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Analysis

# The implementation costs of forest conservation policies in Brazil

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ABSTRACT

Tropical forest conservation is considered a low-cost option for climate change mitigation. But mitigation cost assessments have featured opportunity costs, neglecting policy implementation costs. Here we use official data to identify the Brazilian federal government's operational and institutional budgets related to forest conservation policies implemented from 2000 to 2014. We distinguish the allocated and executed budgets of these policies, and provide scenario-based estimates of their cost-effectiveness. On average, Brazil spent US$ 1 billion/year on forest conservation policies at the federal level. Brazil's substantial reduction in annual forest loss after 2004 was accompanied by a higher operational budget execution of disincentive-based policy instruments, and an absolute increase in both allocated and executed institutional budgets. The post-2004 successful mitigation effort represented additional implementation costs to the Brazilian federal government of US$ 308–923/ha of avoided deforestation, or US$ 0.87–2.60/t$CO_2$ of avoided emissions. Factoring in also approximate municipal and state expenditures, these costs increase to US$ 385–1153/ha or US$ 1.09–3.25/t$CO_2$. We conclude that implementations costs are non-trivial in size, including compared to estimates of land users' opportunity costs. This has important implications for REDD+ policy design, in the sense that implementation costs need to be adequately considered.
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## 1. Introduction

The conversion of forests to agriculture, pasture and other alternative land uses in developing countries has been identified as a major source of greenhouse gas emissions that could be avoided at comparatively low costs (Pan et al., 2011; Stern, 2006). This assertion has motivated much research into how an international mechanism, such as REDD+ (reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks), could be designed to improve the cost-effectiveness of global climate change mitigation, while hopefully providing a wide range of environmental and social co-benefits (Phan et al., 2014).

In this body of research, the costs of REDD+ are often divided into opportunity, implementation and transaction costs. Opportunity costs are benefits foregone when forests are not cleared or otherwise degraded for socio-economic activities, e.g. the profits from the best alternative land use, such as logging, crop production and cattle ranching, minus the benefits from non-destructive forest uses (Angelsen et al., 2012; Pagiola and Bosquet, 2009; World Bank, 2011). Implementation costs are incurred by governments or other bodies (e.g. NGOs and the private sector), which undertake policies or other interventions that reduce forest loss, and can be defined as all the necessary operational and institutional costs of executing forest conservation policies on the ground, e.g. enforcement of land-use regulations and institutional capacity building (Angelsen et al., 2012; Pagiola and Bosquet, 2009; World Bank, 2011). Transactions costs occur when stakeholders negotiate agreements about forest conservation, or in monitoring, reporting and verifying the carbon and non-carbon benefits of REDD+ (Pagiola and Bosquet, 2009; World Bank, 2011).

However, most applied studies on the potential costs of forest conservation under REDD+ focus on opportunity costs of land users under various conservation scenarios (Kindermann et al., 2008; Overmars et al., 2014; Strassburg et al., 2009). While most of these studies confirm the existence of low-cost opportunities for mitigating climate change, they tend to ignore the costs of implementing the necessary policies to promote forest conservation on the ground

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(Fosci, 2013). Implementation costs of forest conservation policies thus represent a major knowledge gap, and policy makers considering engagement in REDD+ have lacked important information for decision processes and policy design (Fosci, 2013; Gregersen et al., 2010; Kesicki and Ekins, 2012; Pagiola and Bosquet, 2009; UNEP, 2014). This knowledge gap could be explained by the great difficulty in getting accurate and organized data on the costs of forest conservation policies (Fosci, 2013; Pagiola and Bosquet, 2009).

In this paper, we address the aforementioned knowledge gap in the context of Brazil – the prime forerunner globally for REDD+ type of policy implementation in a forested country. More specifically, we meticulously gather and classify official budget data to create a time series of implementation costs related to forest conservation policies, incurred by the Brazilian federal government from 2000 to 2014. In this period, Brazil implemented major changes to the enforcement strategy of its forest law, and stood out as the country that achieved the largest reduction in tropical tree-cover loss globally (Hansen et al., 2013). While various factors were at play in explaining this drastic reduction, an emerging body of research suggests that the slow-down in forest loss was to a notable extent a result of national-level efforts to boost the effectiveness of forest conservation policies (Arima et al., 2014; Assunção et al., 2015; Hargrave and Kis-Katos, 2013; Nepstad et al., 2014; Pfaff et al., 2015; Soares-Filho et al., 2010). This allows us to gauge policy cost-effectiveness under literature-based assumptions and scenarios about policy impacts. We also provide gross estimates of the implementation costs incurred by subnational governments and discuss their importance.

The paper is structured as follows. Section 2 reviews previous studies about the costs of forest conservation. Section 3 provides a conceptual background on corresponding policy instruments. Section 4 presents the background on forest conservation policies in Brazil. Section 5 describes our data and methods. Sections 6 and 7 present and discuss the findings of this study, respectively. Finally, Section 8 concludes the study, highlighting its implications for forest conservation and REDD+ policy design in Brazil and beyond.

