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Heterogeneous Impact of a Collective Payment for Environmental Services Scheme on Reducing Deforestation in Cambodia

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Abstract. — Payments for Environmental Services (PES) are increasingly used in tropical countries as incentives to improve forest conservation outcomes, notably in forests managed or owned by rural communities. However, little is known about the performance and the suitable conditions under which collective PES can be effective. We assess the impact of a collective PES on reducing deforestation in the Cardamom Mountains, Cambodia. We use a quasi-experimental approach combining covariate matching with difference-in-difference estimation as a procedure to assess program effectiveness on reducing deforestation. We find that the PES program contributed additionally saving on average about 0.17 percentage point of the enrolled PES area per year during 2005–12. We also highlight that characteristics such as slope, proximity to roads, and number of households are associated with heterogeneous PES impact. We finally call for improving both data availability and impact assessment methods in order to test better theories of change that take into account not only the ability of payments to reduce opportunity costs of conservation but also to consider how PES are turned into improved community collective action likely to improve the local enforcement of conservation.

Key words — Cambodia, impact evaluation, matching, deforestation, Payment for Environmental Services, impact heterogeneity

1. INTRODUCTION

Halting the current loss and degradation of tropical forests is expected to tackle two of the world's greatest and interlinked global environmental challenges, biodiversity loss and climate change (Gibson *et al.*, 2011; Smith *et al.*, 2014). Stopping deforestation can potentially be achieved by recrafting institutions governing the management of forest resources in order to induce behavioral change favorable to forest conservation (Busch & Ferretti-Gallon, 2017; Daily *et al.*, 2009). In this context, and given the mixed results of classic conservation instruments (e.g., command and control, protected areas or integrated conservation and development projects) and the relative scarcity in public funding, Payments for Environmental Services (PES) have emerged as promising mechanisms to provide local incentives to improve forest conservation outcomes in a cost-effective way (Ferraro & Kiss, 2002; Jack, Kousky, & Sims, 2008; Wunder, 2005). PES are classically based on the idea that the transfer of conditional payments from beneficiaries of environmental services (or other stakeholders acting as their representatives such as Governments or Non-Governmental Organizations) to providers (e.g., forest-owners) will increase the supply of these services, notably when they have public good characteristics (Engel, Pagiola, & Wunder, 2008; Ferraro, 2011; Jack *et al.*, 2008).

PES programs are now commonly implemented as conservation instruments around the world, including in emerging and developing countries (Alston, Andersson, & Smith, 2013; Calvet-Mir, Corbera, Martin, Fisher, & Gross-Camp, 2015; Landell-Mills & Porras, 2002). Many PES programs take the form of community-based or collective payments, particularly in developing and emerging countries such as in Africa (Brimont & Karsenty, 2015; Namirembe, Leimona, van Noordwijk, Bernard, & Bacwayo, 2014; Nelson *et al.*, 2010), in southeast Asia and China (Clements *et al.*, 2010; McElwee, 2012; Yang *et al.*, 2013) or in Latin America (Hayes *et al.*, 2014; Kosoy, Corbera, & Brown, 2008).

Evidence of the effectiveness of collective PES to improve forest conservation outcomes are emerging. Impact assessments of collective contracts have been carried out in Mexico (Alix-Garcia, Shapiro, & Sims, 2012; Alix-Garcia, Sims, & Yañez-Pagans, 2015; Costedoat *et al.*, 2015; Honey-Rosés, Baylis, & Ramírez, 2011; Le Velly, Sauquet, & Cortina-Villar, 2015; Sims & Alix-Garcia, 2016), China (Yang *et al.*, 2013), Indonesia (Shah & Baylis, 2015), and Cambodia (Clements & Milner-Gulland, 2015). They suggest a positive, but generally small, impact on forest conservation, which is consistent with empirical evidence available in other tenure contexts (Alston *et al.*, 2013; Börner *et al.*, 2016; Miteva, Pattanayak, & Ferraro, 2012; Pattanayak, Wunder, & Ferraro, 2010). Overall, the effectiveness of PES instruments is also likely to be influenced by contextual characteristics such as environmental, socio-economic, and political contexts (Muradian, Corbera, Pascual, Kosoy, & May, 2010) and PES programs are usually implemented in parallel with other policies and institutions shaping the management of natural resources (Alston *et al.*, 2013; Jack *et al.*, 2008).

Measuring the environmental effectiveness of collective PES contracts is not straightforward (Alix-Garcia, Shapiro, & Sims, 2012; Le Velly & Dutilly, 2016). Rigorous research design should disentangle the environmental impact of PES from other factors likely to contribute to forest conservation or deforestation (Baylis *et al.*, 2015; Ferraro, 2009). More

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specifically, scholars have increasingly relied on econometrical methods based on credible counterfactuals (Greenstone & Gayer, 2009; Pattanayak *et al.*, 2010). In particular, quasi-experimental techniques using matched control groups as counterfactual are helpful to define a credible baseline, i.e., comparing conservation outcomes with what would have hypothetically happened in the absence of the program (Ferraro, 2009; Pattanayak *et al.*, 2010). The increasing availability of satellite images has contributed to the emergence of robust impact evaluation not only by providing precise land-use change maps (even retrospectively) but also by allowing to take into account geophysical characteristics affecting the profitability of land-use change such as distance, slope, or soil fertility (Alix-Garcia *et al.*, 2015a; Blackman, 2013; Miteva *et al.*, 2012).

