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Analysis

Decentralized Land Use Zoning Reduces Large-scale Deforestation in a Major Agricultural Frontier

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ABSTRACT

Reducing large-scale deforestation is a key objective of global efforts to mitigate climate change. An important debate concerns the levels of governance at which deforestation can be reduced effectively. Political economic theory and evidence suggests that national governments are more likely than subnational governments in agricultural frontiers to adopt restrictive forest conservation policies, due to differences in political constituencies and capacity. Here we examine the validity of this claim using an impact study of provincial-level land use planning in Argentina's main deforestation frontier, the Dry Chaco. In 2007, Argentina's provinces were obliged to define land use zoning for their native forests, but had considerable leeway in its implementation. We use data from 30,126 properties in the provinces of Salta, Santiago del Estero, and Chaco, and a rigorous counterfactual estimation strategy to quantify the extent to which adopted zoning plans affected deforestation. We find evidence that provincial-level land use zoning reduced deforestation in all three provinces, but not in all zones and periods. Differences in impact are associated with differences in the location of zones and the timing of planning. Our findings suggest that subnational governments can make important contributions to reducing large-scale deforestation in agricultural frontiers.

1. Introduction

Reducing emissions from large-scale deforestation constitutes a priority for global efforts to mitigate climate change. Tropical forest loss accounts for about 10% of anthropogenic greenhouse gas emissions (Baccini et al., 2012; Harris et al., 2012). Large-scale forest conversion in the tropics and subtropics in the 21st century was largely the result of agricultural expansion for the production of globally traded commodities such as soy, beef, palm oil, and timber (Gasparri et al., 2015; Newton et al., 2013; Rudel et al., 2009). To conserve global forests and associated ecosystem services, multilateral, bilateral, and private donors have begun to incentivize reductions in deforestation and forest degradation (REDD+) with billions of dollars in funding (Agrawal et al., 2013; Silva-Chávez et al., 2015). However, considerable academic and political debate surrounds the choice of strategies and policies that can effectively reduce deforestation at large spatial scales (Angelsen, 2010; Larson et al., 2013; Patel et al., 2013).

An important question for climate change mitigation scholars and policy makers concerns the level of governance at which large-scale deforestation can be addressed effectively (Angelsen et al., 2008). National governments have long held a privileged position among the actors involved in forest-based climate change mitigation, both as decision makers in international negotiations and as recipients of early funding flows. However, scholars have also proposed that an exclusive focus on national governments will not necessarily lead to effective and equitable avoided deforestation policy (Luttrell et al., 2013; Phelps et al., 2010). Strategies to engage other levels of government in the design of such policies have therefore become a major subject of inquiry, with authors examining the feasibility of "jurisdictional", "multiscale" or "nested" approaches (e.g. Agrawal et al., 2011; Cattaneo, 2011; Fishbein and Lee, 2015; Pedroni et al., 2009).

In practice, subnational governments are already actively involved in avoided deforestation efforts across the globe (Ravikumar et al.,

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2015; Sunderlin et al., 2014), and continue to position themselves as partners for forest conservation in international arenas. Thirty-five subnational governments from nine countries (including Brazil, Indonesia, and the USA) cooperate in the Governors' Climate and Forests Task Force (GCF) to advance jurisdictional programs for reducing emissions from deforestation and land use (GFC, 2016). In the New York Declaration on Forests, twenty subnational governments from tropical countries publicly committed to end deforestation by 2030 (UN Climate Summit, 2014). And in Brazil, the two Amazon states of Acre and Mato Grosso moved forward and signed jurisdictional REDD + frameworks into law in 2010 and 2013 (Duchelle et al., 2014).

In spite of this rising interest in the role of subnational policies to reduce deforestation, the extent to which subnational governments are willing and able to inhibit agricultural expansion in active deforestation frontiers remains largely unexamined. Initial reflections on the motivation and capacity (Lambin, 2005) of different levels of governments lead us to assume that subnational governments are *less* likely than national governments to engage in large-scale forest protection. This is because the constituencies of national governments can be expected to be more urban, with higher incomes and educational levels, and lower dependence on agricultural expansion, than those of subnational governments in active deforestation frontiers. Such attributes are generally associated with a higher willingness to pay for forest protection (Vincent et al., 2014), and might translate into stronger political support and motivation for national governments to implement new effective forest conservation measures. National governments might also have a more diverse range of legal instruments, higher budgets, and better enforcement resources at their disposal (Lambin et al., 2014), which might convey them a higher overall capacity to implement strict forest conservation instruments.