## 2. Published Estimates on the Costs of Forest Conservation

At the global scale, Busch et al. (2009); Eliasch (2008); Kindermann et al. (2008); Overmars et al. (2014) and Strassburg et al. (2009) assessed REDD+ costs, focusing primarily on opportunity costs, and found that the mechanism is generally cost-effective vis-à-vis other climate change mitigation options. Phan et al. (2014) ran a meta-analysis based on 32 published studies and found that REDD+ cost estimates vary considerably, since they depend on various factors, such as the method for estimating carbon emissions, types of cost considered, size and characteristics of the targeted forests, agriculture importance in local economy, alternative land uses, and time horizon. In the same vein, Streck and Parker (2012) argued that REDD+ costs also depended on the actors that are incurring those costs, the speed and scale of emission reductions, and the mix of policy instruments.

At the local scale, Bellassen and Gitz (2008); Borrego and Skutsch (2014); Cacho et al. (2014); Fisher et al. (2011); Irawan et al. (2013) and Mattsson et al. (2012) assessed REDD+ costs in Cameroon, Mexico, Indonesia, Tanzania and Sri Lanka. Again, focusing primarily on opportunity costs, most of those studies found relatively low average costs of REDD+, but also highlighted factors that could potentially increase those. Borrego and Skutsch (2014) observed that the social costs of making cheap conservation under REDD+ should be considered, as some of the most vulnerable groups may lose their livelihoods. Cacho et al. (2014) found that farmers may value their unconstrained land rights higher than the profit-generating capacity, so REDD+ offsets would need to substantially exceed opportunity costs. Irawan et al. (2013) observed that the opportunity costs of selected land uses may be prohibitively high, and that government revenues may also suffer reductions. Finally, Mattsson et al. (2012) found that the major share of potential emission reductions under REDD+ would accrue on land managed by smallholders, and thus social criteria should be balanced against climate change mitigation goals.

In Brazil, the most important studies about REDD+ also focused primarily on opportunity costs and the Amazon region (Table 1). Approaches and results generally suggest relatively low cost of REDD+. When implementation costs are considered in these studies, the estimates tend to be based on scenarios and projections, rather than analyses of actual budget accounts.

## 3. Policy Instruments for Forest Conservation

Forest conservation policies, including under REDD+, can be implemented through a variety of instruments (Angelsen, 2009, 2010). Börner and Vosti (2013) proposed a threefold classification, according to how they affect human behavior: disincentive-based, incentive-based and enabling instruments.

Disincentives, such as regulations, bans, fines, standards, taxes and protected areas, seek to discourage environmentally harmful activities. They are relatively easy to establish and may generate government revenues, e.g. through fine collection. This has made them the most widely applied policy instrument (Börner and Vosti, 2013). Incentives reward good environmental stewardship of forests, for example, through subsidies to the adoption of sustainable forestry technologies and payment for environmental services (PES) (Börner and Vosti, 2013). Finally, enabling instruments do not generate by themselves an unambiguous impact on forests, but seek to establish contextual conditions that facilitate sustainable forest management. Examples are land-use planning, land tenure regularization, investments in technology development and environmental education (Börner and Vosti, 2013).

The effectiveness of these instruments depends on the socio-economic and institutional context, as well as policy design (Lambin et al., 2014). A culture of policy evaluation using rigorous counterfactual-based techniques is beginning to emerge in the forest and environmental sectors (Baylis et al., 2015). There is a consensus, however, that cost-effective and equitable forest conservation policy requires a mix of the aforementioned instruments (Barua et al., 2012; L'Roe and Naughton-Treves, 2014; Pinto et al., 2014; Riera et al., 2007; Seymour and Angelsen, 2009).

## 4. Brazilian Background on Forest Conservation Policy

During our period of analysis, Brazil implemented a series of important initiatives related to forest conservation policies (Fig. 1). Examples are the establishment of the National Forest Act, the Soy and Beef Moratoria, the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the Brazilian Forest Service (SFB), the Program for Protected Areas in the Amazon (ARPA), the Amazon Fund, the list of Amazon priority municipalities for policy interventions, and the Action Plans for Prevention and Control of Deforestation in the Legal Amazon and Cerrado ecosystems (PPCDAm and PPCerrado). The Legal Amazon region makes up 100% of the Amazon, 37% of the Cerrado and 40% of the Pantanal regions. These three ecosystems cover 86% of the remaining natural forest area in Brazil (SFB, 2013) and have received great attention in national environmental policy. Although many of these policy initiatives were led by the Brazilian federal government, other actors, such as municipal and state governments, NGOs, the private sector and international bodies were also involved in their implementation.

Brazil is a federal republic and the enactment of its constitution of 1988 (Brazil, 1988) represented the most important step towards decentralizing forest conservation policies after a two-decade period of authoritarian and centralized government. The constitution established that the three governmental levels in the country – municipal, state and federal levels – are jointly responsible for forest conservation policy formulation and enforcement. Only after a decade, though, specific forest laws were enacted to make all three governmental levels

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