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Constructing Payment Schemes for Ecosystem Services at the Local Level

Methodological Approach and Some Lessons Learned

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Constructing Payment Systems for Ecological Services at the Local Level: Methodological Approach and Some Lessons Learned

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Introduction

The regulation of the hydrological cycle is an especially important ecosystem service for poor rural communities in general, and Central America is no exception. Although there have been several attempts to improve and/or maintain the flow of hydrological ecosystem services (HES), most have been short term and based on a traditional top-down approach consisting of command and control measures, ecosystem restoration, and technical assistance. As a result, they do not provide the necessary incentives to induce landowners themselves make production decisions that increase HES (Millennium Ecosystem Assessment [MEA] 2005). With a payment for ecosystem services (PES) scheme—sometimes called "markets for ecosystem services"—landowners should find it individually beneficial to make decisions about their land that are also socially demanded. The creation of PES schemes constitutes a new institutional arrangement that promises to solve the deficiencies of the more traditional instruments by assuming a more integrated approach to watershed management. Notably, PES schemes should be regarded as a complement, rather than a substitute, to these other instruments.

Still, given that HES are positive externalities arising from land use decisions that are costly to supply in most cases, and given that some free-riding is to be expected by the the beneficiaries of HES, PES schemes do not spontaneously appear and do not naturally survive. On the contrary, they need to be designed and nurtured by an agent that acts as mediator between suppliers and beneficiaries and, most importantly, acts as administrator of the scheme or market, thereby ensuring that "the goods" are truly delivered.

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This paper summarizes the methodological approach designed, used, and validated by CATIE and its partners in several local initiatives where some potential for this type of instrument was identified (Campos et al. 2005). It relies heavily on lessons learned from a case study in Copán, Honduras, in which a payment scheme for HES is currently ongoing (Cisneros et al. 2007; Retamal et al. 2007, Madrigal and Alpízar 2007)

An Integrated Approach: Evaluation, Design, and Implementation of HES

Independent of the type of agent promoting the creation of payment schemes for HES, a holistic approach is required to ensure that they work adequately. In this section, we briefly outline the approach used for the evaluation (are payments feasible?), design, and implementation of payments schemes for HES at the local level.

The methodology has four main components: (1) the construction of a dose-response function that captures the relation between land uses and the provision of HES demanded by the potential beneficiaries; (2) an estimation of the costs and benefits associated with each potential land use for the particular site under study; (3) the identification, and eventually measurement, of a demand for HES; and (4) the creation or adaptation of an institutional framework suitable for the scale of the initiative. In our experience, it is important to emphasize that these four elements by no means imply a linear decision-making process, but rather an iterative approach in which the demand, the supply, and the institutional framework affect and are affected by each other.

The municipality of Copán Ruinas in Honduras served as a case study to test the proposed methodology. Approximately 1000 families drink water from a system that is fed by surface sources coming from the micro-watershed of Sesesmil (total area of 39 km^2) and Marroquín (32 km^2). These sources are affected negatively by several activities, such as inappropriate land uses, illegal logging, fires, and agrochemical pollution. In our study, 119 hectares (of 487 hectares of relevant drainage area) were identified as high priority for HES provision, and 32 farmers were identified as key potential providers of these services.

Approximating a Dose-Response Function

A key problem with PES is uncertainty. At the moment, we do not have the information about the biophysical production function needed to establish with certainty the form in which a given land use (i.e., a dose) contributes to the generation of HES (i.e., a response), not to mention the satisfaction of water users in terms of availability and quality of drinking water.

The level of uncertainty and sometimes even misconceptions with which some PES schemes have been established is troublesome and might undermine the use of this instrument in general. Beneficiaries need to trust that the service they demand will be delivered in the future, and we believe that a best practice approach as proposed here can create that trust.

Uncertainty can be reduced by refining the dose-response function,[1] leading in turn to increased robustness and efficiency of PES. Unfortunately, this is costly. Still, at scales of intervention that are small (like a watershed or a municipality in Central America), it is possible to reach a high level of precision by constructing a land use index for HES.

A land use index is a list of land uses based on ordinal criteria, according to their contribution in the generation of HES. Land uses are subdivided into categories, and each level within a category is an incremental improvement compared to the previous level. Given the lack of information and the complexity of the ecosystems, the construction of such an index based on exact quantitative information is unlikely. In other words, it is not possible to establish a cardinal classification of the land uses that reflects exact marginal changes in the provision of HES. The ordinal classification represents a less rigid and more pragmatic alternative, but again it is only an approximation of the true dose-response function.

