Designing Payments for Ecosystem Services: Lessons from Previous Experience with Incentive-based Mechanisms[1]

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October 11, 2007

Classification: Social Sciences: Economic Sciences
Text pages: 15
Figure pages: 1
Abstract word count: 120
Paper character count: 46,147

[1] The authors gratefully acknowledge inputs from two anonymous reviewers, William Clark, Robert Stavins, Gretchen Daily, Pamela Matson, Nancy Dickson, Darby Jack, Jonathan Borck, members of the Sustainability Science Program at Harvard University, seminar participants at the 2006 Harvard-Stanford Ecosystem Services meeting, the 2007 RUPES conference, and the 2007 Yale ISTF meeting. Core funding was provided by a grant from the Ash Institute for Democratic Governance and the Alfred A. Taubman Center for State and Local Government at the John F. Kennedy School of Government, Harvard University. Support is also acknowledged from the Sustainability Science Program at the Center for International Development, the Kennedy School's Norberg-Bohm Fellowship (B. K. Jack), the Teresa Heinz Scholar for Environmental Research Grant (C. Kousky), and the National Science Foundation Graduate Research Fellowship (K. R. E. Sims).

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Abstract

Payments for ecosystem services (PES) policies compensate individuals or communities for undertaking actions that increase the provision of ecosystem services such as water purification, flood mitigation, or carbon sequestration. PES schemes rely on incentives to induce behavioral change, and can thus be considered part of the broader class of incentive- or market-based mechanisms for environmental policy. By recognizing that PES programs are incentive-based, policy-makers can draw on insights from the substantial body of accumulated knowledge about this class of instruments. In particular, this paper offers a set of lessons about how the environmental, socio-economic, political, and dynamic context of a PES policy is likely to interact with policy design to produce policy outcomes, including environmental effectiveness, cost-effectiveness, and poverty alleviation.

1. Introduction

Ecosystem services are the benefits that people derive from ecosystems, including both commodities and regulating, supporting, and cultural services (1, 2).[2] The type, quality and quantity of services provided by an ecosystem are affected by the resource use decisions of individuals and communities. When the benefits of an ecosystem service accrue mainly to those who make management decisions, as in the production of crops or livestock, private markets are likely to work relatively well in inducing service provision. However, when the benefits of an ecosystem service flow primarily to others, such as with water purification or climate stabilization, public interests and the interests of the resource manager may be misaligned. This difference in private and social benefits, or problem of "externalities," results in a classic market failure: individuals will tend to provide too little of the ecosystem service. This basic logic may explain much of the decline of important ecosystem services due to human pressures (2, 4).

Potential policy solutions to externalities problems include public provision of goods and services, private contracts between the provider and the recipients, encouragement of voluntary efforts by firms and individuals, direct government regulation, and hybrid mechanisms such as government supported trading markets (see Figure 1). Many government interventions to control externalities have taken the form of command and control regulation, which mandates that actors undertake specific actions and applies sanctions if they do not comply. In contrast, incentive-based policies address externalities by altering the economic incentives private actors face, while allowing those actors to decide whether and how much to change their behavior. Most incentive-based mechanisms have been initiated through public policies, although privately negotiated incentive-based solutions are possible. Incentive-based mechanisms include charges, (such as taxes, user-fees, and deposit-refund systems), subsidies, tradable permits (including markets for pollution reduction and tradable development rights), and market friction reductions (for example, liability rules and information programs) (5, 6).[3]

Recently, "payments for ecosystem services" (PES) has emerged as a policy solution for realigning private and social benefits resulting from decisions related to the environment. The PES approach is based on a theoretically straightforward proposition: pay individuals or communities to undertake actions that increase levels of desired ecosystem services. A formal definition has been given by Sven Wunder: "A PES scheme, simply stated, is a voluntary, conditional agreement between at least one 'seller' and one 'buyer' over a well-defined environmental service – or a land use presumed to produce that service" (7).[4] In the last decade or so, hundreds of new PES initiatives have emerged around the globe.[5] Costa Rica, Mexico, and China all initiated large-scale programs that give direct payments to landowners for undertaking specific land use practices that could increase the provision of hydrological services, biodiversity conservation, erosion prevention, carbon sequestration, or scenic beauty (10-12). Some

[2] Definitions of ecosystem services vary. Boyd and Banzhaf (3) distinguish between ecosystem functions – the biological, chemical, and physical properties of ecosystems – and ecosystem services – the aspects of ecosystems that are valued by humans. We use the term ecosystem services broadly to refer to both intermediate and final services.

