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Considering farmer land use decisions in efforts to 'scale up' Payments for Watershed Services

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ABSTRACT

Significant effort is being devoted to the expansion of payments for watershed services (PWS) programs at national, regional, and local scales. This expansion faces logistical challenges, in particular identifying appropriate incentives and enrollment processes to provide additional ecosystem services under budget constraints. In Brazil, PWS programs have mostly occurred at the local level, using formulaic contracts to ensure landowners are compensated for provision of specific types and quantities of ecosystem services. However, it is unclear how these financial incentives will function as programs expand to new areas, as pilot programs report high recruitment costs. Using as an example the Cantareira System, an important drinking water supply for the São Paulo metropolitan area, we review PWS incentives in the context of factors that affect farmer land use decisions. We base our research on a review of policies affecting PWS in Brazil, existing PWS in the Cantareira region, and drivers affecting land use and technology adoption by cattle ranchers, drawing from the literature and interviews with farmers and agronomists in the study region. While financial incentives (payments) account for both the value of ecosystem services and opportunity costs of shifting pasture production to forest, several economic, social, political, and biophysical factors will likely affect landowners' decisions to enroll in PWS. This suggests that, while PWS programs may lead to the provision of additional ecosystem services, the complexity of contracts and diversity of local conditions create challenges to broad deployment in the absence of significant outreach efforts.

1. Introduction

Payments for ecosystem services (PES) programs are a policy approach to promote land uses that provide ecosystem services through payments to land managers by ecosystem service users (Wunder, 2005). These direct payments are more likely to be efficient than indirect approaches to shifting behavior, especially in situations where the desired provision of an ecosystem service involves coordinating large numbers of individuals (Ferraro and Kiss, 2002). Watershed management is one field in which PES has been welcomed, as downstream service users (e.g., public drinking water utilities or hydroelectric power producers) often have a range of actors upstream that affect quality and quantity of water supplies (Landell-Mills and Porras, 2002). The appeal of payments for watershed services (PWS) is reflected in the rapid emergence of programs over the past 20 years. Ecosystem Marketplace, a Forest Trends program that tracks market-based environmental programs, reports over 400 PES programs in operation solely to protect watershed services, with transactions totaling nearly $25 billion (Bennett and Ruef, 2016).

This rapid growth in the number of programs has raised concerns about additionality – the outcomes of programs beyond what would have occurred in their absence (Pattanayak et al., 2010). Research into this issue has primarily been conducted *ex post*, frequently using experimental or quasi-experimental approaches to measure impacts of PES programs on land cover or other variables (Arrigiada et al., 2012; Sills et al., 2008; Robalino and Pfaff, 2013; Jayachandran et al., 2016). This has been useful, helping such programs as Costa Rica's national *Pagos por Servicios Ambientales* program address issues with targeting and other opportunities for improvement (Pagiola, 2008).

However, these evaluation approaches are not available in every context in which PES programs have operated. The scale of Costa Rica's PES program lends itself to quantitative evaluation using spatial data, and planning and partnerships were required to apply randomization of treatments during the implementation of other programs for evaluation purposes. Absent these conditions, other approaches are necessary to identify opportunities to program design and implementation.

Here we describe the results of a research project on challenges and

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opportunities for PWS to serve as a tool to increase forest cover on private land in the watersheds of the Cantareira System in southeastern Brazil. The area is the source of a significant portion of the drinking water for the São Paulo metropolitan area, but agricultural activities, in particular pasture for cattle, affect these resources and several PWS programs have been implemented in the region. Several PWS programs have already been implemented in the region, but they have experienced high startup costs and other challenges (The Nature Conservancy-Brasil, 2015; Kfouri and Favero, 2011). Despite these challenges, there is interest in expanding PWS efforts, and a clear need to identify and address potential obstacles to wider landowner participation to secure additional environmental benefits.

We draw from the literature on PWS programs in Brazil to identify the structure of contracts and incentives offered to landowners in the Cantareira watersheds. We then use past research on land use and technology adoption by Brazilian cattle farmers, as well as interviews with landowners and technical staff working in the São Paulo portion of the Cantareira System, to understand drivers of land use change on farms in the region. Using the model of PES adoption proposed by Pagiola et al. (2005), we discuss factors that may affect the additionality of future investments in PWS and lessons for development of this type of program elsewhere in the world.

