Lessons Relearned: Can Previous Research on Incentive-Based Mechanisms Point the Way for Payments for Ecosystem Services?

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Abstract

Payments for ecosystem services (PES) are policies in which individuals or communities are compensated for undertaking actions that increase the provision of ecosystem services such as water purification, flood mitigation, and carbon sequestration. PES policies 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 PES programs as incentive-based mechanisms, policy-makers can draw on insights from the substantial body of accumulated knowledge about these instruments in order to gain a better understanding of the conditions under which PES schemes are likely to be environmentally effective, cost-effective, and equitable. In this paper, we offer six lessons from theoretical and empirical research on incentive-based mechanisms that we think deserve explicit consideration when designing and evaluating PES policies.

Keywords: environmental policy, market-based instruments, payments for ecosystem services, incentive payments, environmental benefits

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The Sustainability Science Program at Harvard's Center for International Development seeks to advance basic understanding of the dynamics of human-environment systems; to facilitate the design, implementation, and evaluation of practical interventions that promote sustainability in particular places and contexts; and to improve linkages between relevant research and innovation communities on the one hand, and relevant policy and management communities on the other. Further information on the Sustainability Science Program can be found at http://www.cid.harvard.edu/sustsci.

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1. Introduction

Ecosystem services are the benefits that people derive from ecosystems. These benefits include commodities, such as timber and fuel, as well as regulating, supporting and cultural services, such as flood mitigation, water purification, recreation, climate stabilization, and scenic beauty (Daily 1997; Millennium Ecosystem Assessment 2005).[1] The type and quantity of services provided by an ecosystem are affected by the land use activities of individuals and communities. When the benefits of an ecosystem service accrue mainly to those who make management decisions, such as is the case with the production of crops or livestock, private markets are likely to work well to induce service provision. However, when the benefits of an ecosystem service flow primarily to others, such as with water purification or recreation, public interests and the interests of the resource manager may be misaligned. This difference in private and social benefits is a classic market failure: individuals will tend to provide too little of the ecosystem service when some of the benefits go to others. This basic logic may explain much of the decline of important ecosystem services due to human pressures (Millennium Ecosystem Assessment 2005).

Recently, “payments for ecosystem services” (PES) has emerged as a potential policy for realigning private and social benefits. The PES approach is based on a theoretically simple proposition: pay individuals or communities to undertake actions that increase levels of desired ecosystem services. This approach has been lauded recently by practitioners and academics for its potential to achieve environmental, cost-effectiveness, and equity goals. By providing incentives to resource users for activities that supplement the flow of a given ecosystem service, the environment can be restored or protected. Using ecosystems to provide the services of water purification and flood mitigation has in some cases been cheaper than using built infrastructure such as filtration plants or levees and dams to provide these services (Appleton 2002; NRC 2004). If ecosystem service providers are poor, a PES approach may also improve equity by compensating them for contributing to the public good rather than forcing them to bear the cost.

In the last decade or so, hundreds of new PES initiatives have emerged around the globe.[2] Costa Rica’s 1996 Forestry Law is a well known example of a PES program. It gives direct payments to landowners for certified land use practices that increase the provision of hydrological services, biodiversity conservation, carbon sequestration, or scenic beauty. In another well-known case, New York City chose to invest in changing the management practices of farmers in the Catskill watershed to maintain the city’s water quality instead of building a filtration plant. Some PES cases have been around for decades. 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.[3] Other cases are less well known, such as RUPES (Rewarding the Upland Poor for Environmental Services), which has several sites in Asia. In one site in Indonesia, RUPES is helping farmers obtain conditional land tenure in exchange for adopting mixed agro-forestry systems that increase erosion control and biodiversity.

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[1] Definitions of ecosystem services vary. Boyd and Banzhaf (2005) distinguish between ecosystem functions—the biological, chemical, and physical properties of ecosystems—and ecosystem services—the tangible or intangible aspects of ecosystems that are valued by humans. They reserve the term ecosystem service for “final” services. We use the term ecosystem services broadly to refer to both intermediate services (such as carbon sequestration) and final services (such as climate stabilization).

[2] A 2002 survey found examples of 287 “markets for environmental services,” many of which fit the definition of PES scheme used in this paper (Landell-Mills 2002). The number has likely increased since then.