The land use index for the case of Copán Ruinas (table 1 shows part of it) has as its point of departure similar indexes for carbon and biodiversity (Alpízar and Madrigal 2005; Murgueitio et al. 2003). It is based on secondary information, field validation, and—most importantly—the active participation and consensus of a group of 30 international experts in the field, who met in a two-day workshop organized for this purpose. The index assigns a specific score to all land uses included. Scores range from 0, for presumed land uses that do not contribute at all to the provision of HES, to 1. The land use index for HES was constructed so that it was general

[1] We prefer the term "dose-response function" (as opposed to biophysical production function) in order to reflect the extreme level of simplicity used in our approach. For example, climatic and geographic variations, which are central elements in a biophysical production function, are not captured in the dose-response function.

enough to cover most productive activities in the humid tropics, but was not particular to the Copán case study.

The degree of complexity in constructing a land use index obviously varies depending on the type of ecosystem service. As mentioned above, CATIE in collaboration with partners (notably those that were part of the RISEMP-GEF project; see Pagiola et al. 2004) has built similar indexes for carbon and biodiversity.

Table 1 Sample from LUI

Category	Score	Use and/or land management
Perennial crops	0.2	Coffee: no shade, no soil cover
	0.5	Coffee: shade, no soil cover
	0.6	Coffee: no shade, with soil cover
	0.7	Coffee: shade and soil cover
	0.8	Certified organic coffee
Forest and plantations	0.2	Forest plantation with bare soil
	0.5	Isolated forest
	0.8	Young secondary vegetation
	1.0	Riparian forest
	1.0	Secondary forest with surveillance
	1.0	Primary forest with surveillance

Prioritization of Areas

Another important source of uncertainty that affects the construction of PES schemes is the targeting of the payments. Simply put, if payments are to successfully achieve the goal of *increasing* the provision of ecosystem services, they have to be targeted first to farmers who are not currently employing the environmentally friendly land uses and practices encouraged by the payments. A second objective, of *maintaining* the current provision of ecosystem services, is also valid and requires payments to farmers already using best practices. A different and related dimension of targeting is the geographic prioritization of areas. In our experience, focusing too narrowly on the first objective creates perverse incentives because it punishes "good" past behavior, so most likely a combination of the two objectives is the correct approach.

Obviously, targeting strategies differ depending on the ecosystem services demanded. For HES, we need to start by determining the relevant factors triggering a demand for increased provision of HES. In our experience, water quality and long-term availability are usually the main concern of local governments and water utilities, whereas stable and sustained water flows are more relevant to irrigation or hydropower generation. Land use practices in a particular watershed can have a significant effect on water quality (reduced sediment content and fecal coliforms, less agricultural runoff), particularly surface water. The effect is less clear, although still relevant, on average water flows. Finally, water quantity in most ecosystems is determined exogenously and, thus, little can be done in terms of land use to affect it.

In the case of Copán, water quality is the main concern, so our study started by identifying the main points of intake for the municipal water utility, and the corresponding drainage areas were mapped and characterized based on current and potential land use. This allowed us to move from the whole watershed (71 km^2) to a drainage area of 487 hectares, and from these to 119 highly prioritized hectares. The exercise of prioritizing areas was based on current and potential land use, as mentioned above, and risk of land use change. This is the result of having the dual objective of increasing the provision of HES, while still paying farmers who in the past adopted environmentally friendly farming practices and land uses. Please note that narrowly focusing on the minimum scale of the payment scheme means that no farmer within those 119 hectares can be left out the scheme. Risk of land use change is also determined by previous policy instruments. For example, the municipal government in Copán had already established an area of restricted use and had purchased land in the relevant drainage area, resulting in fewer high priority areas that needed to be included in the PES scheme.

Valuing the Costs of Providing Ecosystem Services

Estimating a land use index is only the first piece of information land owners need to make land use decisions. They also need to know the net benefits of each land use and the net costs associated from switching from one use to another. These costs and the methodology to estimate them depend on the required change from a baseline. If a certain land use needs to be completely changed, then the opportunity cost method is recommended. If improvements on existing uses are sufficient, then the change in productivity is the suitable valuation method. Three common practices recommended for the provision of HES that could be linked to productivity changes are more expensive inputs or cultivation methods (e.g., improved drainage), less use of agrochemicals, and reduced cultivation areas. The distinction is important because in many cases the generation of HES is carried out in human-altered landscapes, which, depending on the current management, can already have favorable attributes for the generation of HES. A complete change is not only expensive but may also be unnecessary.

In Copán Ruinas, for example, the costs associated with the conservation of forests were estimated using the opportunity-cost method, considering coffee growing as the best alternative use. This method was complemented by data on the cost of establishing and maintaining adequate forest protection through fences and monitoring, to mention just a few. In cases where land use improvements are promoted (for example, establishment of soil and water conservation techniques for annual crops), the productivity-change method was used. The determination of the type of necessary improvements and its possible adoption were analyzed in specific workshops with technicians and farmers from the region of Copán.

