



Analysis

Context Matters: Exploring the Cost-effectiveness of Fixed Payments and Procurement Auctions for PES

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ABSTRACT

Successfully implemented payment for ecosystem services (PES) programs can provide both conservation of nature and financial support to rural communities. In this paper, we explore how PES programs can be designed so as to maximize the amount of additional ecosystem services provided for a given budget. We also provide a brief summary of the use of auction mechanisms in real world PES programs. To explore the potential additionality of different PES program designs we use a conceptual agent based simulation model where payments are either fixed, or set through a uniform or discriminatory auction. The program can also be designed to target payments to land-owners based on their provision of ecosystem services. Theoretically, auctions should be the most effective design, especially if payments are differentiated and targeted by ecosystem service provision. However, what we find is that the context in which the PES program is implemented—baseline compliance with program standards among the participants, correlation between opportunity costs and ecosystem services in the landscape, heterogeneity in costs and budget size—has a determining impact on the relative effectiveness of the different payment designs, with fixed payments schemes being much more effective than auctions in certain settings. Our findings suggest that context should be taken into serious consideration when a PES program design is chosen.

1. Introduction

During the last decades, payments for ecosystem services (PES) have emerged as an increasingly popular policy instrument for environmental conservation. PES programs are based on voluntary transactions between providers and (external, or offsite) users of ecosystem services (ES), whereby the former receives payments conditional on the implementation of land-use or management proxies believed to increase the provision of ES to the latter (Wunder, 2015).

By directly compensating land owners for the opportunity costs of conservation, PES was originally proposed as a more efficient way of using scarce conservation funds than more indirect interventions, such as Integrated Conservation and Development Projects (ICDP) and community-based natural resource management (Ferraro and Kiss, 2002; Ferraro and Simpson, 2002). However, despite frequent calls for impact evaluations of PES (Ferraro and Pattanayak, 2006; Fisher et al., 2014; Baylis et al., 2015), hard evidence on the effectiveness of PES has been slow in coming. Recent years, however, has seen an emerging literature using rigorous impact evaluation methods for assessing the impact of PES, especially for tropical forest conservation and in

particular focusing on the performance of the national PES programs in Costa Rica and Mexico (see Samii et al., 2014; Börner et al., 2016a; Börner et al., 2016b and references therein). Although results are mixed, the general picture painted by these studies is one of quite low efficiency of PES, in terms of measured relative reductions in the (already low) rates of forest loss and degradation in these countries.

A key source of inefficiency, that partially explains the poor estimated performance of PES in forest conservation, is information asymmetries: potential PES recipients usually have better information on the opportunity cost of participation and their baseline provision of ES, than do PES program officials. This leads to two problems that undercut program impacts: adverse selection and overcompensation. Adverse selection implies that agents that would meet program conditions in the absence of payments will self-select into programs, reducing additionality of payments (Ferraro, 2008; Persson and Alpizar, 2013). This problem can be expected to be particularly severe in cases where baseline compliance with program conditions is already high (Persson and Alpizar, 2013). Overcompensation implies that program beneficiaries can extract information rents by receiving higher payments than needed for participation, leading to fewer contracts—and hence

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smaller impacts—for a given program budget (Ferraro, 2008).

One option for reducing the efficiency losses due to information rents is to shift from fixed payment schemes—the most common mechanism for allocating PES conservation contracts today—to auction mechanisms. Procurement auctions, where land owners place bids in order to compete for PES contracts, creates an incentive for land-owners to reveal (some) information about their true opportunity costs of ES provision, which allows program officials to set payments at a level that maximizes the supply of ES for a given PES budget. This has the potential to reduce the problem of overcompensation, especially in a discriminatory auction, where winning land-owners are paid in accordance to their bids (as opposed to a uniform auction, where all winning land-owners are paid the same amount, usually the highest accepted bid or the lowest rejected bid for a given budget).

The theoretical potential for procurement auctions to increase the cost-effectiveness of PES programs can be large (Latacz-Lohmann and Van der Hamsvoort, 1997; Schilizzi and Latacz-Lohmann, 2007). Still, studies have also shown that auctions may actually worsen the problem of adverse selection, by contracting low opportunity cost land-owners that are most likely to provide ES in the absence of payments (Arnold et al., 2013; Burke, 2016) and that the performance of discriminatory auctions is likely to deteriorate over time, as land-owners learn to strategically optimize their bids (Cason and Gangadharan, 2004; Hailu and Schilizzi, 2004; Schilizzi and Latacz-Lohmann, 2007). However, previous studies have not systematically explored how the severity of these effects depend on contextual factors, such as the degree of information asymmetries between land-owners and ES buyers and the distribution of opportunity costs and ES provisions across land-owners (Latacz-Lohmann and Schilizzi, 2005). Furthermore, although the empirical evidence on conservation auction performance in general is positive (see Table 1), data is too limited to draw firm, generalizable conclusions about the circumstances under which ES buyers can expect to gain from implementing procurement auctions.