[3] This is just one of several USDA programs in the U.S. that might be considered PES policies.

As these cases indicate, the design of PES schemes is highly varied. Projects differ with respect to the ecosystem service, the number of service providers, who provides the incentive, whether incentives are given to individuals or communities, the form of the incentive, and the eligibility rules for participation. Despite this variation, Sven Wunder has proposed a definition: "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" (Wunder 2007). Many PES schemes, however, fall short of this definition in practice (Robertson and Wunder 2005). As this definition suggests, PES policies are conceptually part of the family of incentive-based or market-based mechanisms because PES policies rely on incentives for service provision, rather than explicit directives, to achieve desired outcomes.[4] Three decades of theoretical and empirical research on incentive-based mechanisms for environmental policy has allowed scholars and practitioners to better understand when and how incentive-based mechanisms can be used to achieve policy goals. Much of this accumulated wisdom can and should be brought to bear on the design and implementation of PES projects.

In this paper, we highlight six lessons about environmental-effectiveness and cost-effectiveness from the literature on market-based mechanisms for environmental policy and discuss their applicability to PES initiatives. For each insight, we illustrate how the institutional design features of a PES policy and the contextual conditions of implementation can make a PES approach a more or less appropriate policy choice. We also address the potential of a PES approach to contribute to poverty alleviation, discussing the impacts of each lesson on the possibility of using a PES program as a tool for poverty reduction. In the next section of the paper, we briefly introduce the literature on incentive-based mechanisms and explain the parallels between payments for ecosystem services and more widely studied incentive-based mechanisms for environmental policy. We also discuss why we choose to focus on cost-effectiveness, environmental-effectiveness, and poverty alleviation as our evaluative criteria. In section three, we present six major lessons from the incentive-based mechanisms literature and apply them to the PES approach. Section four concludes.

2. Incentive-Based Mechanisms and Payments for Ecosystem Services

2.1 Experience with Incentive-Based Mechanisms

As mentioned above, when firms or individuals make decisions, they account for the benefits and costs they face privately, but usually not the benefits and costs their actions impose on others. In cases when their actions impose costs, or negative externalities (e.g., pollution), too much of the activity will be undertaken. When the externalities are positive (e.g., education), individual actors will tend to produce too little. Potential policy solutions to externality problems include public provision of goods and services, private bargains or contracts between the provider and those who are affected, encouragement of voluntary efforts by firms and individuals, and government regulation. Most government intervention has taken the form of command and control regulation, mandating that certain actors undertake specific actions. In contrast, incentive-based policies address externalities by altering the incentives faced by private actors. 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), tradable permits, and market friction reductions (for example, liability rules and information programs) (Jaffe, Newell and Stavins 2002; Jaffe 2003).

[4] By relying exclusively on positive incentives, PES policies best resemble a sub-class of incentive-based mechanisms, which includes subsidies, tradable permit systems, and market friction reductions.

Incentive-based mechanisms may also be referred to as "market-based instruments" because they rely on market signals to convey incentives for behavioral change.

Incentive-based mechanisms have been implemented with the goal of improving environmental outcomes in many contexts, including the sulfur dioxide trading program in the United States, effluent charges in Western Europe, China, Malaysia, the Philippines, Ecuador, and other countries, motor-fuel taxes in many countries, state-level deposit-refund bottle bills in the United States, air-quality trading permits in Chile, and carbon trading in the European Union (Blackman and Harrington 2000; Jaffe 2003; U.S. EPA 2004). As this handful of examples suggests, incentive-based mechanisms have been used to address a wide variety of environmental problems, including water quality, air quality, over-fishing, and preservation of open space. Dedicated reviews of experience and theory of incentive-based instruments include Shortle and Horan (2001), Jaffe, Newell and Stavins (2003), and U.S. EPA (2004).

