Mobilising Funds for the Restoration of Tropical Forests

Policies, incentives, and financial instruments for large-scale restoration in Brazil and Indonesia

RESTORE+

Working Paper

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International Institute for Applied Systems Analysis
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Executive Summary

- Restoration of tropical forests has become a highly popular nature-based solution to mitigate and adapt to climate change, reverse biodiversity loss and to improve the livelihoods of local populations. The Bonn Challenge, the UN Decade on Ecosystem Restoration, and 230 million hectares in submitted restoration targets globally underscore the international momentum of the restoration movement.

- Despite broad international commitment, the implementation of large-scale restoration continues to be hindered by deficient forest governance, land use trade-offs and important financial constraints.

- The RESTORE+ project is a five-year partnership that aims at addressing these challenges and contribute with policy and technical recommendations to facilitate large-scale restoration initiatives with a focus in Brazil and Indonesia.

- As part of RESTORE+ activities, we studied the main policies supporting restoration initiatives in Brazil and Indonesia, assessed their environmental and socio-economic impact, and building on land use opportunity cost modelling, explored innovative financial mechanisms to mobilise private sector investment to protect tropical forests. This report summarizes the findings and insights of these activities.

- **In Indonesia**, palm oil development is examined to provide evidence-based evaluation of land-use policies and explore entry points for interventions aimed at curbing deforestation rates while allowing for continued agricultural activity.

- **In Brazil**, the project modelled the opportunity costs faced by landowners when deciding whether to preserve or convert Amazonian native vegetation to agriculture, and estimated supply and demand curves for tradable forest assets. This research aims to facilitate compliance with the Brazilian Forest Code's legal requirements on forest conservation in rural private properties.

- Based on a jurisdictional approach for the state of Mato Grosso, the project explores innovative and scalable financing mechanisms to catalyse international private- and public-sector investment to achieve large-scale avoided deforestation and restoration.

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1. Introduction

Restoration of tropical forests has become a highly popular nature-based solution to mitigate and adapt to climate change, reverse biodiversity loss and to improve the livelihoods of local populations. The Bonn Challenge to bring 150 million hectares (Mha) of degraded and deforested landscapes into restoration by 2020 and 350 Mha by 2030, and the United Nations (UN) Decade on Ecosystem Restoration 2021-2030 underscore the international momentum of the restoration movement. In addition to these global restoration initiatives, many countries have included forest-based targets in their efforts to mitigate and adapt to climate change with over 230 Mha in submitted restoration targets globally (Fagan et al. 2020).

However, despite broad international interest, the implementation of large-scale restoration initiatives continues to be hindered by deficient forest governance, competition over land for agriculture, and important financial constraints (Stanturf et al. 2019). In addition, according to countries' published restoration plans, nearly half of all restoration commitments are to be implemented via commercial plantations of valuable trees, such as eucalyptus and palms, which store significantly less carbon than naturally regenerated forests and do not improve biodiversity conservation (Lewis et al. 2019).

Brazil and Indonesia account for more than a third of the worlds tropical forests (FAO and UNEP 2020). They are also the two countries with the highest share of tree cover loss from tropical forests (Curtis et al. 2018), and the largest carbon emitters from agriculture, forestry and other land-use (AFOLU) in the world, with nearly 1 billion tonnes of CO_2 equivalent emissions each in 2019 (FAO 2021). Since the 1990s, agricultural expansion has cost Brazil 65 Mha of native ecosystems converted to cropland and pasture for cattle in the legal Amazon states (Stabile et al. 2020). Today, Brazil is the world's largest producer of sugarcane and coffee, and is responsible for over 30% of soybeans and 15% of beef worldwide, with the agricultural sector representing around 20% of the country's GDP and 10% of Brazil's labour share (FAO 2021). The Indonesian economy, on the other hand, is highly dependent on the export of palm oil, for which it is the largest supplier in the world with over 50% of global production (FAO 2021). Since the early 2000s, ~90% of deforestation and forest degradation occurring in native ecosystems has been the result of palm oil expansion and timber plantations (Curtis et al. 2018), with the agriculture and forestry sector currently contributing over 12% to the Indonesian GDP and representing 33% of the labour share (Indonesia 2020).

Over the last two decades, both countries have made significant contributions to reducing deforestation rates in their native ecosystems. Starting in 2004, a mix of public policies including the expansion of protected areas (Herrera, Pfaff, and Robalino 2019) and market restrictions led Brazil to historic reductions of forest loss in the Amazon, with deforestation rates dropping up to ~80% by 2012, while beef and soy produced on the same land grew ~14% and 94% respectively (Nepstad et al. 2014). However, since 2013, weakened environmental governance and disregard for climate change policies have put deforestation rates on an upward trend (Silva Junior et al. 2021), raising international concerns and pressure on Brazil to re-establish the conditions that made the previous slowdown of deforestation in the Amazon possible. As for Indonesia, following a peak of primary forest loss in 2015 due to massive peatland fires, deforestation has been steadily dropping, with the last few years seeing the lowest rates of deforestation since monitoring started in 1990 (Indonesia 2020). But as with the case of Brazil, political developments under current President Joko Widodo's government have also affected climate policy and environmental conservation. Over the last years, his pro-business government has passed legislation encouraging the expansion of large-scale commercial plantations and mining operations in primary forest areas and continues to prioritize economic growth over environmental sustainability under a "planned deforestation" model (Dwisatrio 2021).

In addition to their efforts to reduce deforestation, Brazil and Indonesia have also committed to very ambitious and similar international restoration targets. In their Nationally Determined Contributions (NDC) submitted to the UN Framework Convention on Climate Change (UNFCCC), both countries set the target of restoring 12 Mha of degraded forestlands by 2030, with Indonesia including also the rehabilitation of 2 Mha of peatlands, also by the end of the decade (Brasil 2017; Indonesia 2021). Though closely related and largely supported by the same institutional framework, forest *restoration* is conceptually and operationally very different to *avoiding deforestation*. Temporally, restoration comes after deforestation/degradation has occurred, and will often require dedicated plans and retargeting policies, in addition to specific implementation mechanisms tailored to the local context (Chazdon et al. 2021).

The RESTORE+ project is a five-year partnership that aims at addressing restoration challenges and contribute with policy and technical recommendations to facilitate large-scale restoration intitiatives with a focus on Brazil and Indonesia. The implementation of their restoration commitments could significantly contribute to climate change mitigation and help to halt ecosystem degradation in their native forests. However, given their strong agricultural profile, achieving these targets poses a significant policy challenge. While both countries have the basic regulatory instruments to protect their forests and have made important progress in recent years in slowing deforestation rates, on-the-ground implementation still faces several institutional, financial, and technical difficulties.

As part of its activities, the RESTORE+ project explores potential solutions to overcome one of the most salient obstacles for the implementation of large-scale restoration in tropical forests: insufficient financial resources to compensate farmers and landowners for preserving native vegetation in their properties intact, or to incentivise the restoration of deforested and degraded lands to their original condition.

The exploration includes an examination of the main policies supporting restoration initiatives in Brazil and Indonesia, an assessment of their environmental and socio-economic impact, and building on land use opportunity cost modelling, an exploration of innovative financial mechanisms to mobilise private sector investment to protect tropical forests. This report summarises the activities, conclusions and recommendations obtained as a result of the work conducted under this workstream.

1.1 Objectives

The main objective of the activities under this workstream is to explore and develop innovative and scalable financial mechanisms to mobilise private sector investment to support the implementation of large-scale restoration initiatives in tropical forests.

In Brazil, the workstream aims at contributing to the implementation, consolidation and expansion of different policies and financing instruments that support the restoration of native vegetation, such as carbon markets, Payments for Ecosystem Services (PES), Reduced Emissions from Deforestation and Forest Degradation (REDD+) initiatives, and the potential market for Forest Certificates (Environmental Reserve Quotas, or CRAs – *Cotas de Reserva Ambiental*) envisioned under the Forest Code.

In Indonesia, the workstream aims at informing key national and sub-national restoration-related policies and contribute to the implementation and consolidation of its submitted NDC and REDD+ initiatives.

We hope that the findings and conclusions obtained as a result of this work, be communicated and disseminated to key RESTORE+ stakeholders, such as the Brazilian and Indonesian governments, the climate change negotiation community, international development banks and non-government organisations (NGOs).

1.2 Overview of activities

The activities described in this report are conducted by three RESTORE+ partner organisations led by the Mercator Research Institute on Global Commons and Climate Change (MCC). Together with MCC, London School of Economics (LSE) and the Environmental Defence Fund (EDF) conducted distinct and specific streams of activities. The International Institute for Applied Systems Analysis (IIASA) acted as general RESTORE+ coordinator and consulting partner throughout the project.

The first stream of activities is conducted by MCC and is related with the identification and assessment of the restoration-supportive policies in Brazil and Indonesia. This assessment included a policy research and literature review to 1) identify the main restoration targets and the policies supporting their implementation in both countries, and 2) to provide a descriptive overview of these restoration-supportive policies.

The second stream of activities is also conducted by MCC and is focused on assessing forest- and land use-related policies in Indonesia. The purpose of this activity is to better understand the economic incentives faced by landholders in a context of continued agricultural expansion and explore entry points for policy interventions aimed at forest protection and restoration. The following three studies are conducted:

1. Examination of the impact that Indonesian palm oil expansion has on non-palm oil manufacturing industries to evaluate whether agricultural expansion has negative or positive effects on industrial growth and productivity.
2. Estimation of the price elasticities of deforestation across the palm oil sector to determine if prices influence rates of forest loss, and which sectors of the palm oil sector react more or less strongly to prices.
3. Estimation of the early effects of the Indonesian Social Forestry Programme (SFP) to evaluate the effectiveness of institutional measures towards reduced deforestation rates in native forests.

The third stream of activities is related with estimating the opportunity costs of restoration. By evaluating the payoffs from alternative land uses, the activity aims to better understand the drivers behind land use change, including restoration. This work stream involves contributions from both EDF and LSE and is focused geographically on the state of Mato Grosso, Brazil. The following three studies are conducted:

1. In order to estimate the scale of financial penalties that would halt illegal deforestation and the compensations required to prompt farmers to avoid deforesting areas that can be legally cleared under the Forest Code, EDF quantifies the opportunity cost of all remaining standing forest plots in Mato Grosso through 2030.
2. Building on the opportunity cost modelling, EDF estimates the market equilibrium for supply and demand of Forest Certificates, contributing to the design and potential implementation of the CRA market in Mato Grosso. This market envisioned under the Forest Code would be an alternative to facilitate landowners' compliance with the legal native vegetation preservation requirements.
3. LSE utilised a land-use model to assess avoided deforestation and restoration opportunity costs faced by farmers. The model estimates optimal land use change and landowner incentives to either conserve the forest or convert to agriculture under uncertain future returns.

Finally, the fourth stream of activities is related with the exploration and identification of innovative and scalable financing instruments to incentivise private investment and public-private partnerships to mobilise funds to support large-scale forest conservation and restoration under REDD+ schemes. This work is conducted by EDF and is mostly focused on Mato Grosso. EDF advances a novel jurisdictional approach coupled with new schemes to scale up forest carbon credits' supply and demand with donor and private funding through the use of innovative contracts, thereby accelerating the emergence of carbon markets and the protection of tropical forests.

These streams of activities are aimed at better understanding the economic costs of restoration and how to accelerate the transition to a more sustainable land use in tropical forests. As long as the economic incentives of agricultural activity continue to surpass the future benefits of forest protection, forests will remain vulnerable to destructive and relatively low-value uses.

In the following chapters, the above summarized activities and their results are explained in more detail: Chapter 2 summarises the policy review conducted by MCC to identify the main policies supporting restoration activities in Brazil and Indonesia; Chapter 3 presents the results of the ex-post assessment of land-use policies in Indonesia; Chapter 4 summarises the work of LSE and EDF in assessing the opportunity costs of restoration in Mato Grosso; and Chapter 5 presents some innovative financial mechanisms to mobilise private-sector investment in forest protection and restoration. In Chapter 6, the report summarises the limitations of the results obtained and the outlook of these activities.

2. Overview of Restoration Targets and Policies in Brazil and Indonesia

In this chapter, we identify the main restoration targets that Brasil and Indonesia have committed to and provide a descriptive overview of the main policies that support these restoration targets. Our review is based on the policy instruments that are mostly referred to as restoration-supportive in the peer-reviewed literature and in government documentation. As such, not all the policies described in this chapter correspond directly to restoration-specific or restoration-dedicated polices. Some are more related with forest protection or avoiding deforestation, but were included here given their prevalence in the consulted literature. Stand-alone restoration programmes, local and municipal-level regulations, and isolated private-sector initiatives were not considered as falling into the category “main policies”.

The overall purpose of this chapter is to understand the policy framework of forest governance and environmental protection in Brazil and Indonesia and how it affects land-use decisions in the context of conservation and restoration initiatives. This governance background provides a useful framework to contextualize the following activities described in this report.

2.1 Brazil

Restoration Targets

Brazil has committed to restore 12 Mha of forests areas by 2030 (Figure 2.1). This target was included in Brazil’s NDC submitted to the UNFCCC in 2015, and then replicated in 2017 under the Bonn Challenge. The same restoration commitment was then reiterated at the national level with the government announcing the restoration of “at least” (Brasil 2017) 12 Mha by 2030.