[3] Incentive-based mechanisms may also be referred to as "market-based instruments" because they rely on price signals, like those in private markets, to convey incentives for behavioral change.

[4] Many projects which are called PES schemes fall short of this theoretical ideal definition in practice (8).

[5] A 2002 survey found examples of 287 "markets for environmental services" (9).

PES policies were initiated before the term "payments for ecosystem services" came into common usage and yet are based on the same theory. For example, the U.S. Conservation Reserve Program run by the United States Department of Agriculture has paid farmers to plant permanent vegetation on environmentally sensitive cropland since the mid-1980s (13).

PES schemes are similar in structure to other incentive-based policies for achieving environmental goals, as highlighted in Figure 1. Therefore, the accumulated experience with and research on incentive-based mechanisms has relevant insights for both academics and practitioners interested in payment schemes for ecosystem services. In this paper we draw upon the literature on incentive-based mechanisms for environmental policy to suggest lessons about how the socio-economic, environmental, and political context in which policies are implemented, together with policy design, influences the outcomes of PES schemes.

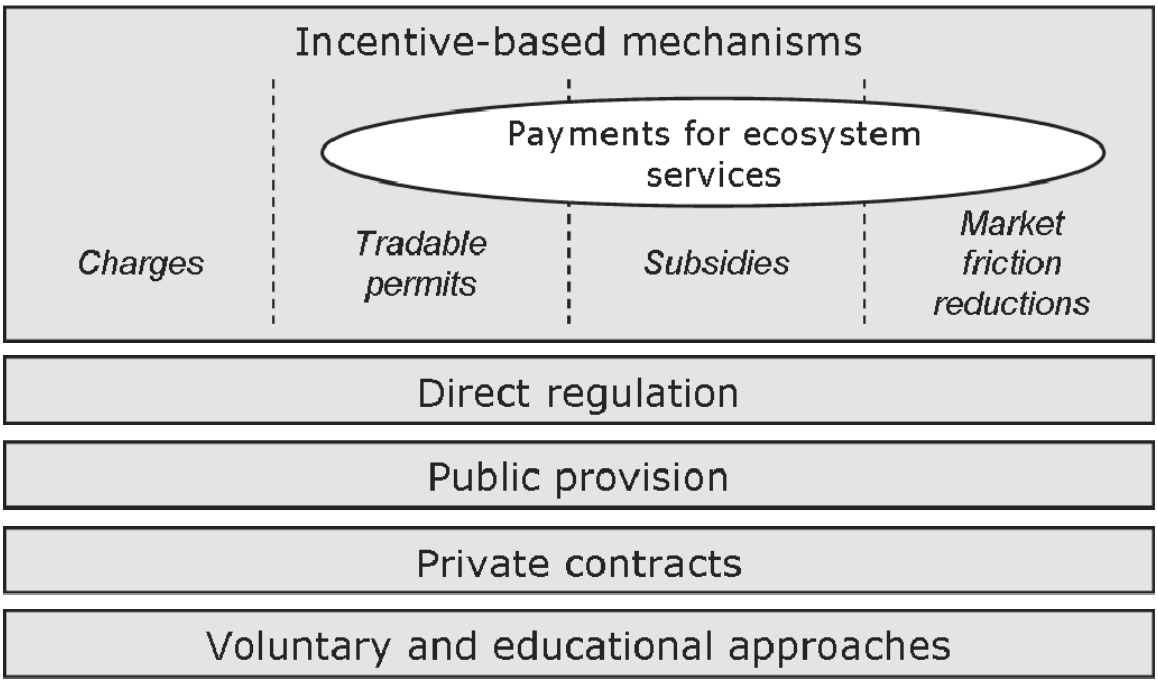

Figure 1. Locating payments for ecosystem services as an incentive-based mechanism within a broader suite of environmental policy instruments

