Targeting Payments for Environmental Services: The Role of Risk

by

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Payments for environmental services have become increasingly popular in both the developing and developed world. Existing programs, however, could be made more efficient by taking into account the risk of losing these services in the design of such programs.

Programs of payments for environmental services (PES) are found everywhere from the Americas to Uganda and their variety and scope is growing every day. They range from the very specific (one city paying one forest owner in Mexico) to the general (paying for water table regulation, biodiversity conservation and carbon sequestration in Australia). The United States boasts one of the largest PES programs in the world, the Conservation Reserve Program (CRP), and in addition is home to hundreds of local land trusts, wetlands preservation and restoration programs and others intended to conserve or renew valuable ecosystems. The justification behind such payment programs is that natural resources may provide services for society that are larger than the individual owner's benefits. While the owner of a resource may find it profitable to exploit these resources, the losses to the world may be greater than the money the resource owner makes. In these cases, it is worth the effort to pay the owner not to exploit the resource. In some cases, it is even worth reimbursing the owner to restore a resource that has already been exploited.

The question of to whom and how much to pay for environmental services has generated a large amount of research. The main conclusion is that an efficient payment program will try to maximize the amount of environmental benefits purchased per dollar spent. In addition, however, new research shows that substantial savings can be had by targeting those pieces of land that are at high risk of being lost. It makes little sense to give large payments for remote areas that are not threatened, particularly where budgets for payment programs are very limited. The paragraphs below explore different targeting strategies that take the threat of benefits loss into account and apply these principles to a nascent PES program in Mexico in order to show the efficiency gains that can be made by considering risk, opportunity cost and environmental benefits.

Payment Strategies and Incorporating Risk

PES programs are far from a new concept. Indeed, the Nature Conservancy has been purchasing lands both in and outside of the United States since 1951. Their strategy is to pay the full market value for a tract of land which they then remove indefinitely from the possibility of production. The U.S. CRP makes long term contracts (10 to 15 years) with farmers to remove highly erodible land from production, for which they are given yearly payments based upon local rental rates. The CRP makes an attempt to apply the principle of maximizing environmental benefits per dollar by using an environmental benefits index divided by the local rental rate to rank plots. The index is a point system based upon the perceived environmental quality of different components of the land, including potential for endangered species habitat and proximity to rivers. Both of these strategies give payments equivalent to the opportunity cost of the land—i.e., what the land would be worth to owners were it not being conserved.

An alternative strategy is to pay the value of the environmental benefits produced by a plot of land. In this case, the "environmental rents," the excess value above the opportunity cost of the land, is enjoyed by the land owners rather than by society at large. This approach is difficult to implement, as the valuation of environmental benefits is a murky business at best. There are also payment strategies that allow land owners and program financers to split these environmental rents by charging the same price for all land entering in the program, as is the case with Costa Rica's payments program.

Most recently implemented payment programs, particularly those in developing countries where land rental rates are difficult to establish, pay a flat fee per hectare of forest or other endangered ecosystem, whether the land was located next to a rapidly growing city or on the top of their highest mountain.

These types of payment programs are of the Nature Conservancy variety in the sense that they intend to preserve land rather than change land use from farming to conservation, although in some cases reforestation efforts are also financed. Theoretically, these payments should vary across space according to the risk of losing the environmental benefits. Based upon the above discussion, one can think of various ways of implementing payments that incorporate this risk.

One might pay exactly the expected opportunity cost of this land, in other words, pay what a farmer might earn by cutting down the forest and planting crops in a given area. However, this area is only the land that he intends to cultivate in a given year and not the forest ranging from his front door to the top of a mountain five miles away. Payments of this type should only be made for land for which expected environmental benefits exceed this opportunity cost. Alternatively, one might pay the value of the environmental benefits that are at risk, but again, only when risk exceeds the opportunity cost. Finally, in the face of a limited budget, one might take inspiration from the CRP and rank the potential land in order of those with the highest benefits per dollar, paying the expected opportunity cost for each acre until the money runs out. A simulation of these three schemes is discussed below, where each is compared to the other on the grounds of equity and efficiency, using as a benchmark the standard, flat rate approach.