Design of Performance-Based Payments

The design of a performance-based payment scheme combines the land use index and the associated costs of each land use. The underlying logic is that incentives offered to the farmers to maintain or improve the environmental attributes of a particular land use should be positively correlated both to the magnitude of costs involved and, most importantly, to the generation of HES as reflected on the land use index. The key is to define a payment per point for each category of the land use index and to pay according to the marginal contribution of each land use present in the category.

Table 2 shows an excerpt of the performance-based payment proposal used in Copán. There are two types of payments: (1) payment for adoption of new land uses, and (2) maintenance payments. The actual payment for improving a particular land use is the result of multiplying the payment per point (US$ 232/hectare) times the index value for the respective land use. For example, if a farmer owns a coffee farm with no shade and bare soil (payment equal to zero) and wants to add cover to the soil in his farm, he will be paid $139 per hectare, distributed over three years. This is the result of multiplying 0.6*$232. The payment of $139 is a balance between costs and expected benefits. Adding soil cover to a coffee plantation is relatively cheap, but results in a high score compared to other practices. Hence, the high payment will clearly favor this practice.

The payment per point for each category results from dividing the total costs of adopting all the proposed practices in the category by the total number of points that can be achieved if all land use management practices are implemented. For example, the establishment payment per point (US$ 232) in the perennial crops category comes from the sum of the total costs of the perennial crops category ($604) divided by the total possible score of the category, i.e., 2.6.

It is important to add that establishment costs refer to the initial investments necessary to adopt land conservation practices or to implement a forest surveillance plan, for example. For the case of perennials, the opportunity cost is zero. Opportunity costs are only included for the case of forests and plantations.

Table 2 Example of Estimation of Performance-Based Payments for Land Use Investment Used in Copán Ruinas

Category	Score	Use and/or land management	Establish-ment costs (US$/ha)	Establish-ment payment (US$/ha)	Mainte-nance costs (US$/ha)	Maintenance payment (US$/ha)
Perennial crops	-	Coffee: no shade, no soil cover	-	**-**	-	**-**
	0.5	Coffee: shade, no soil cover	154	**116**	20	**20**
	0.6	Coffee: no shade, with soil cover	34	**139**	12	**24**
	0.7	Coffee: shade and soil cover	189	**163**	32	**28**
	0.8	Certified organic coffee	226	**186**	38	**31**

Notes: ha = hectare. Payment per point is **US$ 232/ha** for adoption and **US$ 40/ ha** for maintenance

In order to define maintenance payments, a similar estimation was used. Maintenance costs include also opportunity costs if applicable. If the coffee farmer in the previous example satisfactorily installed soil cover, after the third year, he would receive an annual payment equivalent to US$ 24/hectare. In addition, the farmer is free to adopt more improvements for his farm, which implies new payments.

Demand for Ecosystem Services

Ultimately the creation of a payment scheme for ecosystem services depends on the existence of beneficiaries that are willing to pay the costs of these services. On many occasions, local governments or NGOs have approached us with the idea of selling ecosystem services for which demand is non-existent (scenic beauty where there are no tourists), elusive (habitat for key species), or extremely cumbersome (carbon credits). Payments for HES are especially appealing precisely because the beneficiaries are in most cases clearly identifiable, whether water is used for drinking, irrigation, or hydropower generation.

Different beneficiaries of HES require different valuation techniques, but in all cases the aim is to estimate the maximum amount that they are willing to pay for the HES. This amount is just a reference, since ultimately the price is determined by a political negotiation between suppliers and beneficiaries. In theory, payments should cover the costs to the supplier of adopting land uses that increase the provision of HES in the relevant prioritized areas, and should be smaller than the aggregate maximum willingness-to-pay (WTP) of the beneficiaries. In practice, the estimation of benefits entails more methodological complications than do the supply costs. Further, most regulation of public utilities and services use cost-based pricing as the norm and HES are regarded as inputs into production that should therefore be paid at cost. In any case, the estimation of a demand for ecosystem services ultimately defines the scale and, hence, the level of ambition of payment schemes for HES, by determining the amount of money than can be raised through increased water fees.