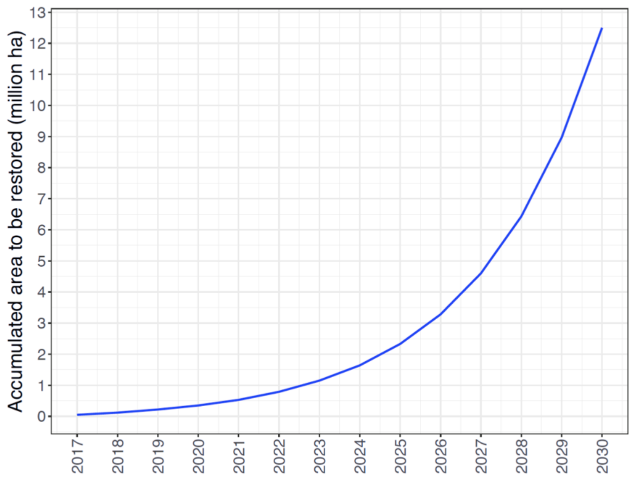


Figure 2.1 Timeline for restoration of 12 Mha by 2030. According to the PLANAVEG, restoration will start with 50,000 ha and will increase at cumulative rate of 38.73% per year (Source: Brasil 2017).

The National Plan for Recovery and Native Vegetation (PLANAVEG)

The PLANAVEG was announced by the Brazilian government in 2017 with the explicit purpose of implementing the 12 Mha restoration target submitted to the UNFCCC and the Bonn Challenge. Its purpose is to enhance coordination and coherence between national and subnational agencies in restoration efforts, together with strengthening policies, financial markets and promoting best agricultural practices. More specifically, the PLANAVEG indicates that restoring the 12 Mha will be achieved by strengthening the implementation and enforcement of the Forest Code (Brasil 2017).

The Forest Code

Brazil's main legal instrument to protect and regulate the use of native vegetation in rural private lands is the Native Vegetation Protection Law (NVPL), also known as the Forest Code. Following a broad reform in 2012, the Forest Code introduced two basic mechanisms under which most protection and restoration of native vegetation occurs: Permanent Preservation Areas and Legal Forest Reserves.

Permanent Preservation Areas (Área de Preservação Permanente, APP) are environmentally sensitive areas considered critical for the provision of essential ecosystem services, such as ensuring clean and steady water supply, protection of geological and soil stability, or conserving biodiversity. The Forest Code mandates for APP to be left intact by landholders. APP typically include riverbanks, springs, mangroves, hilltops, steep slopes and sandbanks (Chiavari and Leme Lopes 2015).

Legal Forest Reserves (Reserva Legal, RL), on the other hand, mandate that every rural landholder must designate a portion of their property, which is restricted from forest clearing, and must be conserved with natural vegetation by their owners. Should vegetation be lower than the legal percentage, landholders must compensate for the deficit by actively reforesting or restoring the land, or face penalties otherwise. RL occupy different percentages of the property area according to the biomes in which they are located (Table 2.1, Figure 2.3).

In establishing the legal percentage that should be left aside as RL, the Forest Code distinguishes between rural properties located inside the Legal Amazon[1] (LA) and those located outside of the LA. Inside the LA, the RL is of 80% in the Amazon biome, 35% in the Cerrado biome, and 20% in grasslands. Within the Amazon biome, the Forest Code provides that the RL of 80% can be reduced by state public authorities to 50% in the states that have more than 65% of their territory covered by Protected Areas (i.e. Conservation Units and/or Indigenous Lands). Outside of the LA, the NVPL establishes a RL of 20%, regardless of the type of biome (Figure 2.2, Table 2.1).

[1] The Legal Amazon is an area of 500 million hectares containing all nine states in the Amazon basin (Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Rondônia, Roraima and Tocantins). Although called Legal Amazon, the region overlaps three different biomes: all of Brazil's Amazon biome, 37% of the Cerrado biome, and 40% of the Pantanal biome. The main characteristic of the region is the abundant and tropical vegetation, including large sections of rainforest.

Table 2.1 Legal Forest reserve requirements for different biomes in Brazil. RL in the Amazon Forest: 80%; in the Cerrado biomes in the Legal Amazon: 35%, in Grasslands and the rest of Brazil: 20%. (*) Indicates that inside the Amazon biome, the Forest Code provides that the RL of 80% can be reduced by state public authorities to 50% in the states that have more than 65% of their territory covered by Protected Areas (i.e. Conservation Units and/or Indigenous Lands) (Adapted from Machado 2016).

Land Use	**Legal Amazon**			**Rest of Brazil**
	Amazon Forest	Cerrado	Grasslands	
Legal Reserve	80% (50%)*	35%	20%	20%
Productive Use	20% (50%)*	65%	80%	80%

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Data sources: Base layers: United Nations Geospatial, 2020. **Biomes:** Brazilian Institute of Geography and Statistics (IBGE), 2006 Biomes of Brazil. **State boundaries:** IBGE, 2018.

Figure 2.2 Map of Brazil with indication of the different biomes and states (Source: UNEP-WCMC, 2022)

According to PLANAVEG, the national deficit of APP and RL is around 21 Mha, and the strategy outlined by the government to achieve the 12 Mha restoration target is to increase compliance with the Forest Code thus curbing the APPs and RL's deficit (Brasil 2017).

The legal obligation to restore RL deficits, however, does not apply to land deforested before 2008. Devised as an affordable way for rural landowners to comply with native vegetation requirements, the Forest Code established an amnesty from fines and from the obligation to restore RL to farmers who illegally deforested for agriculture until 2008.

Rural Environmental Registry (CAR)

Essential for the implementation of the APP and the RL, the Forest Code introduced the Rural Environmental Registry (from Portuguese, *Cadastro Ambiental Rural*, CAR). The Forest Code requires all landowners to geo-reference and register their properties using high-resolution satellite images, identifying in a spatially explicit way the property boundaries and the precise areas and limits of the APPs and RL, and submit all to the Federal Rural Environmental Registry System (SiCAR) (Figure 2.3). The SiCAR integrates and systematises the information provided by rural landowners, facilitating better management and planning of land use in forests, savannas, rural and remote areas. Additionally, the CAR operates as an instrument to monitor and control deforestation.

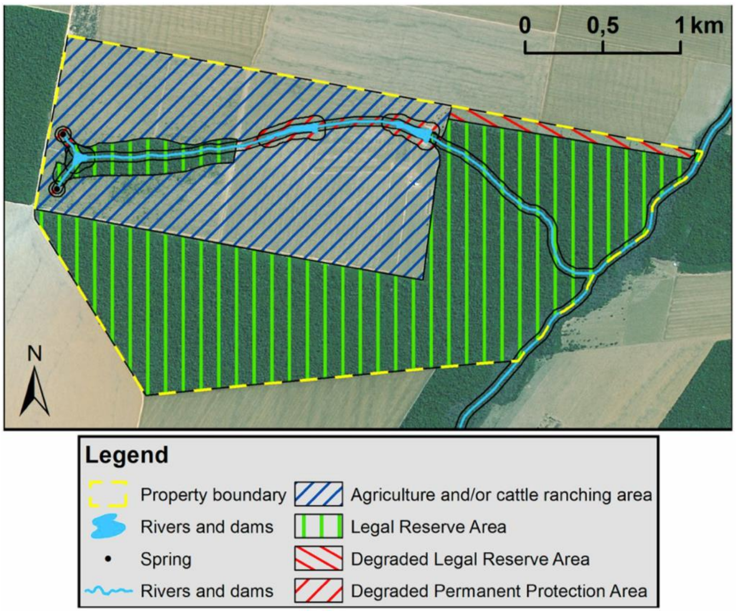


Figure 2.3 Example of a CAR (Rural Environmental Registry) property registered according to the Federal Rural Environmental Registry Standard (SiCAR) (Source: Azevedo et al. 2017).

Forest Certificates (CRA)

Additional to actively restoring the land, the Forest Code provides that landowners who are below the RL threshold may compensate or offset their deficits by purchasing surplus, in the form of Forest Certificates (Environmental Reserve Quotas, or CRAs – *Cotas de Reserva Ambiental*), from landholders who have native vegetation above the minimum RL requirements. This opportunity extends to farmers who over-deforested before 2008. As such, CRA represents another source of income for over-compliant farmers and potentially reduces the cost of environmental compliance for farmers with native vegetation deficits. With the CRA, farmers who over-deforested before 2008 get to choose between continuing with their agricultural activity and purchasing CRAs in compensation or restoring deforested areas in their properties (Figure 2.4). A market for trading CRA, however, has yet to be established. Implementing the CRA could create a market for forested lands, adding monetary value to native vegetation. Given the high costs of restoration and reforestation in some regions, exchange of CRA could become an effective way to facilitate compliance with the Forest Code.

As mentioned, one of the activities of the RESTORE+ includes EDF's work contributing to the design and potential implementation of the CRA market in Mato Grosso, the details of which are presented in Section 4.2 Designing the Market for Forest Certificates (CRAs)of this report.

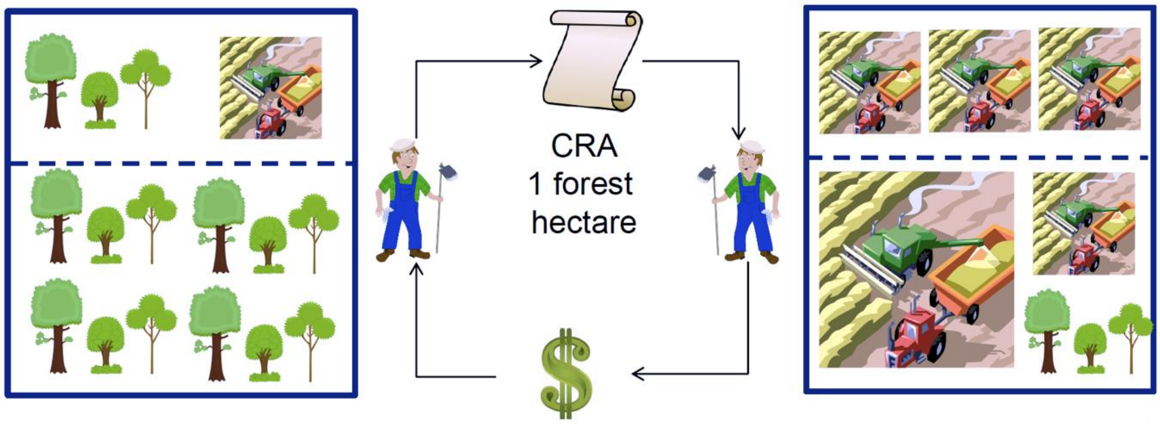


Figure 2.4 This figure shows, on the left, an over-compliant farmer with native vegetation above the minimum Legal Forest Reserve requirement, selling a Forest Certificate or CRA to the farmer on the right, who is below the native vegetation legal requirement (Source: EDF, 2021)

REDD+ Initiatives

Another mechanism to incentivise restoration (or to avoid deforestation and land degradation) is to pay landowners for the conservation of forests under REDD+ programmes. The Brazilian National Strategy for REDD+ (ENREDD+) was launched by the government in 2016. It focuses on actions to prevent and control deforestation and forest degradation and to promote forest recovery and conservation as well as sustainable development. As of today, the core of the ENREDD+ financial architecture is mostly represented by national funds, such as the Amazon and the Climate Fund. By the end of 2020, the implementation of REDD+ activities has involved over US$ 720 million distributed to more than 100 projects through the Amazon Fund (BNDES 2020). While evidence indicates that some REDD+ initiatives have been relatively effective at reducing deforestation and carbon emissions, their impacts on forest restoration are less clear (Bustamante et al. 2019).

Market Restrictions: Soy and Beef Moratoria

While not restoration-specific either, market restrictions have nevertheless played a particularly relevant role in the protection of forests in Brazil. In 2006, major grain traders signed the Soy Moratorium, an agreement not to purchase soy produced in illegally deforested lands. In the following years, illegal deforestation due to soy production fell from 30% in 2004 to 1% in 2014 (Gibbs et al. 2015). Tailored after the soy moratorium, in 2009 the beef moratorium was agreed upon between cattle farmers to not commercialise beef produced in illegally deforested land. More recently, in 2017, and in response to deforestation *leakage*[2] from the Amazon into the Cerrado biomes, a multi-

[2] Deforestation leakage occurs when measures aimed at protecting forests in one area result in a shift of deforestation activities to other areas or regions.

stakeholder forum led by the Brazilian soy industry signed the Cerrado Manifesto to signal support for reducing soy, cattle, and other commodity-related deforestation in the region. Together with the PPCDAm (see next section) and the Critical County programme, the soy and beef moratoria played a key role in Brazil's historic 80% reduction of deforestation in the Amazon between 2004 and 2012 (Nepstad et al. 2014) (Figure 2.5).

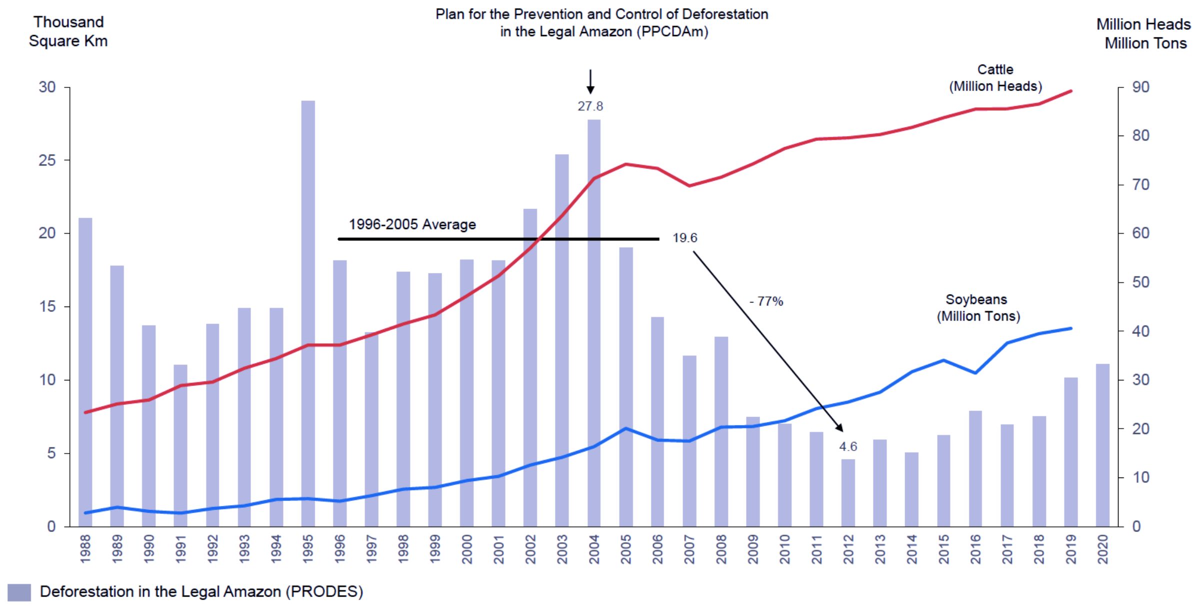


Figure 2.5 Annual deforestation rates in the Legal Amazon (left axis), and agricultural output (right axis) (Source: EDF, 2021).