Today PES programs are used to target a multitude of different ecosystem services (ranging from water protection to carbon sequestration) all over the world. With the wide range of geographical locations and ecosystem services targeted, the context of PES programs vary a lot. In this paper, we study how the variability in context (set by the geographical location of the program and by the type of ecosystem service that is targeted) affect the effectiveness of different PES program designs, in particular the difference between auctions and fixed-price PES schemes. A better understanding of the contexts where procurement auctions are likely to increase cost-effectiveness, and where other design choices (e.g., benefit targeting) may be more promising, can help policy makers tailor PES programs for higher impacts.

To answer the question of how PES auction effectiveness is affected by the interplay between design and context, we first provide a background that highlights the key contextual factors and design choices likely to influence program impacts, based on both theoretical and empirical literature (Section 2). Building on the insights from this, we construct an agent-based simulation model of a conceptual PES program that allows us to vary key contextual parameters and test different fixed price and auction PES designs (Section 3). In certain contexts, the results from the model (Section 4) are in line with expectations from the theoretical auction literature, with discriminatory auction formats significantly outperforming fixed payment schemes. However, in other contexts, similar to some real-world PES programs, such as the ones targeting tropical deforestation in Costa Rica, Mexico and elsewhere—our results show that a fixed payment scheme with ES targeting might be a more cost-effective option. In sum, context matters: a PES design that is highly successful for a forest plantation project in Africa might not be feasible for a forest conservation program in South America. Considering context—be it political, economic or geographical—is thus key for choosing PES program design for maximum conservation impact.

2. Context, Design & the Potential Cost-effectiveness Gains From Auctions

From the theoretical and empirical literature on PES we know that the interplay between implementation context and program design is key in determining outcomes in terms of additional ES provision induced by a program (Persson and Alpizar, 2013; Börner et al., 2016b; Engel, 2016; Ezzine-de-Blas et al., 2016). This is also the case for procurement auctions in PES programs (Whitten et al., 2016). A key question then is if certain contextual factors favours specific PES program designs—i.e., fixed-price payments, uniform-price or discriminatory auctions—over others?

In traditional, fixed price PES, the baseline compliance with program conditions has been shown to be a key determinant of program additionality, with higher baseline compliance leading to larger problems with adverse selection (Persson and Alpizar, 2013). The review by Ezzine-de-Blas et al. (2016) also suggests that PES programs that are asset-building (like planting trees) display higher additionality than programs with activity restricting conditions (such as leaving forests standing), which may at least partly be explained by differences in baseline compliance (deforestation rates on private lands are generally much lower than reforestation rates in the baseline) (Börner et al., 2016b). Table 1 gives an overview of the real-world PES programs that has used auction mechanism to allocate contracts, that we found described in the academic literature.¹ All of these programs are oriented towards environmental services that are mainly asset building (such as tree plantations). This might help explain why most of the PES programs that have used an auction approach report high additionality² compared to large-scale, fixed-price PES programs aimed at forest conservation.

The conservation auction literature has not generally dealt with the issue of non-additionality, with studies implicitly assuming that all ES provided under a PES program is additional. An exception is Arnold et al. (2013), which show that adverse selection can substantially undermine the additionality of conservation auctions, by selecting least-cost land-owners that are most likely to provide ES in the absence of PES. Still, this study does not compare how an auction performs relative to a fixed-price scheme, nor does it test how the strength of this effect depends on the level of baseline compliance.

The relative performance of fixed-price PES and different auction formats is also likely to depend on the correlation between opportunity costs of program participation and ES provision across the landscape (Latacz-Lohmann and Schilizzi, 2005). If the correlation is strongly positive, land plots with high ES values will be costly to include in the program due to their high opportunity costs, while “cheaper” land will provide little extra ES value. If the correlation is closer to zero or even negative, land with high ES values will have low opportunity costs and hence be highly desirable to enrol in the program.

Of course, assessing the correlation between opportunity costs of land and ES provision in a landscape is hampered by the exact same information asymmetry that leads to PES inefficiencies: imperfect information about land-owners' opportunity costs. Still, the correlation is likely to differ in a way that may partly be predictable by PES buyers, for instance based on the ES that is targeted and on the geographical location of the program. Where PES programs target local ES provision—e.g., watershed protection or local pollution—we could expect a more positive correlation, as benefits then tend to be higher in more populous areas where conservation threats (and opportunity costs) tend to be higher. On the other hand, where PES targets global public goods

¹ The list started with the PES programs that was classified as using auctions in the extensive literature review by Ezzine-de-Blas et al. (2016), but was then extended with a few more cases found in the literature. It includes all PES programs using auctions that the authors have been able to find data on in the academic literature.

² Though few of these base their assessments of program impacts on rigorous impact evaluations (using experimental or quasi-experimental methods) (Baylis et al., 2015).

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