender, relocating to nearby areas with secondary vegetation also carries a cost should law enforcement happen to detect the illegal use of these areas. Faced with a higher perceived risk of operating in a given region, offenders might choose to abandon their activities altogether. As a result, deforested areas in this region would be less exposed to human interference and thus more likely to undergo a natural process of regeneration. In this scenario, law enforcement aimed at combating primary deforestation would lead to the growth of secondary vegetation — a positive unintended policy impact.

Findings show that the presence of law enforcement targeting illegal primary deforestation in a region led potential offenders to abandon that region, thereby allowing a natural process of regeneration to take place. This indicates a positive spillover effect from Brazil's monitoring and enforcement efforts. The regrowth response appears to have been strongest in areas that still held some remaining primary vegetation, suggesting that local conditions influence an ecosystem's capacity to naturally recover once abandoned.

CONCLUSION

Findings indicate that Brazil's environmental monitoring and law enforcement strategy had substantial positive — albeit unintended — impacts on tropical regeneration. Thus far, these impacts have remained unaccounted for in policy assessments. Incorporating indirect effects into policy design can strengthen Amazon conservation by shedding light on the practical implications of existing efforts and thereby help tailor policy to meet more specific, and potentially even more ambitious, goals.

These results are particularly salient in light of growing awareness regarding the need for global action to reconcile environmental and development goals. The emergence of international initiatives that support forest regrowth, such as the Bonn Challenge and the UNFCCC Nationally Determined Contributions, attests to the interest of the international community in scaling up ecosystem restoration. Brazil should actively seek to strengthen the protection of its secondary vegetation. Firmly promoting tropical forest regrowth and ensuring its conservation could help Brazil resume its position as a pioneer in global climate action.

NOTES

DATA SOURCES

The analysis explores a rich spatially explicit (raster) dataset built from a variety of publicly available sources. The key variables and their corresponding sources are: georeferenced secondary vegetation cover from TerraClass Amazônia (INPE and Embrapa); georeferenced deforestation alerts from DETER (INPE); and georeferenced deforestation increments from PRODES (INPE). The technical paper provides additional details.

METHODOLOGY

The analysis investigates the potential relationship between law enforcement targeting primary deforestation and secondary vegetation from 2004 through 2014. The sample area covers the full extent of the Brazilian Amazon Biome. The unit of analysis is a 900-meter raster cell, but data are built from raster datasets at the 30-meter resolution. Although satellite-based panel data on regeneration serve as the basis for dataset construction, panel data are collapsed into a cross-sectional ten-year difference in secondary vegetation coverage to mitigate measurement error from the time-series variation. Based on this spatial cross-sectional setup, and using georeferenced deforestation alerts to capture law enforcement, the analysis tests whether cell-level changes in the extent of secondary vegetation are associated with the intensity of environmental enforcement in a cell's surroundings. The estimations include a host of cell-level controls for spatially explicit observables to address concerns regarding omitted variable bias. Reverse causality is not a primary concern given that regeneration does not affect enforcement by the design of the Brazilian monitoring system. The technical paper provides additional 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) and Instituto Clima e Sociedade (iCS) through grants to Climate Policy Initiative.*