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

The PPCDAm is not a restoration-dedicated policy, however, set a crucial policy framework for coordinated forest protection in the Amazon states. Established in 2004, PPCDAm elevated the issue of Amazon deforestation to the President's Chief of Staff, who coordinates the activities of 15 ministries, facilitating operations across many agencies, including the Federal Police, the Army, and the Public Prosecutors Office. Today, the activities under PPCDAm are organized under four major pillars:

i) tenure regulation and territorial planning;
ii) environmental monitoring and control;
iii) promotion of sustainable forest management; and
iv) economic and regulatory instruments.

PPCDAm also set a target initially aimed at reducing deforestation by 20%, which later increased to 80% relative to the 1996-2005 baseline. Furthermore, the institutional framework of PPCDAm facilitated the creation of the Critical County in 2008, a government programme that "blacklisted" municipalities failing to address deforestation requirements, leading to fiscal punishments, such as restricted access to rural credit.

2.2 Indonesia

Restoration Targets

Over the last decade, Indonesia has pledged different restoration targets (see Figure 2.8). During the period of 2015 to 2019, the government set to restore 5.5 Mha of degraded forestlands, and 2.6 Mha of peatlands as part of the National Mid-Term Development Plan. In parallel, in its 2016 submitted NDC, the government announced the rehabilitation of 12 Mha of degraded land and the restoration of 2 Mha of peat ecosystems. This NDC target has been subsequently confirmed by the government in its recently updated NDC submitted to the UNFCCC in July 2021, where it was also specified that the 12 Mha will be achieved with 6.4 Mha of timber plantations and 5.4 Mha of land rehabilitation (Indonesia 2016; 2021). According to the latest government estimation, by late 2019, ~1.1 Mha of forestlands had been restored, which represents 20% of the projected 5.5 Mha (Indonesia 2020). Regarding peatlands, by the end of 2020, only 45% of the 2.6 Mha has been restored, and the deadline was subsequently extended to 2024, together with adding also a new target: the restoration of 600 000 ha of mangroves by 2025 (World Bank 2021).

In addition, the current National Mid-Term Development Plan set new forest-related targets that will orient the Government's work during the 2020-2024 period. In its Chapter 2, the document details measures for strengthening economic resilience for equitable growth, and under a broader goal of improving water quality and security to support economic growth, two forest targets are set: i) to increase the legal area designated for conservation (see Forestry Law No. 41 of 1999 below) from the current 55 Mha to 65 Mha; and ii) to increase the area for production forests from 33.7 to 36 Mha. In its Chapter 7, dedicated to outline measures to improve resilience towards climate change, the report sets three targets for sustainable land restoration: i) to increase the area of degraded peatlands to be restored; ii) to increase the area that has been facilitated for peatland restoration from 122 000 ha per year to 330 000 ha per year; and iii) to increase the current yearly rate of reforestation from 206 000 ha per year to 440 000 ha per year.

Forestry Law No. 41 of 1999

The main regulatory instrument supporting forest and landscape restoration efforts in Indonesia is Forestry Law No. 41 of 1999. According to the Forestry Law, all forests in the Indonesian territory are controlled by the government: an area of ~120 Mha equivalent to ~60% of the country's territory. These forests are called Forest Estate and fall under the administration of the Ministry of Environment and Forestry (MoEF). Most of Indonesia's remaining land area is made up of non-forest public lands, known as areas for other purposes (APL). Forest Estate areas are in turn divided into three functional areas: production, protected, and conservation forests (Figure 2.6). Under this framework, the MoEF issues permits and licences over state-owned forestlands that allow for agriculture activities in production forest areas.

An important aspect of the area definition in the Forestry Law is that land designation does not always correspond to the actual land use or cover (Siscawati et al. 2017). An area designated as production forest, for example, may be covered with primary native vegetation, and an area legally designated to be protected may have a productive palm oil plantation. This discrepancy between land designation and actual land use can have important implications for forest management and environmental protection. Policies and incentives supporting restoration will follow the legal designation of the land before the actual land use. As such, a landholder with standing native vegetation in a productive forest may be incentivised to deforest the land and switch to agriculture given the regulatory and economic costs of forest conservation. Also, a very sensitive issue related to land designation, is that under the Forestry Law, ancestral occupation by indigenous communities was not initially acknowledged and recognised. As a result, large areas of the Forest Estate have overlapping claims between license holders and indigenous communities, with disputes on who should manage and control forestlands (Siscawati et al. 2017).

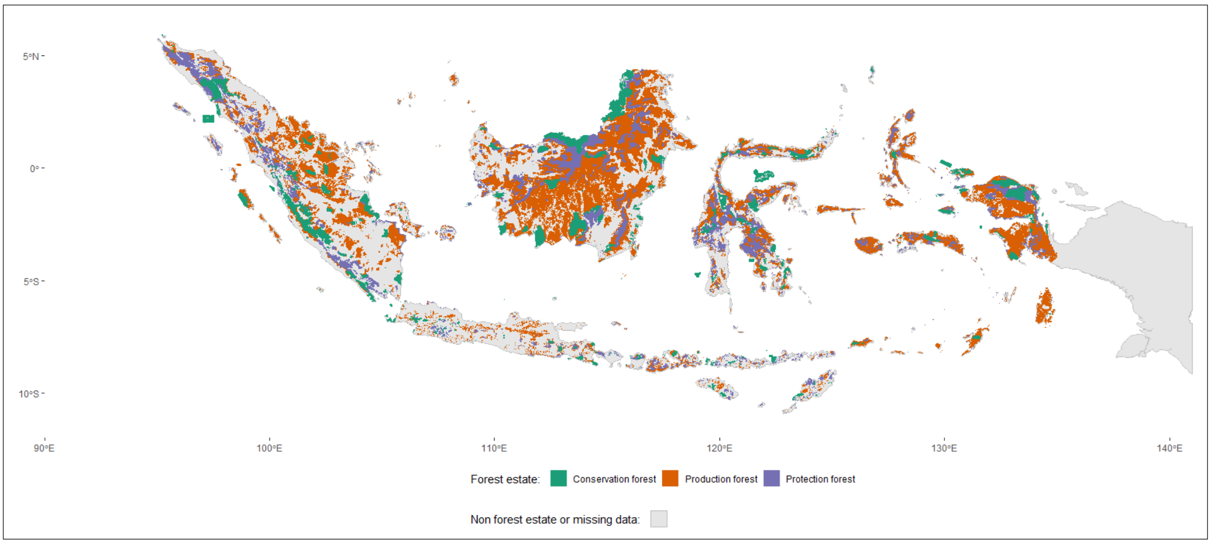


Figure 2.6 Map of Indonesia showing in colours the distribution of the different functional areas of the Forest Estate: Conservation forest in green, production forest in red, and protection forest in violet. Non-Forest Estate areas, including Areas for Other Purposes and land with no designation in grey. Disclaimer: this map is indicative. It is a composite of provincial maps for different years. Legal designations may have changed over time. (Based on data from the Kawasan Hutan 2019 - Kementerian Lingkungan Hidup Dan Kehutanan Republik Indonesia. Ministry of Environment and Forestry)

Ecosystem Restoration Concessions

Under the regulatory framework set by the Forestry Law, one policy instrument that was specifically designed for forest and landscape restoration is the Ecosystem Restoration Concession (ERC). When launched in 2004, ERC represented a new paradigm in Indonesian forest governance; a shift from extractive to ecosystem-based management (Pareira, Kartodihardjo, and Bahruni 2020). The idea was to create a market-oriented governmental instrument to incentivise private sector investment in ecosystem restoration. Under an ERC, the licence holder must promote restoration activities to re-establish a biological balance, and only after the balance has been reached, productive activities may resume. Until then, companies may sell credits for carbon offsets or profit from other activities, such as ecotourism or production and sales of non-timber forest products. The licence also requires an equitable sharing of benefits with local communities, such as job creation (Buergin 2016). In 2010, the MoEF set the target to license and allocate 2.5 Mha of production forests by 2014 and later expanded the target by 500 000 ha by 2019 (Indonesia 2020). According to recent estimations, the MoEF has granted 16 ERC over ~622,000 ha of production forests, equivalent to 20% of the 3 Mha target (Pareira, Kartodihardjo, and Bahruni 2020).

Social Forestry Programme

Forestry Law No. 41 also set the legal basis for the development of the Social Forestry Programme (SFP). As a policy instrument, SFP has a relatively similar promise compared to that of restoration: it aims to secure access to forests, improve communities' livelihood and address deforestation with more sustainable forest management. SFP titles are granted for 35 years and allow communities to benefit from non-timber products, practice agroforestry, do selective logging and, in some cases, have timber plantations. There are four social forestry schemes: community forests (Hutan Kemasyarakatan, HKm), community plantations (Hutan Tanaman Rakyat, HTR), village forests (Hutan Desa, HD), and partnership between state owned companies and local communities (Kemitraan) (Figure 2.7).

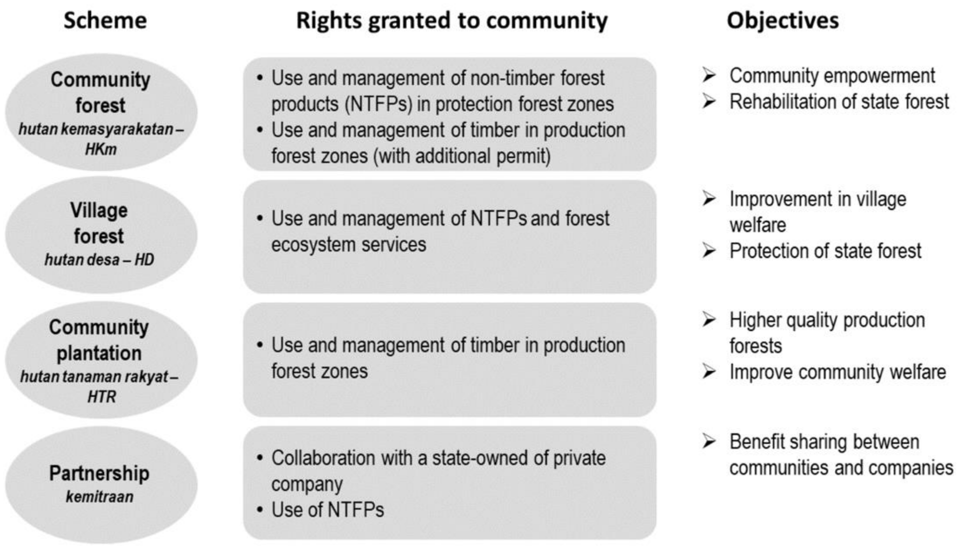


Figure 2.7 Social forestry schemes and objectives (Source: Liu and Bona 2019)

There are contesting views on the relationship between communal land tenure and forest protection in Indonesia, with inconclusive evidence on its effectiveness. Still in 2015, as one key measure for slowing deforestation rates in the country, the government promised to redistribute 12.7 Mha under the SFP by 2019. According to the latest estimations, however, only 1.7 Mha had been allocated to SFP schemes (Indonesia 2020). MCC conducted a dedicated study on the early rollout of the SFP, the details of which are presented further below in Section 3.1 Impact of palm oil expansion on Indonesian industrialization of this report.

Moratorium on new Forest Concessions

Similar to Brazil, the moratorium on the utilization of primary natural forest and peatlands is not a restoration-dedicated policy, but arguably Indonesia's chief command-and-control instrument to reduce deforestation and reduce carbon emissions. The legal basis for the moratorium is a 2011 Presidential Instruction introduced as a result of a bilateral agreement with the Government of Norway, in which Norway pledged one billion US dollars for the preparation and implementation of REDD+ policies in Indonesia. The moratorium involves the temporary suspension on the issuance of new concessions for palm oil plantations, timber plantations, and logging activity on primary forests and peat lands, as well as APL. While WRI Indonesia finds evidence on 45% decreased deforestation rates inside moratorium areas between 2002-2016 (Wijaya et al. 2017), Tacconi and Muttaqin (2019) note that sensitive issues remain unaddressed, such as the non-inclusion of secondary forests, the lack of monitoring and enforcement, and mapping inconsistencies.

One Map Policy

The One Map policy was launched by the Indonesian government in 2016 to digitise data and information related to forest areas in one single public portal. Similar to Brazil's SiCAR, the One Map Policy aims at building one single database consolidating all government maps to ensure that all agencies refer to the same land use information. It is intended to facilitate the resolution of conflicts associated with overlapping claims to the same land, keep a record of forest cover change, monitor compliance with Forestry Law, and detect illegal logging. The Geospatial Information Agency is tasked with collecting, standardising, and integrating different maps to detect concessions' overlaps, inconsistent borders, and other irregularities. Some progress has also been made in the area of customary mapping, by allowing local and indigenous communities to submit their own generated maps. However, the government remains reluctant to fully integrate them, on the basis of different methodologies and standards (Shahab 2016).