2. Situating Policy Design in Context

As illustrated in Figure 2, the framework underlying the lessons presented in this paper is based on the assumption that context interacts with policy design, and that together these determine policy outcomes. We address four aspects of context – the environmental context, socio-economic context, and political context, as well as context dynamics. The policy outcomes we emphasize are environmental effectiveness, cost-effectiveness, and equity. To be environmentally effective, a project must deliver a set level of environmental benefits as defined by physical measurements. To be cost-

effective, a policy must achieve the same level of environmental benefits at a lower cost than other possible policies.[6] The costs of a PES scheme, from a social perspective, include not only direct implementation costs, but also the transaction costs of the program and the costs of forgone alternative productive uses of the resource, often referred to as opportunity costs. Transaction costs include the expense of negotiating contracts, scientific baseline studies, and monitoring and enforcement. Finally, while there are many possible aspects of equity that are important, we focus on poverty alleviation, because it is most frequently discussed in the emerging PES literature (8, 14, 15). We include equity as a relevant policy outcome even though there are many cases of PES policies, particularly in developed countries, where it is not an explicit goal of the program.

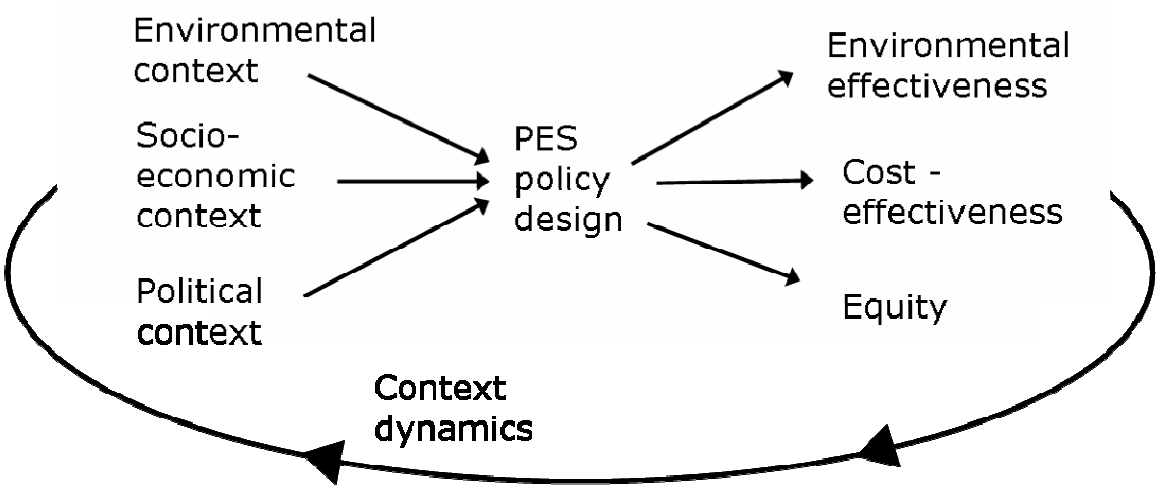

Figure 2. Context interacts with PES policy design to determine outcomes

Given these potential goals for PES policies, the likelihood that all three are achieved will depend on the design characteristics of a PES scheme as well as the context in which it is implemented. Variations in the structure of PES schemes include the form of the incentive or payment, which services are provided, who the providers are, who the implementers and intermediaries are, whether incentives are given to individuals or communities, the eligibility rules for participation, and how the payments are funded. For example, payments might be offered as a lump-sum given for actions such as planting a buffer strip, as a set rate for a scaleable action such as number of trees planted,

[6] The criterion of cost effectiveness takes as given a particular environmental goal (e.g. a level of benefits) and judges policies only on their cost side, by how cheaply a policy reaches that goal. Economic efficiency, on the other hand, compares benefits to costs, and judges a policy by the net benefits, or total benefits minus total costs.

through an allocation mechanism such as a reverse auction,[7] or indirectly through a system of differential use taxes such that tax rates are lower for landholders that engage in desired land uses. PES policies may be funded by taxes, NGO funding acquired from voluntary contributions, direct fees on service consumers, or through other mechanisms. Some PES schemes take the form of tradable permit systems, such as wetland mitigation banking or tradable development rights, some are subsidies, and others work as market-friction reductions by providing information about the origin of products, such as eco-labeling. Despite this variation, PES policies share a common element: as with other incentive-based approaches, payments for ecosystem services policies work by changing incentives, rather than making explicit rules or directives.

