Land Use Policy 70 (2018) 451–462

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Design of tropical forest conservation contracts considering risk of deforestation

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ARTICLE INFO

Keywords:
Forest conservation payments
Socio bosque program
Discrete choice experiment
Deforestation
Forest degradation
Risk

ABSTRACT

Payments for Forest Conservation (PFC) programs financially compensate forest owners to maintain and increase the provision of ecosystem services. Nonetheless, their effectiveness and additionality in preventing deforestation and degradation remain contested. The design of PFC contracts can influence landowner participation and in-turn a program's prospects for additionality. We examined preferences for select PFC contractual attributes among over 200 private forest owners in Ecuador's Amazon basin using a discrete choice experiment. Forest owners at high-risk of deforestation, as compared to others of lower risk, were almost eight-times more likely to select contracts that allowed timber harvest under a management plan, about three-times more likely to select contracts managed by local municipalities or international NGOs, and showed stronger preferences for long-term contracts. To increase enrollment of forest lands at higher risk of deforestation and degradation PFC contracts might need to reconsider the benefits of increasing financial incentives, pursue administration through local municipalities or international NGOs, allow sustainable timber harvesting, and seek permanent agreements.

1. Introduction

Tropical deforestation and forest degradation affect the flow of forest ecosystem services with their continued loss becoming a threat to human wellbeing (MEA, 2005). An estimated 70 million hectares of primary forests were converted to alternative land uses between 1995 and 2015 (FAO, 2015; Gibson et al., 2011) and, out of the remaining intact forestland, 100 million hectares are degraded annually (Basurco et al., 2006). While there are many causes for the under-valuing of forests and their ecosystem services, markets appear to play an important role behind deforestation and degradation trends. Most forest ecosystem services can be classified as public goods, i.e. *de facto* non-excludable services seldom included in market transactions, effectively resulting in societal benefits that are external to landowners (Duncker et al., 2012; Pagiola and Platais, 2007). Alternative land uses (e.g. agriculture, urbanization) are often incentivized financially through public programs while the provision of ecosystem services from forests are not. This results in a sub-optimal allocation of forest land and the undersupply of ecosystem services vital to human wellbeing (Pearce, 2001; Engel et al., 2008).

Public policy makers have looked to market-based interventions to motivate forest owners to willingly conserve their forests (Jack et al., 2008). Payments for Forest Conservation (PFC) programs compensate forest owners for the provisioning of their forests' ecosystem services not traded in traditional markets (Pagiola and Platais, 2007). PFC programs aim to ameliorate market failures and yield a more optimal supply of forests ecosystem services by attributing a market value to their corresponding benefits (Panaiotov, 1994; Van den Bergh, 2002; Engel et al., 2008; Jack et al., 2008; Wunder, 2005, 2015). PFC programs are one branch of a larger category of policies commonly referred to as Payment for Ecosystem Services (PES). While there are many definitions of PES, it is most often referred to as a voluntary conditional agreement between buyers and sellers over well-defined ecosystem services (Wunder, 2005, 2015). One of the best-known PFC efforts is the United Nations' initiative on Reducing Emissions from Deforestation and Forest Degradation, plus, conservation, sustainable management of forests and enhancement of forest carbon stocks (UN-REDD+) program. UN-REDD+ is the world's largest climate change mitigation framework with over 300 projects in over 60 different countries (Sills et al., 2014; UN-REDD, 2015). REDD+ financing has led to a proliferation of national-level PFC programs around the globe implemented through standardized contracts between national governments and private- or community- owned forests (Corbera et al., 2010).

Strategies to strengthen the environmental effectiveness of PFC contracts and enhance their economic efficiency can improve the additionality of REDD+ programs that, to-date, seems to be elusive. The ability of a PFC program to yield positive net conservation outcomes, in addition to what would have been provided without the program, is

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https://doi.org/10.1016/j.landusepol.2017.11.008
Received 7 April 2017; Received in revised form 1 November 2017; Accepted 3 November 2017

referred to as its degree of additionality (Ferraro and Pattanayak, 2006). A growing body of evidence suggests that PFC programs often provide low levels of conservation additionality (Alix-Garcia et al., 2012; Honey-Rosés et al., 2011; Mohebalian and Aguilar, 2015; Pfaff et al., 2008). Weak evidence for PFC program additionality could be linked to a lack of spatial and social targeting of at-risk forest areas (Robalino et al., 2008). To generate greater conservation outcomes, social enrollment bias must be shifted towards landowners who are most likely to cause deforestation (Ferraro, 2008; Wunder, 2007). PFC programs that identify priority areas using geo-referenced and remotely-sensed data have been implemented to maximize conservation outcomes (Nelson et al., 2008; Wendland et al., 2010). PFC spatial targeting has the advantage of the ever-growing availability, low-cost, and greater accuracy of spatially-explicit small-area data. While there have been advances in the spatial targeting of PFC programs, gaps remain in our understanding of the link between additionality of conservation outcomes and forest owners.