REDD+ Initiatives

Indonesia was an early mover on the REDD+ mechanism, which helped the country to better understand the drivers of deforestation and forest degradation (Dwisatrio 2021), and still today, the government considers REDD+ a key policy to provide national-scale incentives to reduce forest and landscape degradation (Indonesia 2020; 2021). Following Norway's US$1 billion pledge, Indonesia undertook the task of setting up the institutional architecture for the implementation of REDD+ activities. As part of this process, significant initiatives were developed alongside the REDD+ preparation activities, including the moratorium and the One Map Policy. Following this initial progress, in 2015 President Widodo dissolved the REDD+ Agency which had been established in 2013, and reorganized it under the MoEF, but with less autonomy and hierarchy (Dwisatrio 2021). In 2019, the Indonesian government established the Environmental Fund Management Agency as the last institutional component of its REDD+ strategy. Accordingly, Indonesia is to benefit from international funding, including the Green Climate Fund, to which it has already applied for US$ 103 million, and the BioCarbon Fund, from which it expects to receive US$ 70 million (Indonesia 2020).

Presidential Regulation No. 1 of 2016: Peat and Mangrove Restoration Agency (BRMG)

Following the massive peatland fires of 2015, the government of Indonesia passed the Presidential Regulation No. 1 of 2016 which created the Peat Restoration Agency (PRA) with the specific mandate to coordinate and facilitate the restoration of 2 Mha of degraded peatlands. The agency has prioritised restoration in seven provinces: Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, and Papua. In 2020, the PRA was amended to include the restoration of 600 000 ha of mangroves and was subsequently renamed as Peatland and Mangrove Restoration Agency (Badan Restorasi Gambut dan Mangrove, BRMG) (Indonesia 2020). The BRMG is responsible for adopting policies related with governance and management of peatlands, including: i) preventing forests and land fires occurrence; ii) suspending the issuance of new licences for the utilization of peatlands; iii) prohibiting further land clearing in protected peatlands; iv) reviewing current forest plantation licences and rearranging concessions' configuration; and v) monitoring restoration activities in production, protected and conservation forests. The BRMG together with the MoEF have collected and consolidated a National Peat Ecosystem Function Map to support peatland ecosystem protection, management, and restoration. According to recent estimations, ~24 Mha of Indonesia's peatland fall under the classification of damaged peatland (Indonesia 2020). The restoration of peat lands in production forests is conducted by licence holders such as timber and palm oil companies and requires the submission of Peat Ecosystem Restoration Plans with a detailed strategy, timeline and budget regarding the restoration activities to be conducted. Companies are required to regularly report to the MoEF about the restoration progress (Indonesia 2020).

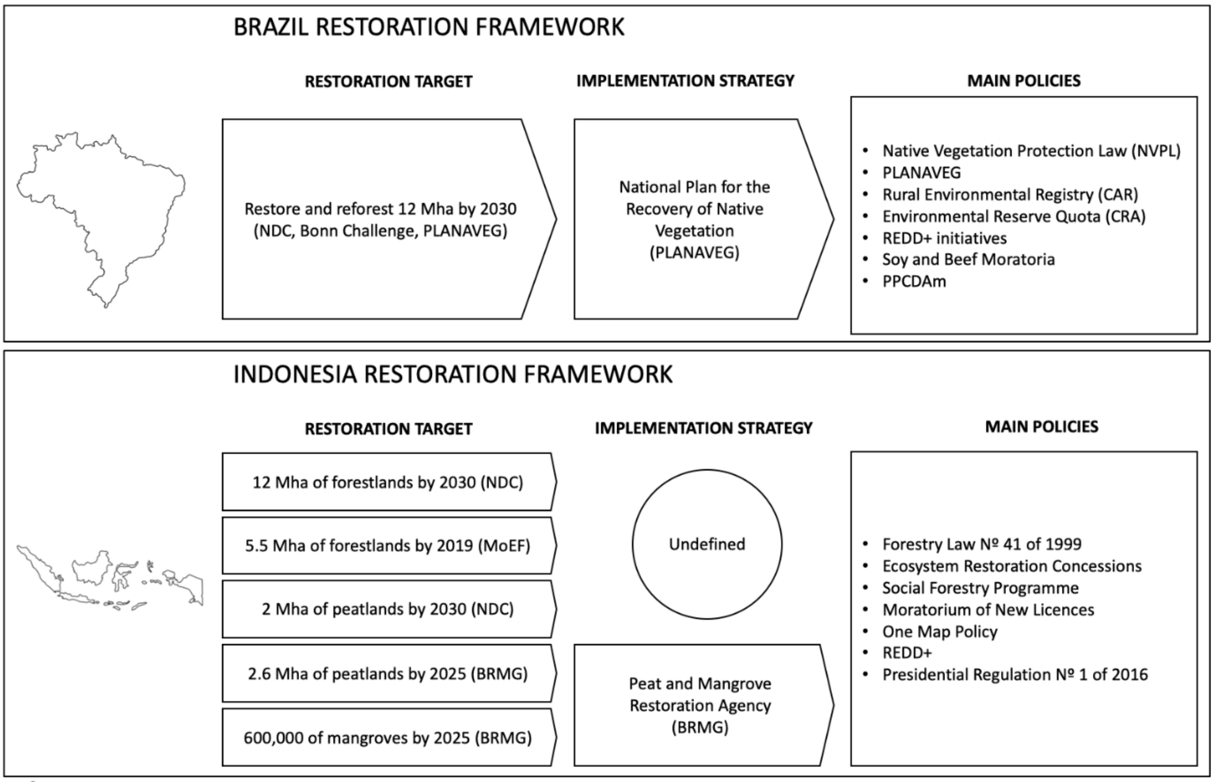


Figure 2.8 Diagram showing the restoration framework of Brazil and Indonesia. The framework identifies restoration targets, implementation strategy and the main policies supporting the implementation of the restoration target and strategy. (Source: RESTORE+).

3. Activities Focused on Indonesia

This section compiles quantitative insights informing the necessary building blocks of an effective financing mechanism to promote land use sustainability. Indonesian palm oil development is examined as to provide evidence-based evaluation of land-use policies and explore entry points for policy interventions aimed at curbing deforestation rates while allowing for continued agricultural activity.

3.1 Impact of palm oil expansion on Indonesian industrialization

The expansion of palm oil in Indonesia served as a quasi-experiment to study the effects of a rapid and large agricultural expansion on an industrializing economy. The investigation conducted by MCC, evaluated how non-palm oil manufacturing industries have reacted to local waves of palm oil expansions in Indonesia. The purpose is to determine if palm oil “crowds out” industrial growth, because workers relocate to plantations, or leads to positive agglomeration “spill overs” on the industrial sector.

Palm oil is a high intensity labour business. The harvesting and collection of fresh fruit bunches are still done largely manually and at least one worker is needed for every 10 to 12 ha. Therefore, the arrival of a new palm plantation in a district has put pressure on blue-collar labour markets. The sector today employs two million people, most of them as plantation workers. Given this context, a preliminary assumption would indicate that palm oil expansion might “crowd out” industrial development.

A stacked difference-in-differences design was used to build suitable control groups and tease out the dynamic effect of the establishment of a palm oil mill of factories from other industries in the same district. In previous studies only the location of a subset of palm oil mills had been known. This investigation benefited from a new panel dataset of most palm mills in Indonesia – the universal mill list –, including their establishment dates (Figure 3.1) and ownership structures, which allowed to investigate pre-trends and anticipation effects directly, and also identify clean shocks from investments in new plantations.

The research brought four main findings:

i) First, a dynamic and average increases in sales (15%), labour productivity (13%), and total factor productivity (13%) of non-palm oil manufacturing plants after the establishment of a palm oil mill in the same district (Figure 3.2).
ii) Second, it was found that non-palm oil manufacturing plants paid higher blue-collar wages in reaction to palm oil booms.
iii) Third, at the district level, the research found a growth in tax revenues and increases in the share of asphalt roads.

iv) Finally, using data on all outputs on the plant level, plants show also an increase share of tradable goods. This pattern is consistent with improved access to markets due to better transport infrastructure.

Since the palm oil islands of Sumatra and Kalimantan have lagged behind the main island Java in industrial performance, it is an important policy question, whether palm oil has crowded out industrial activity there. The research results show the contrary: the average incumbent non-palm oil manufacturing plant experiences positive spill overs from plantations.

These results indicate that the implementation of restoration initiatives will require financing mechanisms that can generate at least comparable economic benefits to those generated by palm oil production in order to compensate for the operational, transactional, and opportunity costs of restoration. Furthermore, the financing mechanism would have also to allow local distribution of monetary benefits, as it occurs with the spill over effect observed with the palm oil industry.

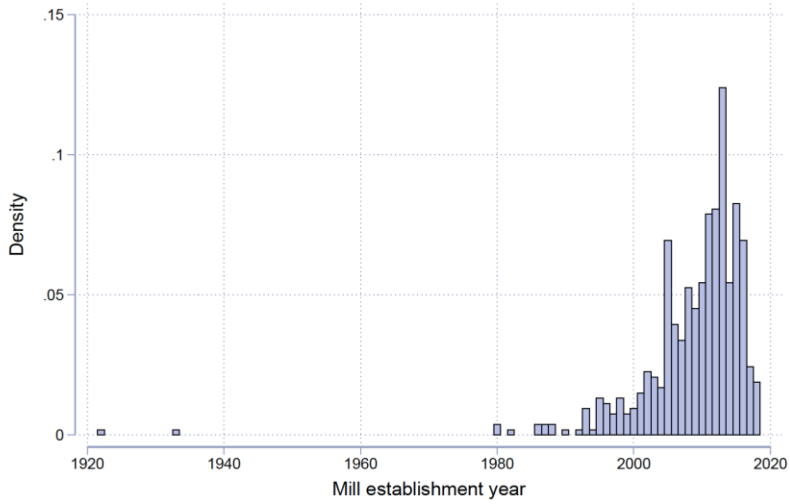
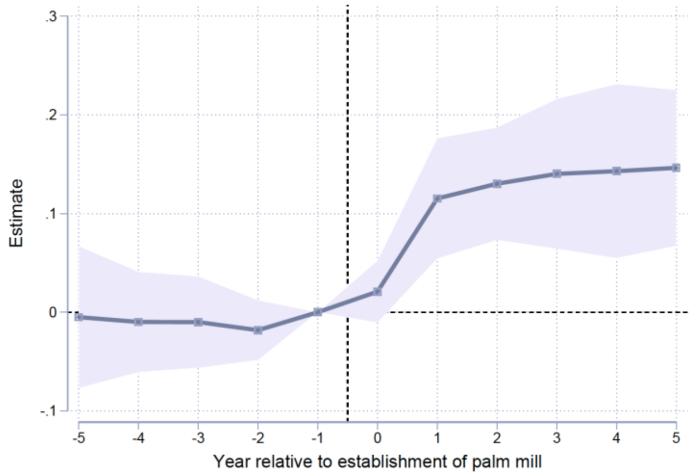
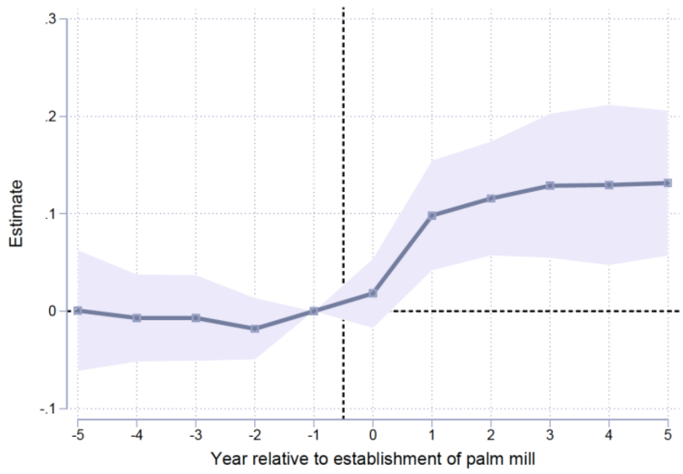


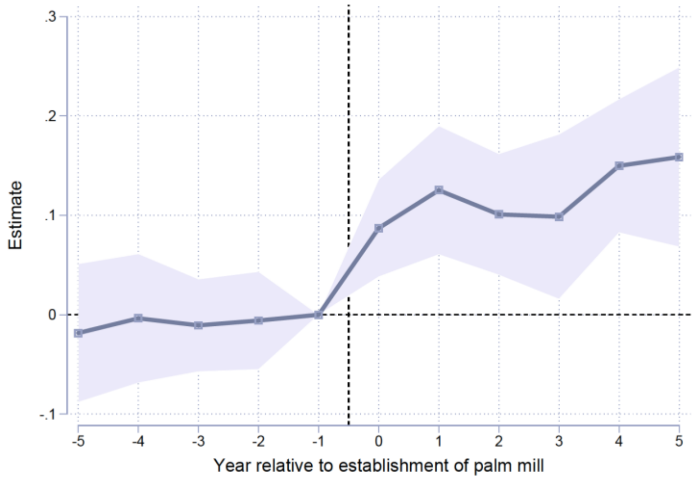
Figure 3.1 Distribution in palm mill establishment years (Source: Kraus et al. 2020, in review).



(a) sales



(b) labour productivity



(c) total factor productivity

Figure 3.2 Non-palm oil factory performance on (a) sales, (b) labour productivity and (c) total factor productivity before and after the establishment of palm mill in the same district (Source: Kraus et al. 2020, in review).

We show that on the local level there seems to be a synergy between the palm oil business and other industrial activities. This result indicates that palm oil may be positive for the industrial development at the local level. However, the result does not tell us about the net effect at the national level as soon as we include a potential crowd-out of industrial sectors created by macro-level forces such as reduced urbanization/agglomeration effects, worsening conditions for other exporting sectors (trade policy, exchange rate). In general, it is hard to build the counterfactual situation for "what would have happened to Indonesia's development path in the absence of the palm oil boom". The present study only investigates one small, very local part of this question.