2.2 Payments for Ecosystem Services as an Incentive-Based Mechanism

As with other incentive-based approaches, payments for ecosystem services rely on changes in incentives to increase or maintain the delivery of publicly valuable ecosystem services. PES projects can take many forms, and resemble a suite of different incentive-based mechanisms. For example, a PES policy that pays landholders to undertake actions that increase a given service lowers the private cost of those actions, and thus resembles a subsidy.[5] Alternatively, compensation for actions might be provided in the form of avoided taxes through a system of differential use taxes (i.e., tax rates that are lower for landholders that engage in desired land uses).[6] Direct payments might be offered as a lump-sum payment for actions such as planting a buffer strip, as a set rate for a scaleable action such as number of trees planted, or through an allocation mechanism such as a reverse auction.[7] A PES project might also be based on contracts between private parties. Other PES schemes might take the form of tradable permit systems, such as wetland mitigation banking in the United States. Finally, PES policies might resemble market-friction reductions by providing information about the origin of products through eco-labeling. If buyers pay a premium for activities that improve ecosystem services, producers receive an incentive to maintain good practices.[8]

Due to the symmetries between PES and other types of incentive-based mechanisms, we suggest that the design and implementation of PES projects could benefit from close consideration of the lessons that have emerged from the study of existing incentive-based approaches to environmental policy. We will also highlight some of the potential differences. In particular, because most PES policies provide a positive incentive (in contrast to taxes or permits), their design should take into account issues common to subsidy-based instruments including new entry, ransom behavior, and the difficulty of establishing whether changes in behavior would have occurred in the absence of payments.

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[5] In theory, environmental taxes or subsidies can be set to align social benefits and costs perfectly so that private actors internalize the externalities imposed on others (Pigou 1920). In practice, this is difficult to achieve because of problems measuring cost and benefits and because of other distortions in markets. In addition, many subsidies are not used to address externalities, but for political or other reasons (see, for example, Myers and Kent 2000).

[6] Germany was an early adopter of this approach (Panayotou 1994).

[7] In a reverse auction, landholders submit bids indicating how much compensation they require to undertake particular actions, which reveal private information about their costs and can in theory identify low cost bidders. Some PES schemes are adopting this approach, following the success of the BushTender auction in Australia (Eigenraam et al. 2005).

[8] Market-friction reduction is a less direct incentive than most PES schemes because it relies on demand for the end product to provide an incentive.

2.3 Evaluative Criteria

The lessons that we will discuss are focused on three dimensions of environmental policy in general, and PES in particular: environmental-effectiveness, cost-effectiveness, and equity. To be environmentally effective a project must deliver the desired level of environmental services. A PES scheme that creates incentives for the conservation of standing forest might be undertaken to provide habitat for pollinators, carbon sequestration, water purification, reduction in sedimentation in a nearby river, or non-timber forest products. Some of these benefits may be retained at the local level (e.g., non-timber forest products), others at the regional level (e.g., water purification), and others at the global level (e.g., carbon sequestration). The ability of the policy to achieve the desired level of these services is its environmental-effectiveness.

To be cost-effective, a policy must achieve the desired environmental outcome at a lower cost than other possible policies. The costs of a PES scheme, from a social perspective, include the transactions 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. It is important to note the distinction between cost-effectiveness and economic efficiency. 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 the policy reaches the 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. To evaluate the overall efficiency of a PES policy requires economic valuation of the benefits from the project. This paper focuses on the choice of policy instrument to achieve a given goal, and thus on the cost-effectiveness rather than the efficiency of a PES policy.

The equity of a policy could be defined in many ways, all of which require the adoption of a normative position regarding income distributions. Poverty alleviation is the equity definition adopted in the *World Development Report (2006)*, and has been most frequently used in the emerging PES literature (Kerr 2002; Alix-Garcia, de Janvry and Sadoulet 2004; Pagiola, Arcenas and Platais 2005; Robertson and Wunder 2005). Accordingly, we choose to focus on poverty alleviation. However, we maintain that a focus on poverty is only one way to judge the equity of programs and other equally valid criteria could be considered, including procedural equity or distributional equity across members of the same income bracket or across geographical dimensions. Program design decisions for any incentive-based mechanism are likely to affect equity and following much of the literature on PES, we address it directly as a policy goal (Alix-Garcia, de Janvry and Sadoulet 2004; Zilberman, Lipper and McCarthy 2006).[9]