In the following sections, we present lessons for PES policy design based on previous experience with and research on incentive-based approaches, grouping the lessons by their relation to the environmental, socio-economic, or political context of implementation.

3. Environmental Context

Previous experience with incentive-based mechanisms has demonstrated that the properties of the ecosystem and/or pollutant under consideration – the environmental context – influence how a policy should be designed and what type of outcomes should be expected (16, 17). Similarly, the properties of the ecosystem service(s) being targeted in a PES scheme will interact with policy design to influence policy outcomes. Two lessons stand out from previous experience with incentive-based mechanisms.

When the marginal benefits from service provision are not constant, more complex incentive schemes are needed to achieve environmental effectiveness. In theory, incentive-based mechanisms can deliver the same environmental benefits as direct regulation. However, experience with pollution control mechanisms has demonstrated that the design of environmentally effective policies is more straightforward when marginal environmental benefits are constant across abatement sources. When marginal benefits are constant, the first ton of pollution abatement provides the same benefit as the 100th ton of abatement, and this is the case regardless of the source or location of the abatement. Constant marginal benefits simplify the design of a policy because expected environmental benefits do not depend on initial conditions, or on which of the agents reduces pollution. Thus, a per-unit tax or simple trading scheme can be used to predictably reach a given environmental target.

For many environmental problems, however, the marginal environmental benefits from an additional unit of abatement are not constant. Instead, they depend on source, location, and initial conditions. For example, toxic chemicals generally create health damages that increase at an increasing rate with the amount of exposure. When marginal environmental benefits are significantly different across sources, more complex incentive-based systems such as ambient permits, differential taxes, or trading zones are needed to explicitly differentiate between polluters based on the location or other characteristics (18).

Similarly, for PES policies, if the marginal environmental benefits of a particular ecosystem service are not constant, simple PES schemes that do not account for how

[7] In a reverse auction, landholders submit bids indicating how much compensation they require to undertake particular actions.

benefits change with different configurations of participants may not be environmentally effective. Many examples of non-constant marginal benefits and threshold effects are found in ecological systems including lakes, coral reefs, oceans, forests, and arid lands (19, 20). For example, the preservation of the habitat of a large predator might require a minimum area of land for species viability – below this level preservation offers no protection benefits with respect to that species. If a PES scheme simply compensates for individual land use changes without considering these irregularities, it may not achieve its environmental objective. However, several PES schemes have been developed that take into account non-constant marginal benefits in order to avoid this problem (e.g., 21, 22). It is important to remember, though, that increased complexity in design is likely to increase costs.

Assessments of the final environmental services depend on the certainty of the relationship between proxies and environmental benefits. Measuring the environmental effects of a policy can sometimes be impossible or prohibitively expensive. Thus, incentive-based policies frequently tie the incentives to a proxy for environmental benefits that is easy to measure and relates to the level of benefits provided. Many air emissions estimates are based on models of material inputs and production processes, for example, rather than on emissions measured in real time at the firm level (23).

Similarly, most PES schemes rely on observable proxies, such as actions or outcomes (e.g., the presence of buffer strips, or amount of forest cover), because direct monitoring of ecosystem service outputs is difficult or costly. Devising appropriate proxies requires an understanding of how activities, such as planting trees, relate to ecosystem functions, such as carbon storage, and ultimately to ecosystem services, such as climate stabilization. Depending on the type of ecosystem service, proxies may be relatively easy or difficult to use. The long-run viability of PES schemes may depend in part on advances in techniques to estimate ecosystem services from easily observable ecosystem properties.

