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Payment for Ecosystem Services: The roles of positive incentives and information sharing in stimulating adoption of silvopastoral conservation practices

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ABSTRACT

Payment for Ecosystem Services (PES) applied to agricultural systems, such as tropical rangelands, seeks to provide multiple services while sustaining food production. However, there is considerable debate regarding the effectiveness of PES programs for changing farmer behavior and enhancing conservation. We interviewed 101 cattle farmers in Costa Rica following the Regional Integrated Silvopastoral Approaches to Ecosystem Management Project (RISEMP) PES pilot (2002–2008). We evaluated adoption of silvopastoral conservation practices—reintroducing trees and shrubs into permanent pastures—that provide varying proportions of public and private benefits; we estimated influence of PES, technical assistance (e.g., farmer training) and information sharing on stimulating their adoption. Our analysis included evaluation of information sharing pathways and accounted for key farm capital characteristics. We found that technical assistance associated with PES had a positive influence on adoption rates, particularly for practices with private benefits of improving rangeland productivity. PES payments alone had the most detectable, positive influence on the adoption of only one type of practice, multistrata live fences, which primarily provides public goods such as biodiversity habitat and carbon sequestration, but are perceived by many farmers to reduce rangeland productivity. Farmers accessed information about management practices through both social and institutional sources. While the RISEMP pilot focused on institutional information sources and technical assistance, future policy design should also include social information networks and consider how farmer-to-farmer communication influences conservation practice adoption.

1. Introduction

Payment for Ecosystem Services (PES) approaches are a core strategy within a growing call for a more direct conservation paradigm that bridges the private interests of landowners and the public benefits of conservation management (Ferraro and Kiss, 2002; Niesten et al., 2004; Scherr et al., 2004; Wunder, 2005). The basic framework of PES is to provide financial incentives to private landowners to implement conservation practices that provide critical ecosystem services such as water and nutrient cycling, pest control, and climate regulation. As agricultural systems must increasingly provide these ecosystem services as well as sustain food production (MA, 2005), the potential for applying PES to farming landscapes has received a great deal of recent attention (Tomich et al., 2004; Wunder, 2007; Wunder et al., 2008). However, there is still considerable debate regarding the effectiveness of PES programs for changing farmer behavior and management practices.

This study evaluates the role of PES in farmer adoption of silvopastoral conservation practices (e.g., reintroducing trees and shrubs) in the tropical cattle rangelands of Costa Rica's Esparza region. Tropical rangelands have become a conservation priority worldwide. In the Mesoamerican biodiversity hotspot, permanent cattle pastures are a primary land use; throughout Central America rangelands account for more than 9 million ha, or 38.7% of the region's terrestrial area (FAO, 2008; Ibrahim et al., 2007). Recent assessments have found more than 50% of these lands to be highly degraded (Szott et al., 2000), which has reduced farm productivity and local livelihoods and diminished provision of ecosystem services (Pérez, 2002). Degradation of natural habitat, biodiversity loss, and increased erosion are the cumulative result of pasture management decisions made by all producers in a region.

Costa Rica is recognized as a pioneer in the PES approach (Sánchez-Azofeifa et al., 2007), however the framework for PES policy and mechanisms were created for forest protection and reforestation and their application to tropical rangelands is quite recent (Ibrahim et al., 2007; Pagiola, 2008; Sánchez-Azofeifa

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et al., 2007; Wunder, 2007). The Regional Integrated Silvopastoral Approaches to Ecosystem Management Project (RISEMP) pilot, 2002–2008, was a follow-up to the first phase of PES in Costa Rica (1997–2000). Review by Sánchez-Azofeifa et al. (2007) found this initial phase to be an important advance for environmental policy, however reduction in deforestation rates could not be attributed to PES alone. RISEMP promoted silvopastoral conservation practices in Costa Rica, Nicaragua, and Colombia with funding from the Global Environmental Facility and World Bank (Casasola et al., 2007; Ibrahim et al., 2007; Pagiola, 2008; Vaessen and van Hecken, 2009). The main objectives of RISEMP were to use PES incentives to increase adoption of silvopastoral practices in degraded systems, and evaluate the resulting improvements in ecosystem function and socioeconomic welfare (Vaessen and van Hecken, 2009).

The RISEMP pilot illustrates two central knowledge gaps in conserving ecosystem services in agricultural systems. First, PES used in the RESEMP pilot is a policy tool that overlays more general decisions about the adoption of agricultural practices and diffusion of innovations. Diffusion of innovation theory describes how information about agricultural practices spreads through a community of practitioners (Rogers, 2003). As practitioners weigh the potential costs and benefits of new practices, information sharing is a key pathway that can support their adoption (Lubell and Fulton, 2007). Market-based policy tools like PES, which alter the costs and benefits of adopting different practices, cannot be understood without analyzing how the policy incentives interact with the social processes that influence practice adoption.