3.2 Price elasticities of deforestation across the palm oil sector

The relationship between agricultural prices, palm oil expansion and tropical deforestation is fairly documented. Yet, for Indonesia, it remains poorly understood how deforestation actors in the supply chain react to palm oil prices, in turn limiting the capacity of regulators to design environmental policies that effectively capture this interaction. Do palm oil prices influence deforestation? And if so, which segments of the palm oil sector react more or less strongly to these prices?

MCC estimated price elasticities of deforestation across the Indonesian palm oil sector. This is the first study to build and use a spatially explicit dataset of prices paid at palm oil mill gates from 1998 to 2015 (Figure 3.3). This novel dataset results from the merger of the *universal mill list* and the Indonesian manufacturing census. MCC researchers measured deforestation as 30m-pixel events of primary forest loss, conditional on eventual industrial or smallholder palm oil plantation development. The sample for estimation is a 2002-2014 annual panel of 3x3km plantation sites located in Sumatra and Kalimantan, where most of deforestation due to palm oil plantations occurred during the period. Since palm oil fruits damage quickly during transport, the research leveraged the relative influence of the different mills surrounding every plantation based on the distances between them. This upstream spatial distribution of mills and plantations is interacted with conditionally orthogonal downstream variations in crude palm oil prices, hence allowing for causal interpretation of the estimates.

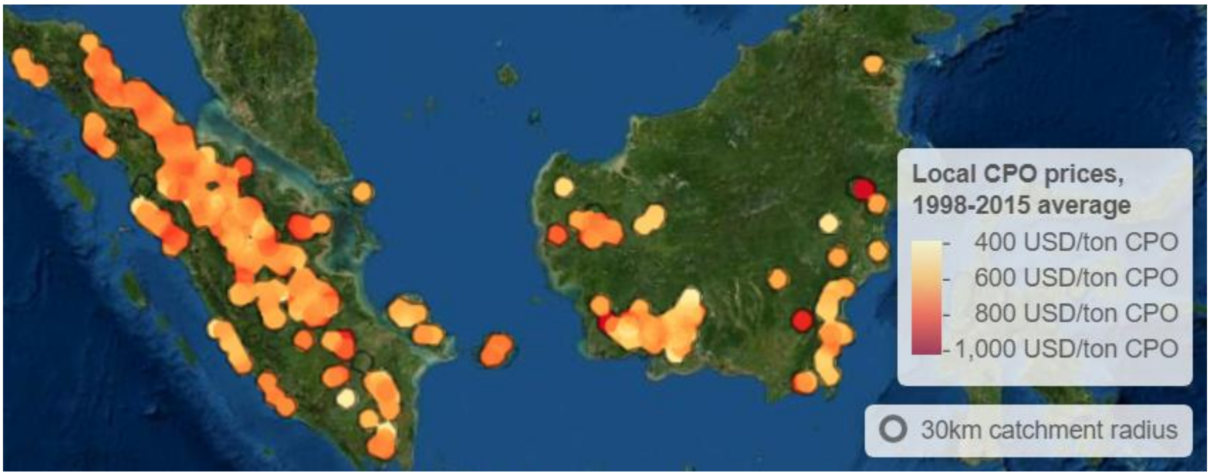


Figure 3.3 Average crude palm oil price signals received at every 3x3km potential plantation site within 30km of a mill. Price signals are computed as inverse-distance weighted sum of prices at the gates of reachable (within 30km) mills. The geographical area includes the Indonesian regions of Sumatra (left) and Kalimantan (right). (Source: Guye and Kraus, 2021, in production).

The research found that illegal deforestation in both industrial and smallholder plantations is price elastic, which is not the case for legal deforestation. The implications of these results are twofold. First, this constitutes evidence that the segments most difficult to monitor can be incentivized away from deforestation. This is an important finding, because the existing conservation schemes do not reach these increasingly prevalent segments of the palm oil sector. These results support that a conservation tax, uniformly levied at mill-level choke points and refunded against proof of deforestation-free expansion, can be enhance enforcement of conservation efforts. Second, the finding that legal deforestation is inelastic to prices suggests that legal deforestation does not react to medium-run market signals, most likely due to long licensing processes. On the other hand, the research finds a substantial price elasticity of illegal deforestation. This indicates the existence of strong incentives to circumvent land use regulations in order to seize economic opportunities of palm expansion. Together, these results imply that more stringent conservatory regulations may extend the licensing process and, in absence of strong monitoring, thus encourage illegal deforestation in the presence of high price incentives. However, this leakage effect may be contained if price incentives are controlled. In all, these results suggest that in the Indonesian context a market-based instrument may help conservatory regulations be more effective.

However, the price elasticity estimated does not enable to *directly* predict the effect of a market-based conservation instrument. First, because such an instrument, provided it distinguishes deforestation-based palm oil, would distort prices more than a uniform palm oil price change would. Second, because there are tax revenues, they could be redistributed to compensate plantations claiming avoided deforestation, thus widening the price gradient between deforestation-free and deforestation-based palm oil and increasing even further the incentive to avoid deforestation. The Indonesian Crude Palm Oil Fund follows a similar mechanism, by which the Government collects levies from exported crude palm oil in order to support sustainable palm oil development in Indonesia. Recent governance concerns of the Fund, however, is a separate issue to further discuss. Finally, the exact effect of such a tax is also dependent on the demand elasticity: the consumer propensity to absorb prices increases.

Table 3.1 Main estimates of price elasticity of deforestation

	Industrial plantations			Smallholder plantations			All		
	Legal	Illegal	All	Legal	Illegal	All	Legal	Illegal	All
Estimate	0.56	5.22	2.15	0.21	2.06	1.54	0.24	3.02	1.65
95% CI	[-1.15; 2.28]	[2.03; 8.41]	[0.63; 3.67]	[-1.99; 2.4]	[0.62; 3.5]	[0.24; 2.84]	[-1.19; 1.67]	[1.32; 4.72]	[0.51; 2.8]
Observations	13203	4989	25511	3055	3445	8784	15263	7894	31918
Clusters	635	443	1143	209	271	529	749	628	1441

The main estimates of the price elasticity of deforestation as shown in Table 3.1 are to be interpreted as points of percentage change in average deforestation associated with a 1% increase in price signals. The price signal is measured as the 4-year average of annual inverse-distance weighted averages of crude palm oil prices at the gates of reachable mills. Deforestation is measured as primary forest loss eventually replaced with oil palm plantations. We differentiate industrial from smallholder plantations based on scale and landscape criteria. We identify illegal deforestation as occurring outside a known oil palm concession and inside a permanent forest zone designation. There are places where not enough information is available to designate the legal status. All estimates are derived from a generalised linear model of the quasi-Poisson family. All regressions include unit and district-year fixed effects, as well as ownership shares and the annual count of reachable mills as covariates. Sample observations are annual records of 3x3km grid cells in Sumatra and Kalimantan from 2002 to 2014. They all have a positive extent of remaining primary forest and are within a 50km (30km in Sumatra) radius from at least one of our sample mills. 95% confidence intervals (CI) are based on standard errors computed with the delta method and clustered at the set of reachable mills. (Source: Guye and Kraus, 2021, in production).

Estimates in this table show that a 1% increase in crude palm oil prices over the preceding 4 years increases the average annual conversion of primary forest to palm oils by 1.6% (last column in Table 3.1). This result implies that a 19% tax on crude palm oil can curb deforestation by 29% (proportional to Indonesia's targeted reduction in carbon emissions under the Paris Agreement) below the 2002-2014 average.

This research shows that while illegal deforestation is price elastic, so that monetary disincentives might be efficient to reduce illegal deforestation, legal deforestation is not, suggesting that premium prices linked with sustainability requirements might work better for legal deforestation. This also highlights the importance of having appropriate policies and efficient law enforcement mechanisms. In all, the results of this study confirm an overarching argument raised throughout this report: policies and regulations aiming at forest protection or restoration might have better results when supported or coupled with a market- or price-based instrument either in the form of a tax, easier access to credit or loans, or PES.

3.3 Early effects of the Social Forestry Programme

The Indonesian government promised to redistribute 12.7 Mha of forest lands to communities under the SFP with the hope – among other goals – to reduce deforestation rates and encourage restoration of degraded forests. As previously noted (Section 2.2 Indonesia), the SFP has a comparatively similar promise to that of the restoration activities investigated in this project: by providing communities with land titles to manage forests, the SFP aims at encouraging a more sustainable forest management such that native ecosystems are protected or recovered to their original condition, while at the same time forest-dependent communities experience improved livelihoods. Following some inconclusive evidence on its effectiveness, we investigated whether communal management of forests leads to reduced deforestation rates.

The analysis conducted by MCC is based on comparing the change of annual forest loss between areas under community titling to areas identified by the MoEF as candidates for future SFP titling. The sample included 4,349 SF permits covering 2.4 Mha granted from 2009 to 2019. Differences in forest cover were determined by comparing satellite-based measurements of annual tree-cover loss between 2001 and 2009 in areas before and after the introduction of each land title with a regression-based stacked difference-in-differences design. The analysis also differentiates between the three main types of SF schemes: i) village forests (Hutan Desa, HD), ii) community forests (Hutan Kemasyarakatan, HKm), and iii) community plantation forests (Hutan Tanaman Rakyat, HTR) (Figure 3.4). HD and HKm titling are the prevailing titling schemes granted by the government and the two pillars of the SFP. Under HD and HKm, communities are allowed to benefit from non-timber products, practice agroforestry, ecotourism and do selective logging in *production* forests. HTR are on average smaller on size and not as prevalent as HD and HKm and are oriented to restore already established *plantation* forests. All community titles are granted for 35 years to communities.

The results in Table 3.2 below indicate that, overall, in HD and HKm deforestation rates have not decreased. If anything, and contrary to the purpose of the SFP, estimates show that deforestation rates under these schemes have increased (columns A to F in Table 3.2). On HTR areas, on the other hand, estimates indicate substantial reductions on forest loss rates in degraded primary forests (column H), indicating increased efforts to restore forests for timber production. The latter result should be investigated with a longer time series. This could also allow to investigate the heterogeneities between different HTR area sizes, as some of them are very small and could be driving spurious results. If the result holds in a longer time series, it would be important to investigate the channels behind it. Beside increased incentives for sustainable forest management, it may also reflect capacity for harvesting after a transfer from private into community ownership. It may also be that the sample selected includes only areas where a harvesting cycle has reached its end or where accessible resources have already been extracted. A visual inspection of the areas does not seem to confirm this, but it would be fruitful to investigate further.

Overall, the results confirm that devolution of land rights to communities may not be sufficient to reverse deforestation of condition to more environmental protection. As such, this study is also a confirmation that policy interventions aimed at forest protection which are decoupled from an adequate financial mechanism, as suggested by the previous research in 3.2 Price elasticities of deforestation across the palm oil sector, do not necessarily result in a decrease in deforestation rates. HD and HKm allow only to benefit from non-timber products, ecotourism and selective logging, which might not provide the sufficient returns to incentivise forest conservation, and contribute to explain continued forest loss in these areas.

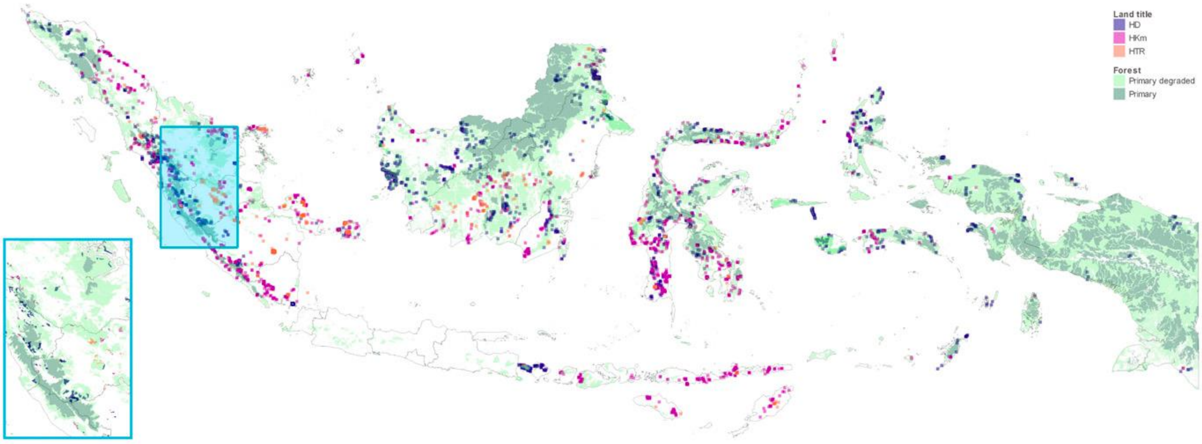


Figure 3.4 This map shows the three main types of social forestry: HD and HKm, which allow nontimber forest product collection, agroforestry, ecotourism, and some selective logging; and HTR, which aims at restoring degraded areas for community timber plantations. Primary forest and primary degraded forest in 2000 are shown in the background, and province boundaries are in grey. Inset in lower left corner is a zoomed map of the smaller area marked in blue on the main map (Source: Kraus et al. 2021).