Table 1. Constructing an Environmental Index

Characteristic	$ per hectare
Cloud forest	
Primary	40
Secondary	30
Temperate or dry forest	
Primary	30
Secondary	20
Added to each hectare of above:	
Overexploited watershed	10
Within ½ mile of a river	
Primary	20
Secondary	10

Case Study: Mexico

Though few experts agree on the exact figure, the consensus is that Mexico has the second highest deforestation rate in the world. In addition, it suffers from decreasing soil quality and increasing water scarcity, problems both associated with forest loss. Furthermore, it is among the most biologically diverse countries in the world, with first place in reptilian diversity, third in bird and fourth in mammal diversity. Its plant diversity exceeds that of the United States and Canada combined, and survival of both the flora and fauna is associated with protection of existing forest according to the Mexican National Forestry Commission (CNF). This combination of facts has thrust Mexican environmental policy into center stage both at home and abroad, and is the inspiration for the paper at hand.

Methodology

According to the CNF, 80 percent of the country's forests are located in ejidos, communities resulting from the post-revolution land reform which hold their property in common. Their large forest holdings make them a logical place to begin addressing the deforestation problem. Using data from a random sample of 450 forest-holding ejidos, we simulated the distribution of payments from the four programs discussed above, beginning with the benchmark, flat payment case. Taking advantage of satellite imagery to calculate deforestation rates, we were able to use the observed deforestation from 1993-2000 as our measure of risk. The payments were simulated for only a year, not over the entire period.

Because environmental benefits are extremely difficult to measure, and because no studies of hydrological forest externalities for Mexico could be found, the budget from the flat payment program was used to establish an overall maximum value for environmental amenities. In order to establish a relative scale of environmental benefits, an environmental benefits index was generated, keeping in mind Mexico's focus on hydrological benefits (the protection of water quality and quantity through maintenance of vegetation). A score was then calculated for each ejido, and these relative scores were then used to calculate environmental benefits at risk. This factor is used in two ways: First, in the expected environmental benefits program, the flat payments budget (the "value" of environmental amenities) is redistributed over these scores. Second, it establishes the benefit/cost ratio used to generate payments in the final program, where ejidos are ranked according to this ratio and then paid their expected opportunity cost. See Table 1 for the point system used to establish the benefits index.

Results

Table 1 shows the results from the simulations. The amount of hectares purchased and overall environmental benefits are highest in the opportunity cost and expected environmental benefits programs, where they are equal by construction. Efficiency is over three times higher in the opportunity cost program. When we compare the flat payments program with the expected environmental benefits program, where the budget is the same for both, we see considerably higher benefits with the latter scheme. The simulation suggests that if a payment strategy had been implemented as a flat scheme in 1993, it would not have affected 47 percent of the deforestation between 1993 and 1994. The expected environmental benefits/opportunity cost program takes as a ceiling the benefits obtained in the flat payments program. The spending required to generate these benefits using the criteria of maximizing benefits per dollar is less than one-tenth that of the actual budget. This final strategy, with an efficiency of .176, is by far the most efficient of the four.

Table 2. Costs, Benefits and Distribution of Different Simulated Programs

Payment type	Flat Payments	Expected opportunity cost program	Expected environmental benefits program	Expected environmental benefits/ opportunity cost program
Total hectares enrolled	1,436,634	1,771,230	1,771,230	1,006,724
Hectares at risk enrolled	12,470	23,207	23,307	11,956
Hectares from ejidos rejecting payments	365,400	15,751	15,751	0
Environmental benefits	226,927	405,675	405,675	226,337
Total budget	$14,420,350	$4,236,857	$14,420,352	$1,310,465
Efficiency (environmental benefits/$)	.016	.096	.028	.173
Gini coefficient of payments	.33	.70	.71	.67

The tradeoff between the flat payments program and the others is equity—its Gini coefficient is considerably lower than the others. (The Gini coefficient is an indicator of inequality that varies between 0 and 1. A score of 0 indicates perfect equality and of 1, perfect inequality.) It is interesting to note that this Gini of .33 is also considerably lower than that of the distribution of environmental benefits (Gini =.76) and of the forest in general (Gini =.73).

Conclusions

We find that the type of scheme typically implemented in PES programs in developing countries is very egalitarian, but highly inefficient. By maximizing environmental benefits per dollar spent, one can preserve the same amount of benefits at one tenth of the cost. A targeting program based on paying only for hectares at risk generates nearly double the environmental benefits of the actual scheme at the same price. A scheme based on paying only the opportunity cost of the forest generates the same amount of benefits, but at a much lower price than one which pays the environmental value of the hectares at risk. Clearly, implementing an environmental payments program is much more difficult than simulating one on a computer. The principles summarized here should, however, be of use to policymakers. In particular, taking into account the risk of losing environmental benefits, the value of these benefits and the opportunity cost will help immensely in designing programs that result in real environmental improvements without straining budgets more than necessary.

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