Empirical evidence exists for multiple cases in which national governments were willing and able to implement effective forest protection policies at large spatial scales. For instance, recent substantial downturns in large-scale deforestation in Brazil, China, and Vietnam have been, in large part, ascribed to national forest conservation policies (Liu et al., 2008; Meyfroidt et al., 2009; Nepstad et al., 2014). Sweeping deforestation bans, such as those adopted in China and the Atlantic Forests of Brazil and Paraguay, were also driven by national governments. Examples of major conservation policies outside active deforestation frontiers, such as the U.S. Northwest Forest Plan (Thomas et al., 2006), protected area declarations in 1990 East Germany (Garrelts et al., 2005), and the European Union's Natura 2000 directive (Kati et al., 2015), provide further evidence for national (and supra-national) leadership in large-scale nature conservation – and for opposition of subnational actors against such policies.

Meanwhile, evidence on the impact of subnational policy on forest conservation in active deforestation frontiers remains scarce. A recent review finds that a majority of existing rigorous studies of the impacts of decentralized forest governance examine forest degradation, not deforestation (Miteva et al., 2012). Of the three rigorous studies studying deforestation outcomes, none finds decentralization to reduce forest loss (ibid.). In Indonesia, decentralization increased deforestation, especially before elections (Burgess et al., 2011); in the Brazilian Amazon, federally protected areas reduced deforestation, while state parks did not (Pfaff et al., 2012); and in Bolivia, better municipality-level forest governance was associated with reductions in unauthorized deforestation, but not total deforestation (Andersson and Gibson, 2007). These findings lend support to the hypothesis that subnational governments are more likely than national governments to prioritize local economic interests over the conservation of ecosystems. This phenomenon has also been observed and described as "zoning following the market" in the context of residential use (Pogodzinski and Sass, 1994; Wallace, 1988; but see Kline, 2005).

Here we provide empirical evidence that subnational approaches to forest conservation can significantly reduce large-scale deforestation in active subtropical agricultural frontiers. We base our finding on a rigorous impact analysis of provincial-level land use planning in the Argentinian Dry Chaco. In 2007, Argentina's federal government obliged provinces to implement land use zoning for their remaining native forests. Using data from 30,087 properties located in the three provinces with the highest historical rates of forest loss (Lende, 2015), we show that the provinces implemented land use plans in ways that significantly reduced property-level deforestation in the short term. As provinces had considerable leeway in the implementation of the law, we interpret these impacts as partial evidence for the motivation and ability of provincial governments to reduce deforestation.

2. Argentina's Dry Chaco and the 2007 Forest Law

Argentina's Dry Chaco is a vast semiarid plain located in the country's northwestern region. Its subtropical forest ecosystems are characterized by rich levels of biodiversity (Bucher and Huszar, 1999; Giménez et al., 2011) and globally significant carbon stocks (Baumann et al., 2016; Gasparri et al., 2008). Throughout the late 20th and early 21st centuries, the Dry Chaco witnessed some of the world's highest deforestation rates, mostly due to the expansion of large-scale soy and beef production by well-capitalized agribusinesses (Aide et al., 2013; Gasparri and Grau, 2009; Vallejos et al., 2015).

In Argentina, provinces are the constitutional original owners of natural resources, and entitled to manage land and forests within their territories (Article 124 of Argentina's 1994 National Constitution). Each province designs its own laws, directives, processes, and administrative structures to define, allocate, and enforce rights to land and its use. However, in order to guarantee all Argentinians the right to a healthy environment across provincial borders, the constitution also allows the federal government to define minimum standards for environmental protection (*presupuestos mínimos*, Article 41). If such standards are adopted, provinces are obliged to translate them into provincial law.

In the wake of rapid deforestation, catastrophic floods, and resulting societal pressure (Romero, 2012), the Argentinian federal government made use of this constitutional provision to define minimum standards for the protection of native forests. The Law #26.331 of 2007, hereinafter referred to as the Forest Law, obliged provinces to conduct a land use planning process with the goal to categorize all remaining native forests into three zones with different levels of protection (García Collazo et al., 2013; Gautreau et al., 2014):

- Category 1 (red): forests of high conservation value, which require permanent protection, but can be used by indigenous communities or for research.
- Category 2 (yellow): forests of medium conservation value, which can be used for sustainable resource use, tourism, gathering, or research.
- Category 3 (green): forests of low conservation value, which can be converted partially or completely.

The Forest Law defined several procedural criteria for the land use planning process, which the federal government proved willing to enforce. For instance, it required the planning process to be "participatory", and prohibited the issuance of deforestation permits until the process was concluded. Argentina's government rejected the land use plan of at least one province (Córdoba), because it allowed extractive activities in red zones and did not follow a participatory process (Silvetti et al., 2011). In another province (Salta), the Supreme Court of Justice revoked all deforestation permits and imposed a moratoria on deforestation in 2009, because the provincial government had not concluded its land use planning process (Di Paola et al., 2011).

However, within these procedural boundaries, Argentina's provinces appeared to enjoy considerable leeway in the allocation and implementation of the three zones across their jurisdiction. First, the Forest Law does not define a minimum percentage of native forests in each province that needs to be protected. Second, while the Forest Law lists ten socio-ecological criteria to characterize the conservation