In our case study, a standard contingent valuation study was used to estimate the population's willingness to pay for a project to protect surface water sources for the city of

Copán. Each family was willing to pay on average 16 lempiras (US$ 1) monthly as an addition to their water bill. This means that the expected maximum budget for the project is approximately $12.720 per year. The Municipality of Copán is currently using project funding to pilot the initial stage of the PES scheme, but the aim is to introduce a fee to the municipal water bill specifically to raise funds for the PES scheme. This new “watershed management fee” requires formal approval from the Municipal Council. The strategy is to wait for positive results from the field before actually spending political capital in passing the new municipal legislation. Here it is important to add that the Municipality of Copán is particularly well organized, so that charging a new fee to water users was perceived as politically realistic.

Legal and Institutional Framework

As mentioned above, payment schemes for HES do not appear spontaneously,[2] but rather require the intervention of an agent that acts as mediator. For HES, this agent is frequently a representative of the beneficiaries (e.g., water utilities, irrigation board) or a local government (municipality). In some cases, a local NGO has taken the lead.

The institutional framework should be adapted to the scale of the intervention (number of prioritized hectares and producers, funding) and should at the very least be capable of reaching agreements with suppliers of HES, monitoring contracts, and managing funds. These contracts are key to the success of a market for HES. They outline the land use index and the associated payments, and explain the conditionality of the payments and the sanctions for violating the rules.

In Honduras, the Water Law assigns municipalities the responsibility and enough autonomy to devise mechanisms for environmental protection, including payments for HES. Still, local norms are needed to regulate the sources of funding and the use of these funds. In Copán, this meant that a set of rules for the Payment for HES Fund was drafted and approved by the Municipal Council. So far, 23 producers have signed contracts (including 18 Maya-Chorti

[2] A notable exception is the bilateral “Coasian” agreements between a group of suppliers and one large beneficiary, for example, hydropower plants, bottling companies, and the like.

Indians) in an area of 150 hectares regarded as highest priority by the municipality's environmental unit.

Given that transaction costs are likely to be high compared to payments to suppliers, the local institutional framework should be kept to the minimum. In our experience, most local governments, irrigation boards, or water utilities already have the financial and technical capacity and the legal mandate to oversee the environmental management of their relevant catchments area, and this capacity should be used for the implementation of PES schemes. Where this capacity is not present, transaction costs are likely to severely hinder any implementation of locally financed PES schemes.

In Copán, transaction costs were estimated as roughly US$ 4000 per year[3] for the management of payments, approximately a sum of $12,000 to 29 producers in 119 hectares. Happily, the environmental unit of the Municipality of Copán already had the technical capacity to manage payments and monitor compliance with PES contracts. In summary, the expected budget collected via user fees is barely enough to cover the minimal scale of intervention, as determined by the sum of high priority areas in the drainage basin, excluding transaction costs.

Conclusions

Given the current and ever-increasing interest in payments for ecosystem services, it is important to have a standardized best practice approach for evaluating the feasibility of this instrument for a particular site. The methodology outlined above contains what we regard as the minimum elements for establishing a PES scheme to regulate the hydrological cycle and help it survive beyond the initial support of donors and NGOs. Importantly, the methodology does not compare alternative instruments, but only serves to determine the feasibility of a payment for HES scheme.

Clearly, the creation of a payment scheme for HES is far from a simple task or a quick fix, and this point seems to be too easily overlooked. The result is payment schemes that do not deliver the promised improvements either because payments are not targeted to the relevant areas

[3] This includes 15% of an accountant's time, 25% of a field operative's time (who has a degree in agronomy or forestry), transport, and materials.

and producers or the dose-response function is too imprecise. Even if beneficiaries are paying now, it is unlikely that they will accept a payment in the future unless some clear results start to emerge from the field. On the positive side, all of the problems are solvable, even for programs that started on a weak basis.

The validation of the methodology for the case study of Copán shows promising preliminary results. The farmers understand that the payments will depend on the land uses they make and the investments they carry out. However, monitoring these improvements implies significant transaction costs. From the beneficiary perspective, the municipality is currently funding the payments and is still in the process of transferring that cost to the ultimate beneficiaries.

A reality check is pertinent at this stage. In Central America, there are approximately 50,000 rural water utilities, some of them as small as a few dozen households. Most of them are severely limited in funding and are not able to raise enough fees to cover even operating costs.[4] This obviously leads not only to deterioration of their relevant drainage areas but also to overall deterioration of infrastructure (tanks, pipes, etc.). Still, access to potable drinking water is of public importance and national governments frequently subsidize operation costs. In such a setting, requiring that payment schemes for HES to be fully self-financed via increased user fees is wishful thinking. Just as in the case of operation costs, national governments may also need to subsidize watershed management. In some way, the central government also benefits from increased provision of HES via reduced public expenditure in health, improved productivity of the labor force, etc.

[4] This is mainly due to either the extreme poverty of their clients or the limited technical capacity to raise or charge fees.

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