While PES policies may sometimes have the theoretical potential to achieve environmental-effectiveness, cost-effectiveness, and equity, previous research on incentive-based mechanisms has demonstrated that tradeoffs frequently occur among these objectives.[10] In keeping with the literature on incentive-based mechanisms, we focus, except where noted, on comparisons between PES policies and

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[9] Cost-effectiveness and distributional equity may also directly affect each other in complex ways. A more cost-effective policy saves money that could potentially be used to help the poor through other means, increasing equity more than accounted for under the specific program. And, in theory, a more accurate measure of social cost should take into account the distribution of costs, since taking away a dollar on the margin from a poor group generally has a higher utility cost than taking away a dollar from a well-off group. We stay with the convention of measuring cost-effectiveness in dollars, which implicitly weights dollars equally among all groups, and discuss equity as separate from cost-effectiveness.

[10] The equity-efficiency tradeoff has sparked lively debate among economists for several decades (Okun 1975; Osberg 1995). Zilberman, Lipper and McCarthy (2006) raise the difficulty in achieving multiple policy objectives with a single instrument.

command and control alternatives. In some cases, we also compare the impacts of a PES intervention with plausible outcomes under the counterfactual of no policy.[11]

3. Lessons Relearned

Lesson 1: The science of ecosystem services matters: achieving environmental-effectiveness may require a detailed knowledge of how environmental benefits are produced

Experience with incentive-based mechanisms for pollution control has demonstrated that the nature of the pollutant and how it interacts with the environment influences the environmental-effectiveness of the policy (Mendelsohn 1986; Hahn and Stavins 1992). In general, incentive-based mechanisms are easier to implement, relative to command and control regulation, when pollutants are uniformly mixed and have constant marginal damages. When the environmental benefits function has non-linear properties, as discussed below, environmental-effectiveness can be compromised if these non-linearities are not adequately addressed. This lesson suggests that an understanding of the science behind ecosystem services is critical for effective PES policy design.

L1.1 Thresholds and other non-linear properties of environmental benefits could compromise environmental-effectiveness or make policies difficult to implement

Policies to control pollution aim to reduce damage to human health and ecosystem functions. When total damages from a pollutant are linear, each additional unit of pollution causes the same amount of additional harm, regardless of the initial level or "stock" of pollution. As a result, the marginal benefits from pollution reduction are constant: the first ton of abatement provides the same benefit as the 100th ton of abatement. Constant marginal benefits (or approximately constant marginal benefits) simplify the use of a tax or tradable permit system because it is easier to estimate the level of environmental benefits that will result from a given tax or pollution cap. However, damages are often non-linear. For example, toxic chemicals generally create health damages that are steeply increasing in the amount of the pollutant. When this is the case, the damages to society change with additional units of pollution released. If the benefit function has a high degree of non-linearity in the range relevant to the policy and this is not taken into account in policy design, environmental-effectiveness could be compromised.[12] Thus, an understanding of the underlying chemistry, hydrology, or ecology of the pollutant or ecosystem service is essential for the design of effective incentive mechanisms for pollution control.

Similarly, for PES policies, if the benefits of a particular ecosystem service are non-linear, designing an environmentally effective policy requires knowledge of ecosystem functions to ensure environmental-effectiveness. Many examples of threshold effects are found in ecological systems including lakes, coral reefs, oceans, forests, and arid lands (see Muradian 2001; Scheffer et al. 2001; Janssen, Anderies and Walker 2004). In such cases, simple PES schemes that do not account for how benefits change with the scale of the project may not be environmentally effective. As a simple example, the preservation of the habitat of a large predator might requires a minimum area of land for species

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[11] Comparison could also be made with other types of conservation policy, for example the Integrated Conservation and Development Program (ICDP) model. However, to concentrate on parallels from the literature on incentive-based mechanisms, we neglect the comparison with ICDPs, referring the reader to Ferraro (2000).

[12] An extreme example is associated with eutrophication from fertilizer runoff. A lake may exhibit minimal environmental damage until a threshold level of nutrient loading occurs, at which point eutrophication sets in (Arrow et al. 2000). In this situation, prevention of eutrophication requires knowing how much loading will cause the system to "flip."

viability—below this level preservation offers no protection benefits with respect to that species. If a PES scheme simply compensates for habitat protection without considering this threshold effect, it may not achieve its objective. Some PES schemes use complex computer models to estimate how benefits change with each additional participant to avoid this problem (for an example, see Eigenraam et al. 2005).

