Mapping properties to monitor forests: Landholder response to a large environmental registration program in the Brazilian Amazon

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ABSTRACT

Across the tropics, development banks and conservation donors are investing millions in property mapping and registration projects to improve accountability for deforestation. An evaluation of the effectiveness and accuracy of existing environmental registries is crucial to assure the success of future efforts. This study presents an evaluation of deforestation and registration behavior in response to one of the largest of these property registration programs to date — the Rural Environmental Registry (CAR) in the Amazonian state of Pará. From late 2007 to 2013, approximately 100,000 properties covering 30 million hectares of self-declared claims were entered in this digital registry. We used fixed effects regression models and property level data to assess how registration influenced deforestation on different sizes of properties. Registration had little impact on deforestation behavior, with the exception of a significant reduction on "smallholder" properties in the size range of 100–300 ha. We link this reduction to interacting incentives from forest protection and land regularization policies and suggest that desire to strengthen land claims motivates these landholders' response to the environmental registry. We also present evidence that some landholders may be registering incomplete or inaccurate parcels into the self-declared system to strategically benefit from policy incentives. Our results for smallholder properties indicate that environmental registries may have potential to facilitate reductions in deforestation if combined with a favorable combination of incentives. However, in places where land tenure is still being negotiated, the utility of environmental registries for forest policy enforcement and research may be limited without ongoing investment to resolve uncertainty around land claims.

1. Introduction

1.1. The importance and challenge of clarifying land ownership

Many of the world's most biodiverse and carbon-rich forests are located in places where land tenure is uncertain. It is difficult to design programs that reduce deforestation without knowing *who* is making land use decisions, and landscape level conservation initiatives require information about private lands beyond protected areas. Reliable property maps are now a requirement for many REDD projects because property boundary data help signal whom to reward for ecosystem services (Larson et al., 2013; Naughton-Treves and Wendland, 2014; Duchelle et al., 2014). Property maps also aid environmental monitoring by indicating whom to penal-

ize for land use violations. Beyond facilitating the allocation of carrots and sticks, property maps can improve understanding of the drivers of land use change by illuminating different patterns among different types of actors (Geoghegan et al., 1998; Liverman and Cuesta, 2008). For these reasons and others, conservation and development organizations, from The Nature Conservancy to the Inter-American Development Bank, are investing millions in large scale land registration programs in Brazil, Colombia, Haiti, Peru, Guatemala, Rwanda, Ecuador and many other tropical countries.

Despite the potential benefits, clarifying land ownership is not without risks. For forests, these include hastened deforestation to establish claims (e.g. De Oliveira, 2008), conflict induced deforestation accompanying land reform (e.g. Alston et al., 2000), and heavier investments in forest-displacing agriculture under greater tenure security (e.g. Liscow, 2013). Risks for people include loss of informal collective access, exacerbated conflict, and capture of land by elites (Araujo et al., 2009; Rajão, 2013; Paulino, 2014). Many of these risks are associated with the act of establishing or *changing* rights to land (e.g. land reform and land titling programs). Because programs

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that allocate land rights can be expensive and politically fraught (Deininger and Feder, 2009), and because outcomes for forests can be mixed (Angelsen and Kaimowitz, 1999; Robinson et al., 2014), groups concerned with forest management are experimenting with land registration programs that simply map existing claims. Rather than alter the security of land rights, the goal of this type of environmental land registry is to reveal and systematize information about land users for the purposes of monitoring and planning (Bennett et al., 2013).

Programs to *reform land rights* have received much scholarly attention, but few studies have evaluated the outcomes of programs to *map land claims* in environmental registries, partly because these systems are relatively new and evolving (Gignoux et al., 2013; but see Rajão et al., 2012; Azevedo et al., 2014). Environmental registries are intended to reduce deforestation by facilitating monitoring and enforcement of environmental policies. However, if most land is not registered, if there are conflicting incentives, or when property data are not accessible or reliable, then registries will not necessarily reduce deforestation. There is also a risk that land users may attempt to subvert the system by undertaking clearing prior to registering, by registering only parts of their land, or by interpreting their registration as a permit to clear (Chomitz, 2007; Rajão et al., 2012; Azevedo and Saito, 2013). This paper provides empirical evidence to aid the design of ongoing land registration initiatives and to elucidate discussions about the role of different actors and incentives that affect Amazon deforestation. We address the following questions about environmental registries: first, under what circumstances does registration cause people to reduce deforestation, or perversely, to increase it? next, what are the tradeoffs between information quantity and information quality when land registrations are declaratory?, and finally, what are the implications of mapping properties without resolving land rights if landownership is still being negotiated, as is often the case at development frontiers? To engage these questions, this study evaluates one of the largest environmental registration programs in the tropics.