Second, it is important to determine whether PES is equally effective for all conservation practices regardless of whether they offer primarily private benefits directly to a farmer, or public goods to the broader community and environment. The effectiveness of different policy tools, including PES, depends on the relative levels of private and public benefit produced by the conservation practices being promoted (Pannell, 2008). Positive incentives, such as PES, are expected to be most effective for increasing the adoption rate of practices with high levels of public goods (Pannell, 2008), because these practices are less likely to be spontaneously adopted by farmers. A core tenet of PES is additionality, using policy to stimulate new conservation that would not otherwise take place (Morrison and Aubrey, 2010). Practices that provide sufficient private benefit to farmers (e.g., by increasing farm productivity) are likely to be adopted regardless of PES payments, which calls into question the necessity of investing scarce conservation resources to stimulate practices that would happen anyway.

To evaluate these knowledge gaps, we interviewed 101 cattle farmers in Costa Rica's Esparza region and estimated the influence of PES participation on the adoption of silvopastoral conservation practices, controlling for the influence of information from local institutions (e.g., extension and outreach agencies), social relationships (e.g., farmer-to-farmer information sharing such as consulting with neighbors about management decisions), and other variables identified by diffusion of innovation theory. We analyzed the role of PES in stimulating adoption of practices with different mixtures of private economic benefits to farmers (e.g., planting improved pasture grasses and forage banks) and public goods in terms of enhanced ecosystem services (e.g., protecting riparian forests) promoted by RISEMP (Table 1). We found that the technical assistance associated with PES has the most consistent effect on adoption rates, particularly for practices with substantial economic benefits in the form of improved rangeland productivity. PES payments alone had the most detectable, positive influence on the adoption of only one type of practice, multistrata live fences, which primarily provides public goods in the form of ecosystem services including: biodiversity habitat; carbon sequestration; and air purification. Multistrata live fences are perceived by many farmers to reduce rangeland productivity; however some farmers also recognize the potential benefit of shade in supporting livestock productivity by mitigating heat stress in cattle. Social and institutional information sources play a complex role in decisions to adopt conservation practices, depending on the content of social discussion, and correlation between exposure to outreach agencies and participation in PES programs.

1.1. Case study overview: PES in Costa Rica

Costa Rica's PES program began in 1997 with the enactment of Forest Law 7575, which provides the legal basis to offer payments to landowners for providing ecosystem services on their lands including: mitigation of greenhouse gases; hydrologic services and water provision; biodiversity conservation; and scenic beauty (Pagiola, 2008). Costa Rica created the National Fund for Forest Financing (FONAFIO) to administer PES contracts funded by revenues from a national tax on fossil fuels, along with additional support from a World Bank loan from 2001 to 2006 and grant from the Global Environmental Facility through the Ecomarkets project. The PES program in Costa Rica continues to evolve: eligible land uses were simplified to forest conservation and timber plantations in 2000; an agroforestry contract was introduced in 2004; and a contract for natural forest regeneration is being introduced.

Reviews of the conservation impacts of the initial phase of PES, which focused on forest protection and services generated by forests, highlighted that deforestation rates could not be attributed solely to PES (Sánchez-Azofeifa et al., 2007). External factors such as declining deforestation rates in the late nineties, falling beef prices, reduced agricultural subsidies, and a limited amount of productive land remaining under forest were critical factors in the broader context for evaluating the impacts of PES on forest conservation (Pfaff and Sánchez-Azofeifa, 2004; Robalino and Pfaff, 2012). Systematic trends in program participation are another consideration that may have constrained program impacts (Arriagada et al., 2009). Arriagada et al. (2009) found that land owners that leave forests unmanaged, wish to protect property rights, and have few viable alternative land uses tended to have higher program participation.

Recommendations that emerged from reviews of program impacts included the need to target PES on lands most vulnerable to land use change to avoid enrolling lands that would have otherwise remained forested (Pfaff et al., 2008). This observation has been echoed in other PES programs in Mesoamerica, including Mexico's Payment for Hydrological Environmental Services program, for which program reviews highlighted that program funds were distributed in areas with low deforestation risk (Muñoz-Piña et al., 2008) and fragmented distribution may have further hindered providing measurable public benefits to downstream users (Alix-Garcia et al., 2009). These observations highlight one of the main critiques of Payment for Ecosystem Services as a policy tool: the need to establish baseline metrics and invest in conservation actions that provide demonstrable, additional benefits.

1.2. The Regional Integrated Silvopastoral Approaches to Ecosystem Management Project (RISEMP) pilot, 2002–2008

In Costa Rica PES has been expanded to include cattle farming landscapes only recently in the context of the RISEMP pilot (Ibrahim et al., 2007). RISEMP differed from Costa Rica's existing PES scheme for forest protection in two important ways. First, the RISEMP pilot promoted a suite of silvopastoral conservation practices, which are broadly defined to encompass incorporating trees into permanent pasture systems (Dagang and Nair, 2003; Nair, 1985) and the associated public benefits of biodiversity conservation and carbon sequestration, while decreasing the total area of degraded pasture (Casasola et al., 2007; Ibrahim et al., 2007; Pagiola, 2008). The seven silvopastoral conservation practices included in RISEMP