4. Socio-economic Context

The socio-economic context – the distribution of resources, the prices of goods and services, and other features of the economy and social system in which a policy occurs – can alter the impacts of a policy. Three lessons are given below.

The greater the heterogeneity in costs, the greater the potential for a PES scheme to be cost-effective compared to a command and control approach. The great promise of incentive-based instruments for environmental policy goals, such as pollution control, is their potential to be cost-effective, compared to command and control solutions, by inducing an allocation of production or abatement that results in the least total cost. If, for example, pollution abatement costs vary, the lowest cost solution allocates emission reductions so that the marginal costs are equal across all providers. Any other allocation would require some of the burden to be shifted to a producer with higher control costs. A higher degree of heterogeneity among producers in terms of costs of abatement will generate higher savings compared to a command and control approach that requires uniform abatement across providers or an approach that does not allow flexibility based on cost of control (24).

PES schemes also have the potential to achieve a more cost-effective provision of ecosystem services relative to a mandatory approach that requires the same actions from all landowners. By offering a set payment for service provision, individuals who can produce the ecosystem service at or below that price have an incentive to enroll in the program, while those providers who have a higher opportunity cost of enrolling do not. A reverse auction for PES contracts can also induce the cost-effective allocation of service provision. Society as a whole gains the same amount of ecosystem services for less cost. However, whether a cost-effective allocation represents significant cost savings, compared to a uniform requirement from all landholders, depends on the heterogeneity of provider costs. Likely sources of individual heterogeneity in the costs of providing ecosystem services include differences in the opportunity costs of land use stemming from biophysical features of the land and its location, as well as individual characteristics of the landholders, such as education, risk aversion, and plot size. The cost-effectiveness of PES policies, compared to a uniform set of regulations, will tend to be higher where there is high variation in marginal provision costs across the population (25).

When the poorest providers are also those with the lowest opportunity costs and the highest service provision potential, PES policies are most likely to help alleviate poverty. Incentive-based mechanisms target the providers with lower opportunity costs. Therefore, the potential for poverty alleviation as a coupled policy goal depends partly on the coincidence between opportunity cost and poverty. For instance, poorer farmers may tend to own marginal lands with higher slope and lower soil quality, in which case the opportunity cost of leaving land in natural vegetation to increase ecosystem service provision may be lower. In this case, PES schemes have the potential to simultaneously direct payments towards the poor and towards the lowest cost providers of desired ecosystem services.[8] In addition, how the income of landowners varies with production of environmental benefits is relevant to whether PES policies will be able to improve equity (15). When land that produces a high level of services is held by poor members of society, then a PES approach may contribute to poverty reduction by paying these landholders for the services they provide (26). However, PES schemes are likely to make a true improvement in poverty outcomes only if they pay landowners an amount substantially higher than what they could have earned otherwise with the land.[9] This implies a likely tradeoff between the cost-effectiveness of the program and poverty alleviation.[10]

When resources are owned by many small-holders, transactions costs will possibly be higher – implying a tradeoff between cost-effectiveness and poverty alleviation. To accurately assess the costs of a policy, transaction costs must be considered. In particular, implementation, monitoring, and enforcement costs can be high under incentive-based approaches if contracts or requirements are tailored to individual users. All else equal, contracting and monitoring are cheaper when the

[8] Alix-Garcia, de Janvry, and Sadoulet (14) describe the opposite case in Mexico.

[9] If poor landholders are more risk averse, then they may demand greater compensation to switch to unfamiliar land uses. On the other hand, the payments under a PES program may be relatively certain compared to other income.

[10] At least one study has found that PES payments constitute only a small fraction of landowners' income, suggesting minimal equity impacts (27).

number of agents is small. The literature on incentive-based mechanisms frequently distinguishes between point-source emissions, which involve identifiable sources with fixed locations, and area or non-point sources, which are diffuse, mobile, or hard to identify. Monitoring and enforcement for point-sources is usually much cheaper. PES schemes are often focused on non-point sources, or many individual landowners whose collective activities alter the levels of a given ecosystem service. This feature will increase policy costs. It is possible, however, that working with a third party intermediary such as an NGO or a community could reduce the costs of working with a large number of providers (28).