1.2. Background: land registration in Pará's Rural Environmental Registry

Environmental registration initiatives in Brazil are globally important because they cover millions of hectares of forested land and are serving as examples for programs in other countries. Brazil's Forest Code requires land users to maintain forest on a certain proportion of their property—up to 80% for most of the Amazon biome (Soares-Filho et al., 2014). To facilitate monitoring and enforcement of this policy, the Brazilian government is developing a System of Rural Environmental Registries (Portuguese acronym: SICAR) with the aim of mapping and digitizing all rural properties in the country. The new national system draws from several antecedent state systems, each with somewhat different procedures and objectives, beginning with the System for Environmental Licensing (Portuguese acronym: SLAPR) in the State of Mato Grosso in the early 1990s (Azevedo and Saito, 2013). Expectations for these programs have been high among the international environmental community and within Brazil (Fearnside, 2003; Chomitz, 2007). For example, a recent study quoted a senior Brazilian government official: "[with GIS], deforestation in these areas is going to have a name and a surname. This fact certainly leads to a sensible increase in the governance capability of the environmental agencies in the Amazon states" (Rajão et al., 2012). We evaluate deforestation and registration behavior in response to the largest of the state programs, Pará's Rural Environmental Registry (Portuguese acronym: CAR), which began in 2008 and by 2013 comprised over 100,000 property boundary registrations covering over 30 million hectares of Amazon Forest (Fig. 1).

There are several characteristics of the environmental registry in Pará that affect its impacts and how it might apply to other regions. Land distribution in Pará is highly skewed; small properties (here a "small" property can exceed 100 ha) abut ranches of several thousand hectares or more due to waves of agrarian reform settlements and colonization projects targeting different actors (Pacheco, 2009). Pará is famous for land conflicts and properties continue to be claimed, expropriated, and fought over—sometimes violently (Schmink, 1982; Fearnside, 2001; Wright and Wolford, 2003; Simmons, 2005). Forged titles are common, official titles are rare, and the ability to make and defend claims to land is at the forefront of people's minds, especially in frontier regions (Oliveira, 2013; Campbell, 2014; Reydon et al., 2015). Faced with the challenge of informal and contested land rights in much of the state (one study estimated as much as 53% as of 2008) (Barreto et al., 2008), the designers of Pará's CAR program adopted a two-phased system. In the first phase, the goal was coverage: as many claims as possible would be mapped by land users, who essentially drew the boundaries of properties on high resolution imagery, aided by GIS technicians deployed across the state (SIMLAM, 2008; Benatti and Fischer, 2011). This provisional stage epitomizes the goal of trying to simply map claims without altering or adjudicating land rights. A "definitive" CAR license could later be obtained after a second phase in which property boundaries and ownership were externally verified and owners submitted a plan for complying with environmental laws (SIMLAM, 2008). Five years after the start of the program, as of November 2013, only 2% of the CAR registrations in Pará had advanced to "definitive" licenses. The other 98% of registrations were "provisional" CAR licenses, automatically generated in response to self-declared boundaries entered in an online system.

1.3. Theory: incentives, perceptions, and property size

A policy's impacts come partly from its design and objectives, but also from the way people respond according to their own aims and agendas. We examine property size patterns in Pará's environmental registry to provide clues about landholder motivations when they registered their holdings.

Why would landholders choose to make their properties more visible to environmental monitoring? Both the government and private sector have offered an array of incentives to encourage registration, including access to certain kinds of credit and markets[1] (Azevedo et al., 2014; Gibbs et al., 2015). Another strong incentive for mapping a property into a government system in this region is to bolster the strength and legitimacy of land claims, even though a provisional CAR license expressly *did not* signify any change in the legal status of land claims in Pará (Pará State Decree N° 1,148/2008). Nonetheless, field-based studies have described a common sentiment that land policy in this region is in an uncertain stage of rapid formation and as such, claimants have been hustling to gain a favorable position under policies deemed likely in the future; mapped boundaries in a government registry may gain legal status later (Campbell, 2014). Moreover, for properties below a certain size, enrolling in the environmental registry was a required step in a concurrent but less widespread program for obtaining formal land titles through Brazil's land regularization program, *Terra Legal* (Duchelle et al., 2014). *Terra Legal* aims to do what CAR does not – it is program designed to help smallholders acquire land titles. Despite policy-makers' intentions to keep the processes of mapping and claiming separate, landholders may reasonably perceive the processes to be overlapping.

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[1] Registration in the CAR was technically mandatory in Pará beginning in 2008, but sanctions for non-compliance were seldom, if ever, applied (Azevedo et al., 2014).