*Table 3.2 Effect of social forestry titling on deforestation. "Land title" reports the coefficient on the interaction term between an indicator for treatment and an indicator for years after treatment. The unit of analysis is the study area. Treated units are areas with community titles, and control units are areas designated for treatment by the government. The outcome is the deforestation rate, that is, area deforested divided by total area, at the level of the unit of observation. We show results for deforestation rates in all forest combined and restricted to degraded primary forest and primary forest. Significance levels are indicated by *, **, and *** for 10%, 5%, and 1%, respectively (Source: Kraus et al. 2021).*

	HD			HKm			HTR	
	(A) All forest	(B) Degraded	(C) Primary	(D) All	(E) Degraded	(F) Primary	(G) All	(H) Degraded
Land title	0.14**	0.27***	0.35*	0.08	0.00	0.75**	–0.10	–0.83***
	[0.02, 0.26]	[0.08, 0.46]	[-0.03, 0.73]	[-0.06, 0.21]	[-0.26, 0.27]	[0.16, 1.34]	[-0.24, 0.05]	[-1.21, -0.46]
Precipitation	–0.15***	–0.16***	–0.32***	–0.15***	–0.16***	–0.31***	–0.15***	–0.16***
	[-0.20, -0.11]	[-0.23, -0.09]	[-0.52, -0.11]	[-0.20, -0.11]	[-0.23, -0.09]	[-0.51, -0.11]	[-0.20, -0.11]	[-0.22, -0.09]
Clusters	18,552	10,554	1,497	18,746	10,438	1,416	19,259	10,246
N	3,714,021	2,073,305	287,727	3,717,707	2,071,101	286,188	3,727,454	2,067,453

Here again, combining policy – the SFP – with an adequate financing mechanism – such as PES, for example – could help increase the value of conservation above the opportunity costs of agriculture and deforestation. Reduced deforestation on HTR schemes, on the other hand, suggest that there is an opportunity for increased forest protection when incorporating forest communities in efforts to restore degraded timber plantations. Further research could investigate if this is related to expected future returns of the standing forest or merely less harvesting capacity of the title holder.

Combinations of policy and financing mechanisms that aim at reconciling conservation and development need to incorporate more nuanced evaluation of land cover changes, particularly in consideration of local inhabitants. This study shows that mechanisms that address institutional issues without providing adequate financial resources also experience difficulties in delivering the expected results. Further, it also identifies specific areas where reducing deforestation through institutional measures can be effective, and presumably even more effective when combined with financial incentives.

4. Activities Focused on Brazil

In this section, the report presents the separate assessments conducted by EDF and LSE on the opportunity cost of avoided deforestation and restoration in Mato Grosso, Brazil. The purpose is to better understand the economic incentives of landowners to keep the native forest intact, convert it to agriculture or restore converted ecosystems. The distinction is quite relevant since clearing the land for agriculture will usually bring quick returns to landowners from selling the resulting timber, while restoration will require significant up-front investment in preparing the soil, buying seeds and seedlings, and a long-term horizon for returns. Expectedly, a farmer would have a stronger economic incentive to convert the forest to agriculture rather than replacing crops or pastures for cattle with native vegetation. Under the Forest Code, the distinction becomes even more relevant, as it mandates landowners either to restore native vegetation in their land, or to pay other landowners to conserve native forests on theirs in compensation. This juxtaposition of restoration and avoided deforestation becomes important as they directly compete with each other.

The state of Mato Grosso has a size similar to that of Germany and France combined. Native vegetation including the Amazon, Cerrado, and grasslands biome cover ~60% of the territory. It is also a key jurisdiction for commodities production at the national and international levels. It has the biggest soy, corn, and cotton production and the largest cattle herd in the country. Reconciling agricultural production with environmental conservation is a continued challenge on the state's agenda.

4.1 Opportunity cost of avoided deforestation in Mato Grosso, Brazil

In order to estimate the scale of financial penalties that would halt illegal deforestation and the compensations required to prompt farmers to avoid deforesting areas that can be legally cleared under the 2012 Forest Code, EDF quantified the opportunity cost of all remaining standing forest plots in Mato Grosso through 2030. Coupling opportunity costs of avoiding deforestation with information on carbon stocks and property-level information on forest area relative to legal requirements, EDF developed CO_2 marginal abatement cost curves for illegal and potentially legal deforestation for each land type. The cost curves (Figure 4.1) can inform deforestation reduction and performance-based REDD+ policies, including the design and proposal of a novel financial compensation mechanism for landowners willing to protect their forest above legal limits.

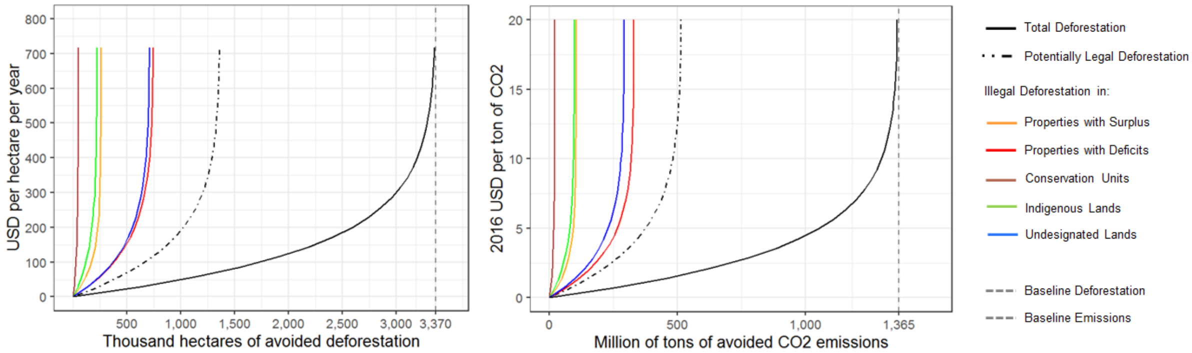


Figure 4.1 Opportunity Cost (left) and CO2 Marginal Abatement Cost (right) curves for Mato Grosso (Source: Pietracci et al. 2021, in progress)

The analysis by EDF concludes that one million hectares of potentially legal deforestation can be spared with payments of around 200 US$ per hectare per year (Figure 4.1, left). On aggregate, considering illegal and potentially legal deforestation, emissions of 1 billion tons of CO_2e can be avoided at an opportunity cost lower than 5 US$ per ton of CO_2e (Figure 4.1, right).

4.2 Designing the Market for Forest Certificates (CRAs)

Building on the opportunity cost modelling for Mato Grosso, EDF estimated the restoration and opportunity costs for rural properties that are not in compliance with Brazil's Forest Code, to inform the design of a potential market for CRAs in Mato Grosso. This market, envisioned under Brazil's Forest Code, would give flexibility to landowners who deforested beyond the legally allowed threshold before 2008 to return to compliance levels. Legal compliance can be achieved by either restoring native vegetation in their properties or by supporting forest protection offsite by purchasing Forest Certificates (CRAs) from landowners with native vegetation above legal thresholds. Hence, this market has the potential to lower the costs of compliance with the Forest Code (Herrera et al. 2021, in production).

The analysis focused on Mato Grosso, the leading agricultural state in Brazil, where there is an estimated 9.8 Mha deficit of native vegetation in private properties, of which 1.1 Mha need to be restored and 8.7 Mha could be either restored or compensated via the CRA market (Figure 4.2, left). For the 8.7 Mha of native vegetation deficit that can be compensated in the CRA Market, restoration plus opportunity costs by property are shown in (Figure 4.2, right).

As landowners trade CRAs, this market will be paramount in determining the number of hectares of additional avoided deforestation and restoration. EDF analysed how different CRA market designs (varying by biome, by property size, and by restricting the pool of suppliers) influence market quantities and prices and the amount of additional avoided deforestation and unreleased carbon emissions, as well as the number of reforested and restored hectares and carbon removals.

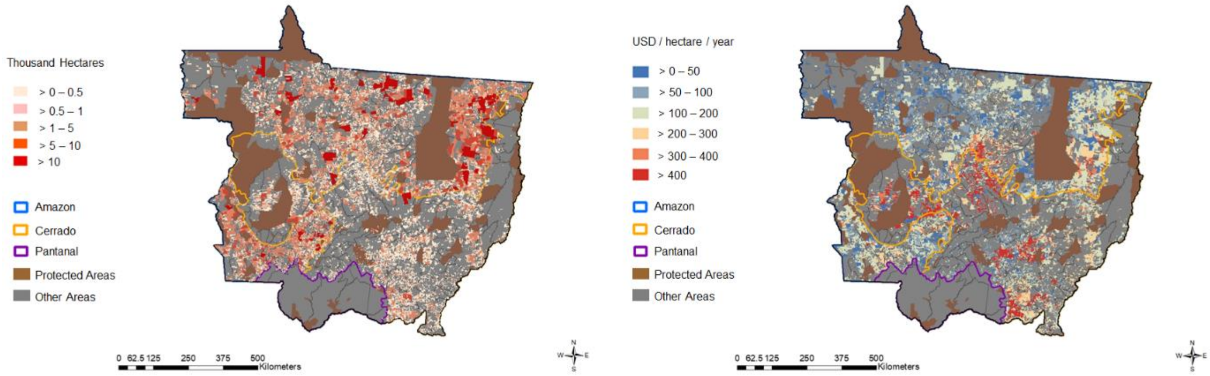


Figure 4.2 Spatial distribution of 8.7 Mha of native vegetation deficit (left); Spatial distribution of restoration plus opportunity costs per hectare per year in Mato Grosso in 2016 (right) (Source: Herrera et al. 2021, in production).

The results show significant differences across the Amazon and Cerrado biomes. In the Amazon biome in Mato Grosso, the deficit that can be compensated amounts to 7.3 Mha while the surplus is 2.6 Mha. It would result in a market equilibrium of approximately 2.4 Mha of traded CRAs at a clearing price of 178 US$/ha/year. (Figure 4.3, left). This equilibrium would leave 4.9 Mha to be restored.

In the Cerrado biome, on the other hand, the deficit that can be compensated amounts to 1.4 Mha while surplus sums up to 3.9 Mha (Figure 4.3, right). This over-supply of CRAs would drive prices to near zero and leave zero hectares to be restored. Therefore, restricting CRA supply only to hectares at-risk of deforestation, such as those near existing roads and agricultural land, or allowing for interstate trading could help achieving additional hectares of avoided deforestation and restoration.

In sum, the analysis suggests that i) different market designs yield different levels of reduced deforestation and restoration, and ii) there are trade-offs between cost reductions of compliance with the Forest Code and real environmental gains under this market from both protection and restoration. To address these trade-offs, targeted REDD+ payments and restoration incentives can complement the CRA market.

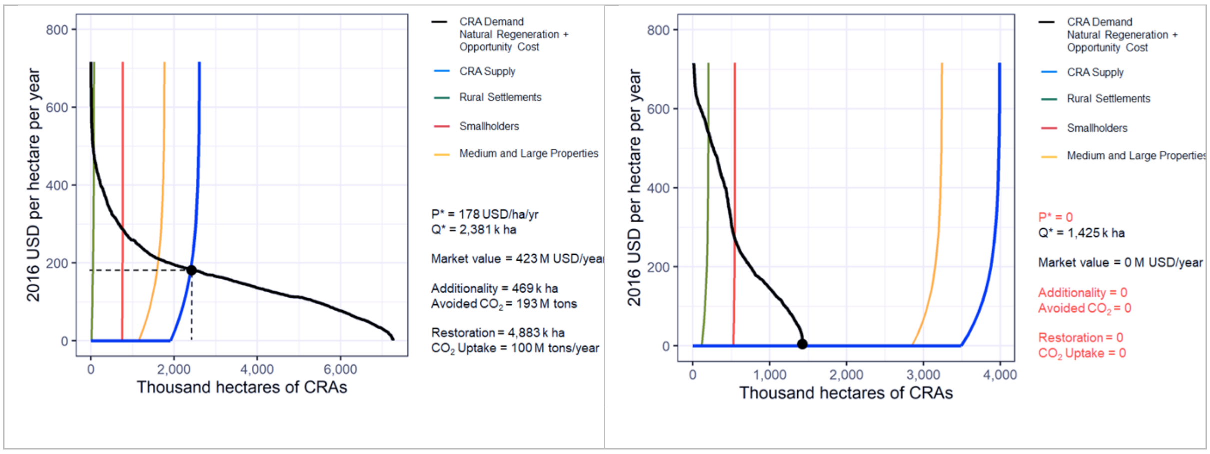


Figure 4.3 CRA market demand and supply curves for the Amazon (left) and Cerrado (right) biomes in Mato Grosso (Source: Herrera et al. 2021, in production).

4.3 Exploring land-use returns to deliver incentives for avoided deforestation

In addition to EDF's work in Mato Grosso, LSE utilised a land-use model to assess avoided deforestation and restoration opportunity costs faced by farmers. First developed by Engel et al. (2015) and later adapted in Palmer et al. (Palmer, Taschini, and Laing 2017), the model estimates optimal land use change and landowner incentives to either conserve the forest or convert it to agriculture under uncertain future agricultural returns. In theory, the presence of uncertainty in agricultural returns should delay land conversion until the value of non-use benefits equals the value of land in the next-best alternative use plus conversion costs plus an option value. The model is used to simulate PES scenarios to estimate the level of incentive needed to ensure that the landowner i) continues to postpone the decision to switch from forest to agriculture, or ii) is incentivised to switch from agriculture back to the forest. Put simply, the model quantifies the landowner's opportunity costs of forest conservation as the forgone returns to agriculture. The model assumes a least-cost approach to conservation – i.e., that Mato Grosso's government is budget-constrained, and seeks to maximize conserved forestland area within this budget. Importantly, though carbon storage may be a primary goal, payments in the model relate to landowner opportunity cost. Furthermore, the model relaxes the assumption of full permanence and it considers the situation where landowners are not good-faith actors – that is, even if they sign up for a conservation payment and even if continued conservation payments remains in expectation the preferred land use, the landowner might decide to convert their land. As such, the model adopts a probability of breach of conservation agreement of 10%.