Another type of non-linear effect is present when different ecosystem services are produced simultaneously, or when production of one service precludes production of another. For example, reforestation of an upper watershed undertaken to produce carbon sequestration benefits may increase biodiversity habitat, but may reduce downstream watershed benefits. One solution to these interconnections in service production may be to bundle services and provide incentives for provision of a group of services simultaneously (Landell-Mills 2002; Landell-Mills and Porras 2002; Eigenraam et al. 2005). In other cases there may be unavoidable tradeoffs among services.

L1.2 The spatial distribution of participants matters when environmental outcomes generate hotspots

A non-linearity in the benefits from pollution abatement also arises when the location of the pollutant's source affects the damages. When a pollutant mixes uniformly in the air or water, environmental benefits do not depend on the location of pollution abatement and thus the environmental-effectiveness of the policy does not depend on which agents abate. For uniformly mixed pollutants, a simple system of taxes or tradable permits, in which all agents face the same tax rate or permit rules regardless of location, can be effective. Carbon dioxide is a standard example of a uniformly mixed air pollutant, since emissions contribute equally to climate change independent of location. Many pollutants, however, do not mix uniformly over the relevant scale, such as ground-level ozone, mercury, and dioxin. In these cases, the spatial location of emission matters, so using simple taxes or tradable permits to control these pollutants may create "hot spots," or local concentrations of pollutants. To minimize this problem, more complex incentive-based systems such as ambient permits, differential taxes, or trading zones that explicitly differentiate between polluters based on the location of emissions may be needed.[13]

Similarly, the importance of spatial differentiation in the design of a PES policy depends on the characteristics of the targeted ecosystem service. For climate stabilization, the location of carbon sequestration is irrelevant from an environmental-effectiveness perspective. Water quality, on the other hand, may require explicitly engaging the landholders closest to a river or lake. Several PES programs have tried to take spatial location into account by varying the incentives based on location or spatial configuration of the participants. Recent rounds of the U.S. Conservation Reserve program rank bids according to an "environmental benefits index," which consists of a combination of factors under the farmer's control (choice of cover type and restoration practices) as well as geographic factors including air quality and water quality priorities.[14] Similarly, the EcoTender project in Australia ranks bids by landholders across multiple environmental benefits, explicitly taking spatial configuration into account through a sophisticated model that analyzes bid configurations to determine the maximum benefits for least cost across a variety of desired environmental services (Eigenraam et al. 2005).

L1.3 Additional scientific understanding of environmental production functions is needed in choosing proxies for changes in environmental quality

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[13] For example, the Los Angeles' RECLAIM system, an emission trading program, has zones for air pollution permit trading to prevent a high concentration of permits—and thus a concentration of pollution—in one location (Jaffe, Newell and Stavins 2002).

[14] Other programs and policies have been proposed in theory: ambient trading permits as far back as Montgomery (1972). Johst et al. (2002) looks at spatially explicit compensation payments and considers how payments can be tied to outcomes rather than activities.

Very few pollution emissions are measured in real time at the firm level because such monitoring is either technically impossible or too costly. The current continuous monitoring of sulfur dioxide (SO_2) and nitrous oxides (NO_x) by the U.S. EPA at major power plants in the United States is a notable exception. Usually, emissions estimates are calculated by measuring how much pollution results from production activities based on models of material inputs and production processes.[15] Incentives on emissions reductions are not direct, but target proxies such as changes in quality or quantity of input that are based on models of how these changes affect environmental benefits.

Similarly, most PES schemes rely on observable proxies, such as actions or goods (e.g., mixed agro-forestry cropping systems, buffer strips, or an amount of forest cover), because direct monitoring of ecosystem service outputs is difficult or prohibitively expensive. 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. In other words, a scientific understanding of the "production function" of ecosystem services is crucial to designing PES policies. Straightforward relationships between actions and ecosystem services that lend themselves to transparent, observable, and meaningful proxy activities improve the effectiveness of PES policies. The long-run viability of PES schemes will depend in part on advances in techniques to estimate ecosystem services from easily observable ecosystem properties.