Better knowledge of the relationship between PFC program design and forest owner participation is necessary to achieve greater social equity, economic efficiency and environmental effectiveness (Mayrand and Paquin, 2004). This relationship is formalized through the establishments of legally-binding PFC contracts. The identification of contract design characteristics with the potential to yield greater conservation additionality is a priority to the effective design of PFC programs (Schomers and Matzdorf, 2013). Moreover, it is imperative to enhance understanding of how heterogeneous segments of forest owners perceive and value PFC contractual attributes that in-turn affect their willingness to enroll in legally-binding conservation programs (Kurtz and Lewis, 1981; Song et al., 2014a; Song et al., 2014b). To that end, it is crucial to quantify how contractual preferences influence participation particularly among forest owners more likely to engage in deforestation and degradation practices (Mohebalian and Aguilar, 2015; Persson and Alpizar, 2013).

2. Aims and objectives

We aimed to examine how salient contractual attributes influence the likelihood of PFC program enrollment by quantifying their marginal effects on stated preferences, and to assess average differences in stated enrollment among landowner groups classified by their likelihood of engaging in deforestation and degradation practices. Empirically, in the context of Ecuador's Socio Bosque Program (Span.: Programa Socio Bosque – PSB), we completed a discrete-choice experiment (DCE) among forest owners in the country's Amazon basin to: (1) identify salient contractual attributes of the PSB that likely drive enrollment; (2) quantify the effects of a hypothetical change of PSB contractual attributes regarding contracting agency, length of agreement, payment level and allowance of timber harvest, and (3) estimate how changes from the PSB *status quo* attributes could yield different enrollment outcomes while considering the likelihood of forest owners engaging in land use change or deforestation. We chose Ecuador's PSB for our empirical research because of the relevance of its design to many other tropical PFC programs (Mosandl et al., 2008).

3. Literature review

3.1. Ecuador's forests and the PSB

Ecuador, while one of the most ecologically diverse countries in the world, has experienced some of the highest rates of deforestation in South America (Mittermeier et al., 2004; Mosandl et al., 2008). Ecuador's government has registered over two-thirds of its forests as protected areas and placed strict regulations preventing the harvest of timber from native, public, and privately-owned forests to deter further losses (Blaser et al., 2011). Still, many forest owners in Ecuador's Amazon region are believed to sell timber in small volumes in informal markets (Finer et al., 2009; Mejía and Pacheco, 2014; Mena et al., 2006; Suárez et al., 2009). Furthermore, there is preliminary evidence of degradation of tree species of high timber value when lands are not under any type of conservation program or categorization (Mohebalian and Aguilar, 2018).

Markets and institutions of the informal timber industry play an important role in forest owner land use decisions. In Ecuador's Amazon basin, local and national woodworking and furniture industries comprise the dominant markets for timber (MAE, 2011). Thus, the demand for timber starts with buyers in nearby towns and cities where prices are usually set. Very often, the informal sale of timber is facilitated by local intermediaries who act as middlemen between forest owners and final buyers. An intermediary will commonly approach small forest holders via informal social networks and conduct the harvesting and transportation of timber or serve as a broker between the forest owner and final buyer. Small-scale harvesting of timber on private forest land is also performed by family and local community members. The extent to which a forest owner is involved in the harvest and transportation of timber can influence revenues (Mejia et al., 2015). Within this context, Vasco et al. (2017) found that forest owners more likely to have harvested timber illegally had larger forest properties and benefited from economies of scale. These forest owners also lived further from cities, and benefited from more relaxed law enforcement in remote areas of the Amazon. More detailed description of the markets and institutions surrounding the Ecuadorian Amazon region and timber extraction is offered by Mejia et al. (2015) and Vasco et al. (2017).

Sustainable forest management is a recognized strategy of diversifying rural household incomes and as a means of alleviating poverty (Dorward et al., 2001; Angelsen and Wunder, 2003). Compliance with forest management plans and the use of reduced impact logging techniques can result in greater long-term and continued timber revenues (Walters et al., 2005; Karsenty and Gourlet-Fleury, 2006). While the cost of legally harvesting timber with a management plan may reduce returns per unit harvested, its application can increase overall profits from harvesting due to economies of scale and selection of trees of greater value (Mejia et al., 2015; Kautz, 2003). When forest owners consider possible increases in timber market value, growth rates and their long-term forest property rights, sustainable forest management is often the preferable choice to traditional logging methods (Pearce et al., 1999).

Timber extraction plays an important role in the livelihood of forest owners in the Ecuadorian Amazon. While the majority of forest owners in this region have harvested and sold timber, this source of revenue comprises less than a quarter of households' average annual income (Vasco et al., 2017; Mejia et al., 2015). Although, not the primary income source for most rural poor households, forest related income serves as a fallback in times of economic hardship and provides a source of start-up capital for investment (Pattanayak and Sills, 2001; McSweeney, 2002). The additional income derived from the sale of timber can make an important long-term difference in a household's financial well-being.

The adoption of sustainable management plans can also play an important role in resource conservation. Forest degradation is largely driven by anthropogenic forces such as markets that place high-value on particular timber species but can also be facilitated by a common lack of awareness among forest owners of the detrimental effects of non-sustainable timber removals (Mohebalian and Aguilar, 2018). In this regard, the adoption of management plans serves an important social function by enhancing landowners' knowledge and can help assist in their decision-making process regarding timber removals (Butler et al., 2007). Forest management plans mimic natural disturbance cycles and can ameliorate the risk of degradation by using low-impact logging methods (Dykstra and Heinrich, 1996; Sist, 2000). Forest owners who adopt sustainable forest management practices, compared to non-adopters, have been found to improve residual forest biological composition and increase carbon sequestration in their properties