5. Political Context

Decades of experience with incentive-based instruments have illustrated that the political influence of winners and losers from incentive-based policies will shape design and implementation (29-31). Similarly, some types of PES policies may be more politically feasible than others, ultimately influencing the range of potential outcomes. We highlight four lessons for PES policies with respect to political context.

The funding available to "buy" services depends not just on the latent demand for ecosystem services, but on the structure of the funding mechanism. The rationale for a PES approach is that the recipients of the services have some measurable value, or "willingness to pay" for those services. However, converting that latent demand into funding that reaches the suppliers of ecosystem services is a central challenge of PES schemes.

When services are linked to an excludable good, such as (in some cases) drinking water, beneficiaries buy the service directly through the market. In other cases, where ecosystem services are non-excludable, such as climate stabilization or biodiversity, there will always be an incentive for the beneficiaries to not pay and free ride – or hope to free ride – on the benefits provided by others. This is a lesson stressed by economists: people are unlikely to pay for something they can receive for free. This suggests that voluntary approaches such as donations to NGOs or purchase of carbon credits on the Chicago Climate Exchange are unlikely to generate funding close to the level at which the services are valued.

For ecosystem services that are public goods, then, compulsory mechanisms for demand generation or government payments for provision will be necessary to overcome free-riding. Transferable development rights are one innovative way to pay for services (e.g., 32). Under this approach, the developer pays to set aside land in one location and in exchange the government allows more intensive development elsewhere. Governments can also tax beneficiaries to raise money for PES policies, although who is targeted by the tax will clearly have distributional and political economy implications.

Although PES schemes can be more cost-effective overall, their political feasibility depends on the political power of those who bear the costs and benefits. Despite the potential cost-effectiveness of taxes and tradable permits for pollution control, the adoption of incentive-based approaches has been slow. In the United States, freely allocated tradable permits have been an exception, which is likely due to the fact that all stakeholders prefer this policy approach. The share of the burden paid directly by industry is low, environmental groups are more satisfied with the fixed cap on pollution provided by tradable permits as opposed to a tax, politicians benefit from the fact that the

allocation of permits can be arranged to satisfy influential players, and permits create a barrier to market entry, protecting existing firms (30).

Ecosystem service providers are likely to prefer a PES policy over traditional regulation because a PES approach offers compensation for environmental improvements and participation is voluntary. However, while a PES approach is likely to be favored by the landholders eligible for payments, overall viability will be determined by the preferences and power of all relevant stakeholders including beneficiaries of the ecosystem service, policymakers, financiers, community members, and program administrators. A non-governmental entity may have a better chance at implementing a PES scheme because the funding comes from outside and relieves local communities and taxpayers. Preferences for the policy may be determined not just by economic interests but also by broader concerns. For example, some PES projects in Bolivia met with opposition both from those who saw them limiting future economic development as well as those who saw them as a privatization of nature (8). Political considerations are also likely to change the shape of policies during implementation. For example, in Mexico's Payments for Hydrological Services program, funding targets were shifted away from key overexploited watersheds toward broader coverage with the purpose of more widely distributing program benefits (33).

Existing subsidies which are a product of the political process may interfere with effective incentives. PES policies may be undermined by existing subsidy programs or tax regimes designed to encourage resource use that is counter to the ecosystem service goals of the policy. In Indonesia, for example, the RUPES program is working to provide incentives to farmers to maintain jungle rubber mixed agro-forestry systems. At the same time, the government provides subsidies to farmers who clear land for conversion to rubber monoculture, which depletes environmental services (33). In some cases, eliminating an existing subsidy on an environmentally bad behavior might be as environmentally effective as creating a new incentive-based policy, and might create fewer other distortions (34).

Non-governmental actors will be more effective where they complement government institutions. While PES polices will almost certainly achieve better results in places with well-functioning civil institutions, PES schemes driven by non-state actors may be able to partially compensate for weak state institutions. For instance, non-governmental organizations can provide much of their own monitoring and enforcement capacity. As another example, for suppliers to be willing to modify their land use practices to engage in a PES initiative, they must perceive security in their ability to receive compensation for the modification. When this security is not provided by state legal institutions, it may be provided through informal institutions. PES schemes may be able to take advantage of existing cooperative agreements between local communities, as examples from Bolivia suggest (35). Gaining trust through a participatory process may help some PES schemes reduce long term monitoring and enforcement costs and promote equity outcomes (36, 37).

