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Social dimensions of procurement auctions for environmental service contracts: Evaluating tradeoffs between cost-effectiveness and participation by the poor in rural Tanzania

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ABSTRACT

Determining the level of payment and selecting participants are important but frequently neglected issues that affect social, economic and environmental performance of payment for environmental services (PES) programs. We use a pilot auction to address these issues in the context of a PES program in Tanzania's Uluguru Mountains. Two-hundred fifty-one local farmers submitted sealed bids in the auction. The results reveal the supply of PES contracts at different prices. Simulations using the auction results and household data show large tradeoffs between achieving cost effectiveness and maximizing participation by poor households. A monitoring survey 21 months after the auction found that most auction winners' trees had survived, with performance uncorrelated to the farmer's poverty status or bid level. Although aspects of our auction design limit the strength of some of the conclusions we draw from the data, our study shows how pilot auctions can assist decision makers in estimating payment levels for PES contracts. Auction participants stated that the auction provided transparency in contract allocation and that winners felt peer pressure to comply with contracts, which suggest areas for future research regarding the potential advantages of using auctions to allocate PES contracts in developing countries.

Introduction

Payment for environmental services (PES) is a new conservation paradigm in which conditional incentive payments encourage land stewards to invest in land-use practices that lead to conservation or production of environmental services (Ferraro and Kiss, 2002; Wunder, 2005). PES has spread rapidly over the past decade and has become the dominant approach for securing forest-based carbon sequestration under climate change mitigation initiatives (Miles and Kapos, 2008). There are now numerous projects that pay local landowners to sequester carbon by planting new forests or protecting existing ones (Hamilton et al., 2010; Jindal et al., 2008). As is evident from other articles in this special issue of *Land Use Policy*, many PES projects in developing countries aim to achieve social objectives such as poverty alleviation in addition to environmental objectives.

A key concern in PES design is to identify a payment level that compensates landowners' opportunity costs while maximizing the impact of the conservation budget (Ferraro, 2008). Payment that is too high or too low will not likely achieve conservation outcomes cost-effectively (Jack et al., 2008). In long-term projects, such as those that provide carbon sequestration through tree planting, the payment level may need to be determined ex ante because renegotiation is expensive once the project has begun.

The challenge of identifying contract prices in the absence of competitive markets for environmental services has led to skepticism of the PES approach (Kosoy and Corbera, 2010). When markets do exist, as in the case of carbon sequestration, they are so differentiated that a single price cannot be paid (Hamilton et al., 2010). Moreover, it is difficult to directly transfer cost estimates from one project to another since the cost of implementing a new land use practice can be highly site- and farmer-specific, with differences that are unobservable to outsiders. When measuring such costs is expensive, especially in new project sites, service providers may have little incentive to reveal their true costs through farm or household surveys (Ferraro, 2008). Designing a transparent way to allocate conservation contracts with an efficient

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contract price is both financially and practically significant for PES projects.

One way to achieve this design is through conservation auctions in which PES contracts are allocated to potential environmental service providers through competitive bids (Ferraro, 2008; Jack et al., 2008). Compared to conventional auctions, the roles of buyers and sellers are reversed in PES auctions: the lowest bids from potential service providers win rather than the highest (Ferraro, 2008; Giampietro and Emiliani, 2007). Such auctions are a standard procurement procedure in non-environmental settings and have become popular in PES projects in developed countries such as the United States, Australia and the United Kingdom (Latacz-Lohmann and Schilizzi, 2005). However, they have yet to be deeply explored in developing country contexts where a high proportion of PES projects are proposed, including many projects aimed at carbon sequestration and reduced emissions from deforestation and forest degradation (REDD). These projects could benefit from a method to estimate an efficient price for PES contracts. In addition, PES projects that aim to increase the participation of poor landholders need a way to assess, ex ante, complementarities or tradeoffs among environmental and social objectives under alternative allocation rules.

We know of only two examples of conservation auctions in a developing country context. One took place in Indonesia in which the contracts were for coffee field investments to reduce soil erosion (Jack et al., 2008). The other was designed to explore differences in farmer behavior when participating in an auction versus responding to a fixed-price offer for a tree-planting project in Malawi (Jack, 2010). Jack et al. (2008) calls for additional auction studies to further test the approach in developing country settings. Building on these previous studies, we invited farmers in a study site in the Uluguru Mountains of Tanzania to submit bids for the amount of money they would require in return for planting trees on their fields. Combining data from auction bids and a household survey, we report: (i) the costs of implementing tree planting contracts, (ii) the extent to which poorer households were likely to receive contracts at different payment levels, (iii) tradeoffs between achieving cost-effectiveness and promoting participation of poorer households, and (iv) contract compliance rates.