2. Methods

2.1. Study site description

The Cantareira System is a large reservoir complex used to store drinking water for the São Paulo metropolitan area – the largest urban agglomeration in South America (Whately and Cunha, 2007). The basins that drain into the reservoirs lie within the states of São Paulo and Minas Gerais, covering roughly 230,000 ha (Fig. 1). The entire system is located in the Atlantic Forest ecoregion, a biodiversity hotspot with globally significant levels of plant and animal diversity and endemism (Myers et al., 2000) and only 11–16% of its native vegetation cover (INPE and SOS Mata Atlântica 2015). The Cantareira System is a focal area for forest restoration by the Atlantic Forest Restoration Pact (AFRP), which has a goal of restoring 15 million hectares of forest by 2050 (Melo et al., 2013; Banks-Leite et al., 2014).

The Atlantic Forest is also home to over 125 million people (IBGE 2016) and produces roughly 70% of Brazilian GDP (Melo et al., 2013). Recent droughts have raised concerns over the state of the Atlantic Forest and the impacts of deforestation and land degradation on the drinking water and hydropower supplies that are critical to the country's economy (Nobre et al., 2016; Tafarello et al., 2016).

Although roughly 40% of the Cantareira region is still forested, native vegetation cover is highly fragmented by agriculture. Pasture for cattle and eucalyptus plantations are the dominant agricultural activities by land area, although some municipalities also have high concentrations of greenhouses for vegetable and seed production (São Paulo State Agricultural Extension Service 2008). The total population of the three study municipalities in São Paulo state (Nazaré Paulista, Piracaia, Joanópolis) was approximately 53,208 individuals as of 2013 (IBGE 2016), with 1882 landowners raising cattle for dairy and beef during the last available state agricultural census (São Paulo State Agricultural Extension Service 2008). The municipalities are all close to the São Paulo metropolitan area and accessible by major highways, which has resulted in expansion of housing construction driven by urban demand. This combination of agricultural activity and rural development in an important catchment has made the region a priority for riparian restoration efforts, including PWS, to improve water quality.

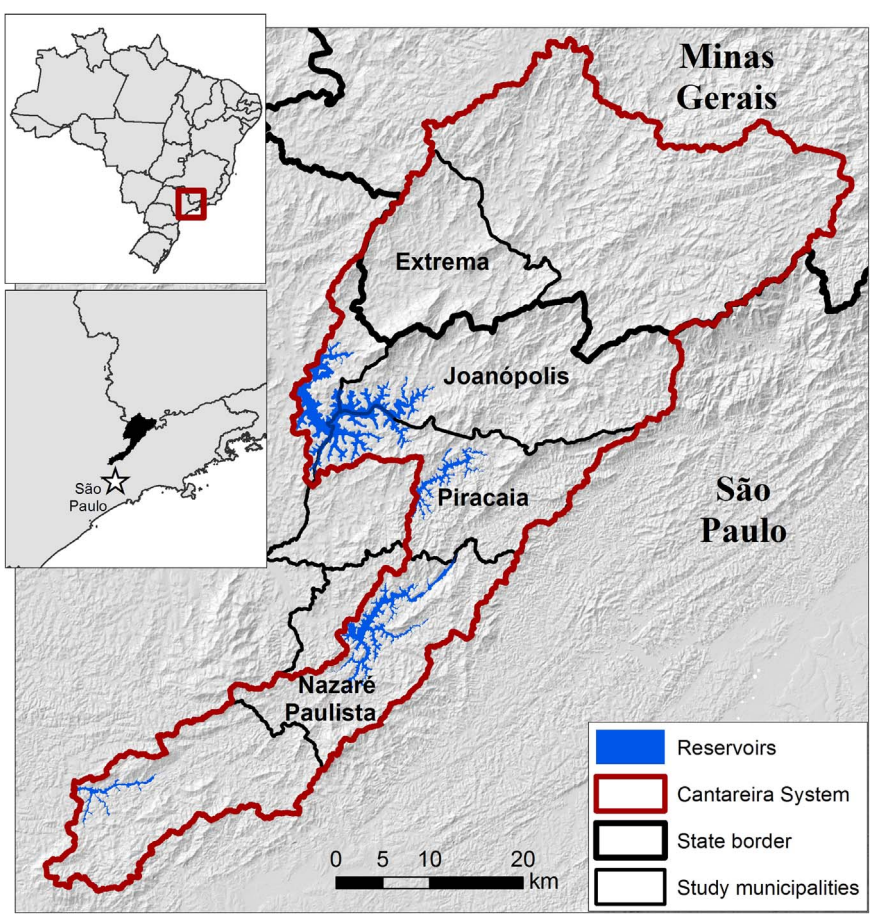

Fig. 1. Map of the Cantareira System, including study municipalities.

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