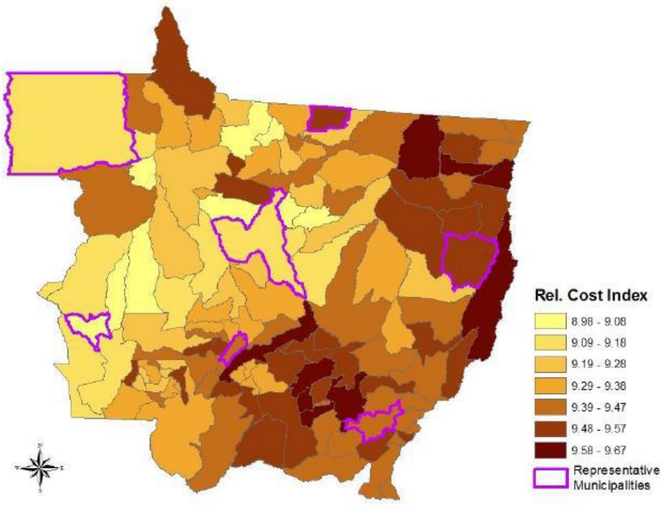


Figure 4.4 Relative cost index of payment for avoided deforestation per municipality. Lighter-colored, lower opportunity cost municipalities are concentrated in the central, western, and north-western regions, while the eastern and southern regions contain the majority of especially high opportunity cost municipalities. Equally, these are the municipalities where restoration is more costly (Source: RESTORE+, preliminary result).

The model allowed LSE to build a map of the relative cost index (RCI) for the entire state of Mato Grosso (Figure 4.4). For a PES scheme to incentivize a landowner not to convert their forestland to agricultural land, the payment must be sufficient to outweigh the opportunity cost of the most attractive agricultural activity available to that landowner. Thus, for each municipality, the most important data point is the highest return crop for the landowner. The regional variations of the results are particularly relevant: as Mato Grosso lies in the south-eastern region of the Amazon biome, the outcomes are consistent with intuition that north-western areas of Mato Grosso have a lower opportunity cost of standing forestland. These areas of Mato Grosso are relatively more forested, which is consistent with the standard economic prediction that more easily exploitable resources will be used first. Thus, these results correctly correspond to a relatively low opportunity cost of forestland and thus a lower minimum payment for conservation.

This tool – the land-use model and the RCI map – can help regulators and policymakers to identify the properties at greater deforestation risk or where landowners might have stronger incentives to convert the forest to agriculture, favouring a more refined spatial targeting of conservation funds, thus optimising financial resources for restoration.

5. Innovative Financing Mechanims for Restoration

Returns on forest protection investments usually require a long-term horizon, when relatively small on scale fail to attract large investors, and it is still difficult to leverage the public benefits provided by forests for financing purposes. The following factors continue to hinder more extensive investments to support tropical nations for the contribution of their forests to climate change mitigation: i) difficulty for buyers to connect and transact with jurisdictional programs, ii) uncertainty over future climate policies and lack of market standards, iii) the lack of long-term demand limits investment and political support for REDD+ programmes, iv) the perception that jurisdictional scale is only for “donor” capital, and v) the lack of a tradeable unit verified to a high-integrity standard that aligns with international policy frameworks, such as the Paris Agreement and Warsaw Convention.

In this chapter, we present some innovative and scalable financing mechanism that could help mobilise funds and catalyse both private- and public-sector investment to compensate for the opportunity costs of avoided deforestation and restoration faced by landowners in Brazil and Indonesia.

EDF has used its expertise built on instruments for scaling finance for conservation and restoration in a wider network of initiatives and projects (outside of RESTORE+) to develop impactful financing mechanisms in the Brazilian and international context. In turn, EDF’s involvement on these activities have brought important insights for the project, which are analysed in more detail below.

5.1 The Jurisdictional Approach

EDF has been developing innovative mechanisms to finance large-scale REDD+ programmes based on the “jurisdictional” approach (Figure 5.1). Unlike small and stand-alone forest projects, national and subnational governments – or jurisdictions – hold regulatory and law enforcement power, institutional capacity, and the public legitimacy to coordinate different stakeholders, including public donors, private investors, agricultural producers, indigenous people, local communities and the civil society. In addition, the jurisdictional approach secures higher environmental integrity on issues such as leakage, permanence, and additionality, ensures accounting integrity and alignment with international climate change mitigation frameworks, and reduces the costs of implementing large scale REDD+ strategies.

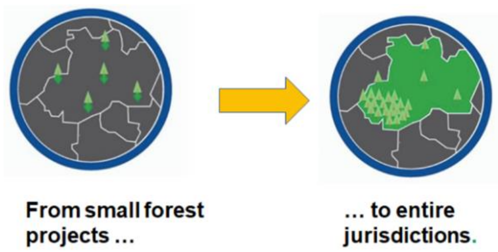


Figure 5.1 The jurisdictional-level approach to REDD+ programs (Source: EDF, 2021)

As an example of a jurisdictional approach, EDF and Forest Trends developed an integrated finance strategy that combines different potential sources of REDD+ funding and other financial instruments to support the state of Mato Grosso in implementing its Produce, Conserve and Include (PCI)[3] sustainable rural development strategy (Rupert et al. 2021, in progress). The strategic plan combines different REDD+ funding sources and geographic scales over time with other initiatives such as the rural credit for low carbon agriculture program – the *Agricultura de Baixo Carbono* (ABC) Program, contributions from the agribusiness, the Floresta+ payment for ecosystem services program, CONSERV (see 5.4 CONSERV), and policies like the CRA market into a larger jurisdictional REDD+ strategy (Figure 5.2).

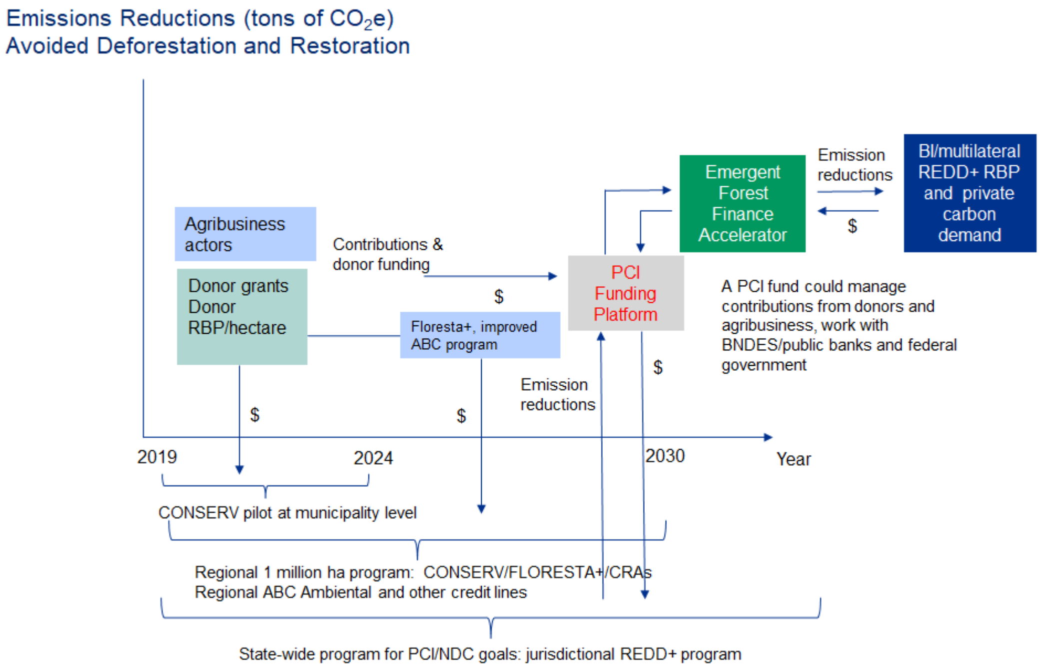


Figure 5.2 Integrated financing strategy for REDD+ programs in Mato Grosso (Source: EDF, 2021)

5.2 ART/TREES and the Emergent Forest Finance Accelerator

The Architecture for REDD+ Transactions (ART)[4] is one specific initiative aimed at scaling supply and demand for high environmental integrity jurisdictional REDD+, including both forest protection and restoration at a jurisdictional scale. ART is an independent organisation that registers, verifies, and issues high quality emission reduction credits to countries and subnational jurisdictions to attract REDD+ finance. It does so under The REDD+ Environmental Excellence Standard (TREES) which sets the technical, safeguard, verification and registration standards for jurisdictional crediting of REDD+. Both ART and TREES were designed to be consistent with UNFCCC policies, including the Paris Agreement, Warsaw Framework and Cancun Safeguards, ensuring no double counting of emission reductions, and alignment with the highest standards of environmental and social integrity.

As a complementary initiative to ART, EDF developed the Emergent Forest Finance Accelerator (or Emergent), a non-profit intermediary that will facilitate high-integrity carbon market transactions to

[3] For further information visit: http://pci.mt.gov.br/
[4] For further information visit: https://www.artredd.org/

deliver private and public funding to large-scale initiatives to protect and restore tropical forests. It will do so by purchasing high-integrity carbon credits (verified by ART) from jurisdictional – national or subnational – REDD+ forest protection programs of at least 2.5 Mha, and then sell these credits to buyers who seek to meet their climate mitigation and emissions reductions goals. This will speed-up, simplify, and standardise the credit-buying process for both forest nation sellers and private sector buyers. By acting as an intermediary, Emergent will help companies and governments navigate the complexities of evolving standards as well as market and policy uncertainties, thus contributing to the emergence of a carbon market for REDD+ programmes.

Launched in 2019 during the UN Climate Week, Emergent is supported by a consortium of partners including Norway's International Climate and Forest Initiative, the Rockefeller Foundation, Oak Hill Capital, Good Energies Foundation, Global Development Incubator, and Latham & Watkins. Emergent will start trading credits in 2022 at an initial cost of at least US$ 10 per ton of CO_2. The expectation is that prices will rise as forest ecosystem services grow and increasingly reflect the value of their numerous social, biodiversity, economic and environmental co-benefits.

5.3 LEAF Coalition

Taking advantage of the platform already set by Emergent, EDF played a key role in the establishment of the Lowering Emissions by Accelerating Forest finance (LEAF) Coalition, the largest global private-sector initiative to protect tropical forests. Launched in April 2021, and administered by Emergent, the aim of the LEAF Coalition is to mobilise at least US$ 1 billion to finance jurisdictional-level REDD+ programmes. Initial participants include Airbnb, Amazon, Bayer, BlackRock, Boston Consulting Group, Burberry, Delta, E.ON, Ernst & Young, GlaxoSmithKline, Inditex, Intertek, McKinsey & Company, Nestle, PricewaterhouseCoopers, Salesforce, SAP, Unilever, and Walmart.org, as well as the governments of the United States, United Kingdom, and Norway. Figure 5.3 shows the working mechanism of the initiative.

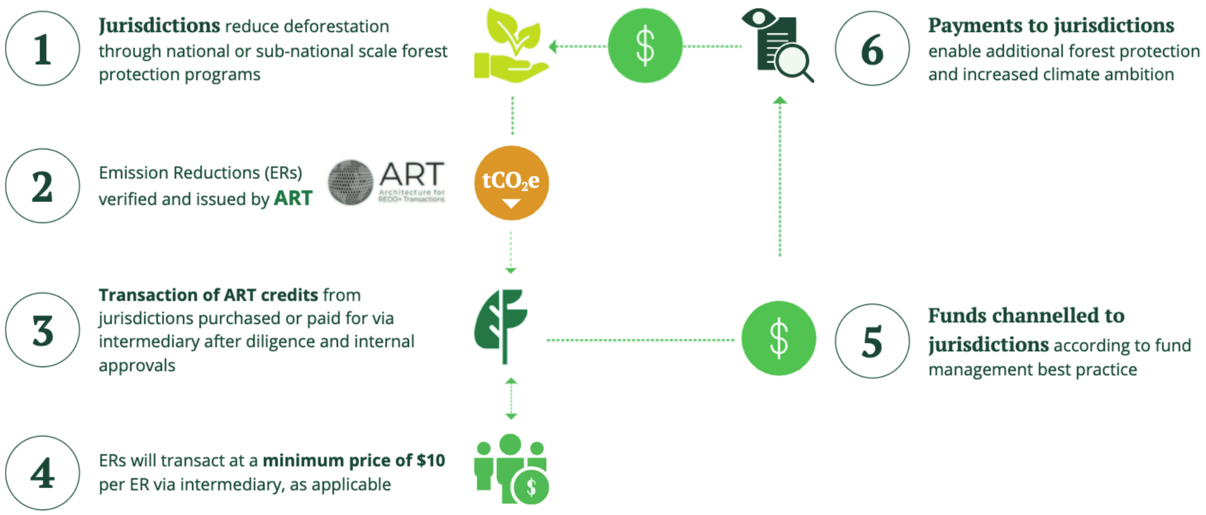


Figure 5.3 Diagram showing the working mechanism of the LEAF Coalition to finance jurisdictional REDD+ programs (Source: leafcoalition.org).

During the World Leaders Summit on November 2021, the LEAF Coalition announced that it had succeeded in mobilising the initial US$ 1 billion and that Costa Rica, Ecuador, Ghana, Nepal and

Vietnam will be the first group of jurisdictions to enter in purchase agreement discussions. Several other jurisdictions have successfully completed an initial technical screening process, including Burkina Faso, Kenya, Nigeria, Papua Guinea, Uganda and Zambia. RESTORE+ relevant jurisdictions include the Brazilian states of Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Roraima and Tocantins, and the Province of Tshuapa (Democratic Republic of Congo). Indonesia, on the other hand, has communicated that it is not yet ready to apply for funding from the LEAF Coalition due to differences between the ART-TREES and Indonesian methodology to measure forests and calculate carbon emissions, and also concerns over potential conflicts that the jurisdictional approach might bring to Indonesian centralised forest governance.