6. Context Dynamics

As environmental, socio-economic, and political contexts change over time, the signals created by incentive-based mechanisms will also change. Possible future changes should be taken into account when designing PES policies, since these dynamic changes

in context can alter how a policy performs, determining whether it is able to maintain a high degree of cost-effectiveness, environmental effectiveness, and equity over time.[11]

By changing prices, incentive-based policies may unintentionally enhance the profitability of an environmentally harmful activity, undermining environmental effectiveness. Incentive-based mechanisms work by changing relative prices, making environmentally beneficial activities more profitable and environmentally harmful activities more costly. However, the subsidy-like structure of many PES schemes carries with it many of the problems characteristic of subsidies (39, 40). The pollution control literature has demonstrated theoretically that a subsidy that provides firms with incentives not to pollute could also make it more profitable in the long run for some firms to enter the industry or to stay in the industry when they otherwise would not have (41). These firms produce additional pollution, reducing the environmental effectiveness of the subsidy.

Similarly, the additional environmental benefits provided by a PES scheme may be compromised by new entry or other responses to subsidies over time. Paying farmers to keep land in forest on some plots might increase the profitability of farming, leading to the clearing of additional plots (42, 43). Or, if land-owners are credit-constrained, receiving cash payments for good behavior on one parcel of land may provide the income needed to begin an environmentally harmful use on another. To the extent that PES programs are small and do not change regional prices, or if there is a fixed-factor of production, then this type of slippage or new entry is less likely to occur (41). These secondary effects must be taken into account when trying to measure the environmental benefits gained as a result of PES policies.

Incentive-based mechanisms can also create the conditions for "ransom" behavior: threats or undesirable actions aimed at leveraging additional compensation (44). If pollution reduction requirements for firms are assigned relative to a baseline, firms may deliberately increase pollution emissions to manipulate baseline emissions. Ransom behavior is also a major concern for PES programs. The problem of "ransom" can be alleviated by basing policies on a clear historical baseline or by basing incentives on levels of activities rather than changes. Providing incentives for levels, however, may create tradeoffs between avoiding ransom behavior and paying landholders for activities that might have occurred in the absence of the program (45).

Incentive-based policies that encourage innovation will be more cost-effective over time. Incentive-based mechanisms have the potential to provide an incentive for firms to look for and adopt new technologies that will lower the cost of protecting the environment in the long run. For instance, under a system of taxes or tradable permits, an innovation that lowers the cost of abatement will produce costs savings for the firm (46). Command and control regulation, on the other hand, does not usually reward firms for reducing emissions beyond the target and therefore fosters less innovation (47, 48).[12] Existing literature has demonstrated that innovation and investment in new technology are most likely to occur when rewards are tied to marginal improvements in environmental impacts and when flexibility is allowed in techniques for reducing

[11] One approach to addressing the challenges presented by context dynamics has been discussed in the literature on adaptive management (38).

[12] On pollution abatement and the inducement of technological change, see: (48) and (46). On technological change related to agriculture and natural resources, see: (49), (50), (51).

pollution and in the timing of reductions, allowing firms to choose from a wider set of possible abatement options (48). The extent to which innovation occurs is also likely to depend on agents' perceptions of the longevity of the incentive instrument (16).

Payments for ecosystem services can also offer incentives to adopt or invent innovative approaches to providing ecosystem services at lower cost. Since most PES policies base rewards on proxy actions rather than on production of final ecosystem services, however, the incentive to innovate may not be as direct. For example, the RUPES project in Indonesia bases rewards to farmers on erosion control activities on coffee farms, not on sedimentation loads in nearby streams. This type of system provides incentives to innovate over activities but does not encourage innovative approaches for further reductions in sediment loads. Allowing flexibility in methods by basing rewards on reductions in sediment loads would encourage additional innovation, but would be more expensive to monitor, and would force landowners to bear the risk that a given activity may not actually reduce sediment loading.