Nevertheless, significant challenges persist to ensure reliability in the evaluation of collective PES contracts. Finding a credible control group is complicated because of the numerous observable and non-observable characteristics influencing conservation decisions, while data on non-treated units are not always available. Besides, the collective management of natural resources is often complex and shaped by multi-scale institutional arrangements (Farley & Costanza, 2010; Kerr, Vardhan, & Jindal, 2014; Muradian *et al.*, 2010), which present difficulties to define a unit of analysis able to accurately measure the effectiveness of PES in reducing deforestation (Alix-Garcia, Sims, *et al.*, 2015; Baylis *et al.*, 2015; Le Velly & Dutilly, 2016). Furthermore, evaluations estimating the average impact of a program generally provide limited information about how to better target interventions in order to improve the effectiveness of the program (Imbens & Wooldridge, 2009). As institutional and biological diversities are likely to be considerable among collectively owned tropical forests (Chomitz, 2007; Naughton-Treves & Wendland, 2014; Ostrom, 2005), it is important to assess if conservation impact is heterogeneous across and within communities involved in a PES programs (Börner *et al.*, 2016; Miteva *et al.*, 2012).

In this article, we analyze the Conservation Agreement (CA) program implemented by Conservation International (CI) in the Cardamom Mountains, a dense rainforest at the southwest of Cambodia, Southeast Asia. Conservation Agreement is the main PES-like tool of CI's international Conservation Stewardship Program. Since 2006, 51 agreements have been signed in 14 countries. However, despite efforts of CI to use impact evaluation in their conservation strategy (McKinnon, Mascia, Yang, Turner, & Bonham, 2015), to our knowledge, no impact evaluation of CA program effectiveness has been published. We use a method based on quasi-experimental counterfactual to evaluate the effectiveness of CA in reducing deforestation. We show that the CA program had an overall significant impact on reducing deforestation: it contributed saving on average about 0.17 percentage point of the enrolled PES area per year during 2005–12. We also highlight that characteristics such as slope, proximity to roads, and number of households are associated with heterogeneous PES performance. Our discussion calls for improving both data availability and impact methods to better disentangle institutional dynamics affecting the costs and benefits of conservation in the assessment of environmental impact of collective PES.

The next sections introduce the study area and the method used. Section four presents our results and section five discusses them in the light of debates around the effectiveness of conservation policies in community-based and collective contracts.

2. STUDY AREA

(a) *Deforestation trend and conservation policies in Cambodia*

Cambodia is one of the most biodiverse countries of Southeast Asia (Cambodia's National Biodiversity Steering Committee, 2014). However, it is also among the countries with the highest proportion of tree cover loss these last 15 years (FAO, 2015; Hansen *et al.*, 2013). Deforestation has significantly accelerated since 2009 in a context of rise of international commodity prices, especially rubber (Petersen, Sizer, & Hansen, 2015). Cambodian forests are de jure state property so the extraction of forest products or land-use change are subjected to restrictions and require official permits or temporary transfers of rights. However, the major cause of deforestation is linked with the expansion of Economic Land Concessions (ELC) for large-scale plantations (Poffenberger, 2009). ELC corresponds to a government's strategy to develop the industrial agricultural sector to sustain economic growth. According to the Land Law enacted in 2011, the Government can grant up to 10,000 ha of land per ELC, which include logging rights. Other important causes of deforestation at smaller scales include agricultural expansion and fuelwood consumption (Poffenberger, 2009).

Forest conservation strategies are mainly crafted by the Ministry of Environment (MoE) and the Ministry of Agriculture, Forestry and Fisheries (MAFF) with the support of international NGOs (Milne & Chervier, 2014). Historically, conservation policies have relied on command-and-control approaches, including the management of a large protected areas network (Clements *et al.*, 2010). However, since the mid-2000s, several national NGOs have shown a growing interest in communal management of forest resource based on the development of legal provisions for formal communal land tenure, in addition to the recognition of traditional/customary use rights. In parallel, international NGOs have promoted PES programs in cooperation with the Cambodian government. Collective contracts articulated around communes constitute one pillar of their intervention strategy (Chervier, Déprés, & Neang, 2012).

(b) *Conservation international's conservation agreement programs in the cardamom mountains*

Cardamom Mountains are the largest remaining continuous forest in mainland Southeast Asia and are widely recognized as being of global and local conservation importance (Daltry & Momberg, 2000; Killen, 2012). However, like the rest of the country, the Cardamom Mountains also face increasing deforestation pressures. These pressures are not only due to ELC expansion but also to the development of two large-scale hydroelectric dams – Stung Tatay and Stung Atay hydropower – which are part of the Government strategy to resolve national electricity shortages. [1] At commune level, deforestation is also occurring due the expansion of small-scale commercial and subsistence agriculture by smallholder farmers around existing villages. This expansion results from the demographic growth following the aftermath of the Khmer Rouge regime and, more recently, in-migration from the over-populated Cambodian lowlands (Pillot, 2008). The weak law-enforcement capacities of MAFF and MoE, associated with the lack of formalization of local rules governing the use of forest resources further worsen deforestation (Travers, Clements, Keane, & Milner-Gulland, 2011).

CI has been working in the region since 2002, financially and technically supporting the Cambodian Forestry

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