5.4 CONSERV

IPAM (Amazon Environmental Research Institute), in partnership with EDF and Woodwell Climate Research Center, developed the CONSERV[5] program – a novel financial mechanism by which rural landowners in Brazil, with native vegetation above legal requirements, can be paid for preserving their forest surplus. As its name suggests, CONSERV was designed to compensate the conservation, but not reforestation or restoration activities. Eligible farmers, voluntarily apply to receive payments, to protect their excess native vegetation. Farmers are paid every six months after remote sensing and/or field verification that the forest in their properties has not been disturbed. The amount to be paid is established by technical and objective factors, including deforestation risk, opportunity costs of the alternative land use, regional lease prices for agricultural lands, environmental assets in the preserved areas, and a priority index for conservation, which takes into account carbon stocks, biodiversity and impact in reducing forest fragmentation.

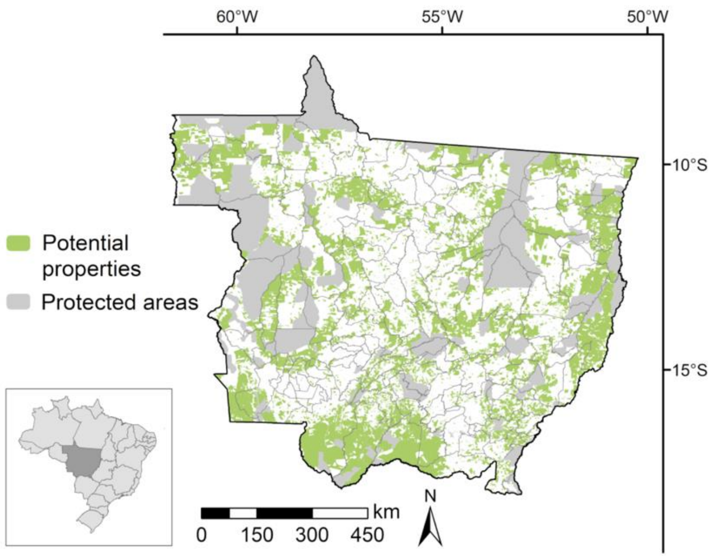


Figure 5.4 Mato Grosso has over 7 million hectares of native vegetation above the legal requirements that could potentially be legally deforested by landowners (Source: https://conserv.org.br/).

Launched in 2020, CONSERV has been first implemented in the state of Mato Grosso due to its unique status as the leading producer of grain and beef in the country, and because it has over 7 Mha of

[5] For further information visit: https://conserv.org.br/

native vegetation beyond the legal requirements which could potentially be legally deforested (Figure 5.4). In its pilot phase, CONSERV aims to enrol at least circa 20,000 ha, with payments to farmers coming from the governments of Norway and the Netherlands. The goal is to scale up CONSERV to become a business model for conservation of private forests in Brazil.

As forests become the dominant nature-based solution to mitigate and adapt to climate change, financial initiatives aimed at mobilising private investment to protect and restore forests such as Emergent and the LEAF Coalition enjoy of ever-increasing international attention (The Economist 2021).

During the COP26, 141 nations (including Brazil and Indonesia) promised to end deforestation and accelerate restoration by 2030, with over US$ 19.2 billion public and private funds committed in support (ukcop26.org). REDD+ programmes and the emergence of carbon markets will be essential to mobilise these funds to support the protection and restoration of tropical forests.

The EDF analyses contribute to overcome some of the challenges of developing novel scalable financing mechanisms for jurisdictional REDD+ and restoration. The LEAF coalition, the CRA Market, the CONSERV program, and the integrated financing strategy for Mato Grosso PCI program, demonstrate how such financing instruments for REDD+ and restoration can catalyse scalable investments.

6. Discussion and Conclusion

Brazil and Indonesia have committed to very ambitious restoration targets to be implemented by the end of the decade. While similar in area to be restored, the strategy and policies that support their implementation differ significantly.

Perhaps the most evident observation that can be drawn from the policy overview in **Chapter 2**, is that while Brazil has one restoration target, namely, to restore 12 Mha by 2030, Indonesia has multiple, including two forest, and three wetland targets. From the consultation of government documents and official publications, there is no apparent relation nor contradiction between the 12 Mha and the 5.5 Mha forest restoration targets. Since the latter was originally meant to be achieved by 2019, it is possible that the government is no longer considering it as currently valid, and that it has been effectively absorbed by the 12 Mha. Something similar occurs with the peatland restoration target. While the NDC indicate the restoration of 2 Mha by 2030, the BRMG and the MoEF (2020) refer to the restoration of 2.6 Mha by 2025. The recently announced target of restoring 600 000 ha of mangroves by 2025 adds to the confusion. This apparent, but unconfirmed overlap can be also extended to forest targets in the current National Mid-Term Development Plan. There seems to be a divide between what the government pledges to internationally with what is announced domestically. Perhaps the NDC targets have yet to be officially ratified at the domestic level or translated into policy by the MoEF and the BRMG. The latest government documentation does not provide clarification on this point.

A second observation is that following the announcement of its restoration target, Brazil announced a specific and dedicated plan for its implementation, the PLANAVEG (see 2.1 Brazil. In the case of Indonesia, however, that specific plan is missing for its forest restoration target(s). Besides from projecting how many hectares will be restored annually, no restoration-dedicated strategy has been advanced by the government with indication of the policies that will support its implementation. The Forestry Law (see 2.2 Indonesia establishes some provisions on land and forest rehabilitation, and ERCs are dedicated instruments to restore degraded land, but there is no evident linkage between these regulations and Indonesia’s restoration targets. The case is somewhat different with wetland restoration. The 2.6 Mha peatland restoration target was announced simultaneously with the creation of the agency responsible for implementing it: the BRMG. The same applies to the restoration of 600 000 ha of mangroves. The BRMG has outlined a clear timeline and strategy for implementation, with indication of the territory where restoration will be prioritised, the policy instruments that will support the process and a dedicated budget for operation.

In addition, given Brazil’s and Indonesia’s strong agricultural profile, the introduction of restoration policies will face important opportunity costs. The three studies conducted in Indonesia and summarised in **Chapter 3**, provide insights on the necessary building blocks for an effective financing mechanism to support conservation and restoration policies. According to the study on the impact of palm oil expansion on Indonesian industrialisation, appropriate financing instruments for restoration have to be able to generate at least a comparable amount of economic benefits to compensate the operational, transactional and opportunity costs of restoration. Moreover, these instruments would also have to allow local distribution of monetary and economic benefits within the region. Further, the study on the price elasticity of deforestation suggest that monetary disincentives might work to reduce illegal deforestation, but also that premium prices linked with sustainability requirements might be more effective. Finally, the study on the SFP shows that mechanisms that address institutional issues without providing adequate financial resources also do not deliver the expected results. In all, these studies confirm an overarching argument presented in this report: the need to couple policy interventions aimed at protecting forests with appropriate market-based instruments that compensate for the opportunity costs faced by landowners.

In **Chapter 4**, the modelling done by LSE shows that for a PES scheme to effectively incentivise a landowner not to convert their forestland to agricultural land, the payment must be sufficient to outweigh the opportunity cost of the most attractive agricultural activity available to that landowner. The challenge, therefore, is to furnish a policy framework conducive to synergies between socioeconomic activity and environmental conservation that turns restoration into a competitive land use option. The Brazilian market for CRAs is one innovative mechanism that would allow landowners to comply with restoration requirements outside of their properties, significantly lowering the costs of restoration. EDF's estimations in Mato Grosso indicate that nearly 89% of the 9.8 Mha native vegetation deficit could be compensated via a functioning CRA market. This means that 8.7 Mha would not have to be actively restored by landowners and could continue to be used for agricultural production. The cost reduction of compliance with restoration requirements is considerable. However, policy interventions would be necessary to avoid market distortions that could drive prices of CRAs to near zero and leave zero hectares to be restored. Restricting CRA supply to only "at-risk of deforestation" land or allowing for interstate trading could help achieving real environmental gains under this market. Here again, our work suggests that policy interventions for restoration will probably deliver better results in terms of environmental conservation and agricultural output when supported with appropriate financial instruments that can mitigate the opportunity costs borne by landowners when, instead of deforesting, conserve or restore the land with native vegetation.

The innovative financing instruments developed by EDF and presented in **Chapter 5** offer a promising alternative to mobilise and catalyse both private- and public-sector investment to accelerate a paradigm shift that would allow to turn the conservation of tropical forests into an alternative as or more profitable than converting it for agricultural use. Beyond carbon sequestration, forests provide several benefits, including conservation of habitats for biodiversity, improved provision of ecosystem services and support for local and indigenous communities. However, with the exception of some PES and REDD+ programmes, appropriate market instruments to monetise forests' full economic and ecological value are lacking. As a result, forests are left to low value uses and vulnerable to deforestation. EDF's jurisdictional approach was designed to bridge some of the transactional costs of most REDD+ and PES programmes, by speeding-up, simplifying, and standardising the credit-buying process for both forest nation sellers and private sector buyers. Emergent and the LEAF Coalition were developed following this approach and were designed with the specific aim of creating international markets for forest protection. The expectation is that demand for forest credits and their price will rise to reflect the increasing value of native forest ecosystems and their co-benefits. However, these instruments might not be readily applicable in every jurisdiction. Again, the problem with forest definitions and the heterogeneity of activities that may be understood as restoration continues to hinder broader implementation of these initiatives. It is unlikely that instruments such as Emergent or the LEAF Coalition will help finance the plantation of 6.4 Mha of palm trees as detailed in the Indonesian restoration strategy. Such plantations simply do not meet the requirements of environmental integrity and permanency required to be eligible for jurisdictional level REDD+ programmes.

In order to attract interest from investors and donors, restoration programmes need to be designed in a way that the core elements of restoration, namely: carbon storage and sequestration, biodiversity conservation and support for local communities, are adequately balanced and promoted. This entails tightening forest and restoration definitions, transparently reporting restoration strategies, harmonising accounting methodologies and metrics, and reconciling competing land uses. The RESTORE+ project works to this purpose. The findings summarised in this report help to better understand the costs of forest restoration and conservation, and the need to combine restoration policies with adequate financial mechanisms that turn forest conservation into an economically attractive alternative while allowing for continued agricultural production.

7. Publications and Dissemination Activites

The following table provides a detail of the publications and dissemination activities that the workstream described in this report has resulted in:

Partner	Type	Title of publication/Name of event	Outlet	Status
MCC	Research paper	Committed to restoring tropical forests: An overview of Brazil's and Indonesia's restoration targets and policies	Environmental Research Letters, special issue with focus on tropical landscape restoration	Published
MCC	Research paper	No aggregate deforestation reductions from rollout of community land titles in Indonesia yet (Kraus et al. 2021)	Proceedings of National Academy of Sciences of the United States of America	Published
MCC	Research paper	Spill-overs to manufacturing plants from multi-million dollar plantations: evidence from the Indonesian palm oil boom (Kraus et al. close to submission)	tba	Close to submission
MCC	Research paper	Price incentives and unmonitored deforestation: evidence from Indonesian palm oil mills (Guye and Kraus, 2021)	Journal of the Association of Environmental and Resource Economists	Under review
MCC	Research paper	What influences the implementation of natural climate solutions? A systematic map and review of the evidence (Schulte et al. 2021)	Environmental Research Letters, special issue with focus on tropical landscape restoration	Published
EDF	Research paper	Designing the market for environmental reserve quotas: property-level analysis of environmental compliance strategies in Mato Grosso, Brazil	Environmental Research Letters, special issue with focus on tropical landscape restoration	In production
EDF & IIASA	Research paper	Forest protection and permanence of reduced emissions	EDF Economics Discussion Paper Series	Published
MCC	Conference presentation	Differential price elasticities of deforestation across the Indonesian oil palm sector	Association of Environmental and Resource Economists 2021 Summer Conference	Presented
MCC	Conference presentation	Targeting market-based incentives to curb deforestation: Evidence from Indonesian palm oil mills	26th European Association of Environmental and Resource Economists	Presented

			Annual Conference. Berlin 2021	
MCC	Conference presentation	Price incentives and unmonitored deforestation: Evidence from Indonesian palm oil mills	2021 Conference in Development Economics	Presented
EDF	Conference presentation	Designing the market for environmental reserve quotas: property-level analysis of environmental compliance strategies in Mato Grosso, Brazil	XXV IUFRO – International Union of Forest Research Organizations World Congress (2019) in Curitiba, Brazil	Presented
EDF	Conference presentation	Designing the market for environmental reserve quotas: property-level analysis of environmental compliance strategies in Mato Grosso, Brazil	Team of specialists from IPAM (Amazon Environmental Research Institute) in Brazil	Presented
EDF	Conference presentation	Designing the market for environmental reserve quotas: property-level analysis of environmental compliance strategies in Mato Grosso, Brazil	Internal workshops and web-series of the RESTORE+ consortium	Presented
LSE	Conference presentation	Preliminary findings of model assessment to estimate optimal land-use change and landowner incentives to either conserve the forest or convert to agriculture under uncertain future returns in Mato Grosso, Brazil	Internal seminars at the London School of Economics and RESTORE+ consortium	Presented
LSE	Stakeholder exchange	Preliminary findings of model assessment to estimate optimal land-use change and landowner incentives to either conserve the forest or convert to agriculture under uncertain future returns in Mato Grosso, Brazil	Discussion of results with Shell and South-Pole Carbon	Presented
EDF	Outlook activity	Present the CRA Market research and its policy recommendations to Mato Grosso state officials and contribute to a sound design of that market to maximize environmental gains	Presentation to Mato Grosso state officials	Planned
MCC & EDF	Outlook activity	A paper on ancillary benefits of forest protection and restoration as alternative points for scaling finance	Discussion series of journal publication	Planned
MCC	Outlook activity	Several researchers have reached out to request our dataset on the social forestry programme, which ay thus be used collaboratively in future studies.	Potential papers	Tentative discussions
MCC	Outlook activity	More macro-level study on the structural change effects of palm oil would usefully complement the local level results. Such a study could also further investigate the effects of migration and a potential deceleration of urbanisation in the population centres of the respective regions.	Potential papers	Tentative internal discussions

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