Allowing multiple ways to comply with an incentive-based approach will increase resilience to price changes that affect the production of environmental quality. Just as flexibility in methods for achieving environmental objectives can promote innovation, it can also allow firms to adapt to changes in prices, usually of inputs or technologies, which affect the cost of a particular method for pollution control (4). Similarly, when PES policies offer many ways of achieving service provision, participants will be more likely to withstand changes in the relative prices of technologies. For instance, if many different types of vegetation can be used for buffer strips, and there is an increase in the price of one species, landowners can switch to a cheaper alternative and continue to provide the service. By allowing a variety of ways to provide the same ecosystem service, either by increasing the range of allowable proxies or directly rewarding the ultimate service, participants are able to switch away from more expensive approaches in the face of price increases.

Price changes that increase the overall costs of the policy will have distributional consequences and could compromise the environmental effectiveness of the program. Prices could change in a way that makes the costs of providing the environmental good more expensive with any possible method; the ultimate effects of such a change depend on the structure of the policy. In a system of pollution taxes, an overall increase in the cost of abating pollution would lead to less pollution control, as more firms prefer to pay taxes instead of abate. In China, pollution levies on industry have decreased in effectiveness as the value of industrial output has increased while charges remain constant (23). In a system of tradable permits with a fixed cap, when the cost of abatement goes up, the price of the permits rise and firms bear a higher cost but the total amount of pollution control remains the same.

Changes in prices over time, particularly of agricultural goods, can have similar effects on PES schemes. Increases in agricultural output prices raise the opportunity cost of keeping land in natural vegetation. Both the budgetary costs (to the organization) and the true costs (the opportunity cost) may increase beyond original expectations. The distributional and environmental effects depend on how the PES program is structured: if landowners are locked into long-term contracts then the environmental goal may be met, but landowners will bear the increase in costs. If contracts are short-term then a budget increase may be necessary to sustain the environmental effectiveness of the project.

Private sector pressures on the land also represent a distinctive threat. If timber companies or oil palm plantations offer to buy a village's land, even the best-designed PES scheme may be unable to compete with changes in opportunity cost of this magnitude (52).

7. Conclusion

Payments for ecosystem services policies represent a growing trend in conservation policy. By altering private incentives to induce desired outcomes, PES schemes offer a direct and possibly more equitable method for achieving environmental outcomes than other approaches. However, the context in which a PES initiative is implemented matters greatly for effective policy design and achievement of stated goals. We have argued that insights about how context matters can be carried over from the existing literature on incentive-based approaches to environmental policy and applied to PES policy design and implementation.

The importance of context in achieving policy goals emphasizes that no single policy is right for every scenario. Previous experience with incentive-based approaches suggests it is unlikely a PES approach will always be able to simultaneously improve livelihoods, increase ecosystem services, and reduce costs. Potential tradeoffs among these goals can be assessed reasonably well by considering the correlation between characteristics of poor landholders and their land, characteristics of the costs and benefits of providing ecosystem services, and the political feasibility of different policy options.

The lessons also suggest other areas in which additional research is needed. Several PES projects that have been running in developing countries for some time are starting to offer provocative findings about the use of PES mechanisms (53, 54). New projects will only be able to learn from the successes and failures of their predecessors, however, if the manner in which outcomes relate to the environmental, socio-economic, and political contexts of the policy are systematically documented and compared across a range of cases.[13] With more long run experience, rigorous program evaluation will provide additional understanding of the effectiveness of different policy designs over time (55), as well as information on how PES schemes respond to exogenous shocks. Collaborations between ecologists and economists can better specify the production function for ecosystem services. This information will improve the design of input proxies and reduce the uncertainty surrounding environmental effectiveness. More research is also needed on how incentive-based mechanisms can account for potential trade-offs and synergies in the production of multiple ecosystem services. Additional analysis of large scale PES policies can help us to understand the broader effects on the economy from scaling-up PES schemes (12, 13).

[13] Several inventories of PES schemes are underway, including efforts by The Natural Capital Project and the Organization of American States.

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