Auctions for conservation contracts

If there were N heterogeneous farmers, they could hypothetically be ordered by their opportunity cost of planting trees on their farms. This includes the direct cost of planting trees and taking land out of crop production (Paarsch and Hong, 2006), and it is affected by their willingness to accept cash in return for planting trees, their risk and time preferences, their trust of the buyer, and other factors:

$$b_{1:N} \leq b2 : N \leq \ldots\ldots\ldots \leq b_{N:N} \quad (1)$$

where $b_{1:N}$ is the opportunity cost of the lowest cost provider, and $b_{N:N}$ is the opportunity cost of the highest cost provider. If this cost ordering were known, we could estimate the supply of tree planting at each payment level. However, farmers' real opportunity costs are private information. Simply asking them to state these costs would not necessarily yield a reliable estimate unless they had an incentive to reveal their true costs (Ferraro, 2008).

In general, by ensuring competition among farmers for a limited number of contracts and carefully setting the rules to determine winning bids, one can create incentives for farmers to reveal their true opportunity costs (Latacz-Lohmann and Schilizzi, 2005; Cason and Gangadharan, 2004; Latacz-Lohmann and Hamsvoort, 1997). Auctions can induce this competition by creating market-like conditions. They can take a number of forms. For example, in a first-price reverse auction, winning bidders are paid exactly what they bid; this is called discriminatory pricing when multiple units are selected as winning bids. In a second-price reverse auction the price is set by the lowest rejected bid, which is higher than what the winner actually bid; this is called uniform pricing when multiple units are selected (Latacz-Lohmann and Schilizzi, 2005). Vickrey (1961, 1976) showed that in a second-price, sealed bid auction, potential suppliers can do no better than to reveal their true opportunity costs.[1] In a Vickrey uniform price auction, the lowest rejected price is the price that exhausts the available budget when everyone bidding below the price is paid that price. Thus, the lowest bidders could receive a payment substantially higher than what they bid. This design feature may be considered an advantage in pro-poor project settings.

Conservation auctions have been used in many developed countries to estimate the efficient payment level in PES projects and to allocate conservation contracts, although to our knowledge no one has used a second-price Vickrey auction format (Khanna and Ando, 2009; Cummings et al., 2004; Latacz-Lohmann and Schilizzi, 2005; Stoneham et al., 2003). Latacz-Lohmann and Schilizzi (2005) explain that there are many competing factors that determine whether to use a first- or second-price auction. Rothkopf et al. (1990) suggest that the two most important factors that thwart the use of Vickrey auctions are the fear of bidder collusion and resistance among bidders to reveal their true values to others. Klemperer (2002) suggests that presence of a thick market with many bidders, and using a sealed bid process should help address bidder collusion. Further, resistance among bidders to conceal their true costs can be addressed by keeping the winning bids secret (Rothkopf et al., 1990). This can be done in a uniform payment system where only the last rejected bid is announced by the auctioneer.

In a developing country setting, especially when the focus is on research, the uniform second-price auction has two advantages: it encourages bidders to bid their true opportunity cost, which enables the researcher to construct a supply curve from the bids gathered, and it eliminates potential confusion and resentment that might arise if neighboring farmers receive different payments for undertaking the same activity. Requiring bids to be sealed rather than communicated orally provides another advantage: it enables the auctioneer to observe the entire distribution of bids from potential suppliers rather than only those bids that are at or above the uniform price. This distribution provides data for estimating the conservation supply curve (Paarsch and Hong, 2006).[2]

An important concern in the use of auctions for PES in a developing country setting is the possibility that unsophisticated bidders may not understand the auction process or the contract

[1] In a Vickrey auction with each bidder submitting a single bid, bidding truthfully is a weakly dominant strategy (also assuming that there is a continuum of bids, or a good approximation to a continuum). In such an auction, if bidders bid lower than their opportunity cost and do not win a contract, they are no better or worse off than if they had bid their true cost. If they bid lower than their true cost and they win a contract, they either are no better off than if they had bid their true cost (because they still receive the same lowest-rejected payment) or they are worse off (because they end up receiving a payment that is below their opportunity cost). If they bid higher than their true costs and win the contract, they are no better off because the payment is still the last rejected bid, and it would have been the same even had they bid their true cost. If, on the other hand, they bid higher than their true costs and do not win a contract, they either are no better off (because their true cost is still higher than the lowest-rejected bid) or they are worse off (because by losing the contract to a lower bidder, they lose the profit they would have made by bidding their true cost). Thus, independent of the bids from other bidders, a bidder can never do better than bidding their true willingness to accept.

[2] We assume that bidders' values are independent, i.e. bidders' values of a contract (or opportunity cost of a change in land use) are uncorrelated (Milgrom, 1989). We believe that this is a reasonable assumption in the PES context where the cost of adopting a certain practice is farmer- and farm-dependent, and where service providers cannot resell the conservation contracts they receive (Paarsch and Hong, 2006).