L1.4 When incentives are targeted at certain providers to achieve environmental-effectiveness, PES programs can reduce poverty if the targeted providers are also the poorest

When the level of ecosystem services provided by a PES policy depends on the location of providers or on pre-existing levels of ecosystem services, achieving environmental-effectiveness will require differential treatment of service providers, as discussed in the sections above. When landholders critical to service provision, such as those nearest to a stream (in the case of improving water quality) or those with the steepest sloping land (as in the case of erosion prevention) also tend to be poor, then a PES approach may have positive equity implications, since the poor will receive incentive payments. The RUPES program, which targets upland communities and individuals in Asia, maintains that these communities are both essential for maintaining water quality and biodiversity, and tend to be among the poorest rural communities (Leimona 2004). However, in other cases, the landholdings that provide the most important ecosystem services are controlled by relatively well-off individuals or communities. For example, Zilberman et al. (2006) analyze the theoretical impacts of different geographical scenarios on equity and find that, according to their model, if more productive land generally generates more ecosystem services, then the wealthy are likely to gain from the policy. The poor will benefit, on the other hand, if less productive land generates more ecosystem services. The analysis suggests that complementarities are most likely to exist between equity improvements and environmental-effectiveness where environmental benefits are correlated with poor service providers.

Lesson 2: The costs of a policy are lowered by targeting emissions reductions to those who can abate most cheaply

The great promise of incentive-based instruments for pollution control is their potential to be cost-effective, compared to command and control solutions, by inducing an allocation of emissions control that results in the least total cost. If there are several polluters (or ecosystem service providers) with different costs, the least total cost solution allocates provision of the environmental good, in this case pollution reduction, so that the marginal costs are equal across all providers. It is the least expensive solution because any other allocation would require some of the burden to be shifted to a producer with

[15] For an example, see U.S. EPA (2004).

higher cost. Under an incentive-based mechanism, society achieves the same amount of pollution reduction as under a uniform pollution standard but at lower overall cost. However, the potential cost savings from the least cost allocation over a uniform allocation is larger when there is a higher degree of heterogeneity in abatement costs among different actors.

L2.1 The greater the heterogeneity in provider costs, the greater the potential cost savings

As defined above, a cost-effective approach to pollution reduction equates the marginal cost of abatement across firms by reducing pollution from low cost firms up to the point where an additional unit of abatement from any firm costs the same. Taxes on emissions can induce this type of allocation and are an instructive example. Under a tax, firms have an incentive to reduce pollution levels until the marginal cost of abatement is equal to the amount of the tax (assuming increasing marginal abatement costs). A firm would not choose to emit more because it would be cheaper to cut back by a unit than to pay the tax on that unit. Tradable permits provide the same type of incentive structure.

Because the cost-savings from these incentive-based mechanisms come from reallocating the burden of emissions reduction from firms with high abatement costs to firms with low abatement costs, the amount of heterogeneity in these costs is a key determinant of potential savings. A higher degree of heterogeneity among producers in terms of costs of abatement will generate higher savings compared to a uniform command and control approach in which all firms are required to reduce pollution by the same amount (Jaffe 2003). Command and control regulations could be similarly cost-effective if it were possible to mandate pollution reduction from each firm in proportion to its pollution control costs. This approach, however, would require that the government know pollution control costs for each firm—information that firms are unwilling to reveal to the regulator. Taxes and permits induce behavior consistent with this private information.

PES schemes also have the potential to achieve cost-effective provision of ecosystem services. If the government or other implementing agency offers a set payment level 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. Society as a whole gains the same amount of ecosystem services for less cost. A reverse auction for PES contracts can also induce the cost-effective allocation of service provision.[16] Whether a cost-effective allocation represents significant cost savings, compared to a uniform requirement from all landholders, depends in large part on the heterogeneity of provider costs. However, an incentive-based allocation of abatement responsibility should always be lower in terms of opportunity cost than a uniform command and control alternative.

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 risk preferences and other individual characteristics of the landholders. For example, a landowner may have lower opportunity costs of leaving land in natural vegetation if the land is poorly suited to agriculture due to steep slopes or low soil quality. If a PES policy requires labor inputs, such as planting buffer strips or terracing land, opportunity costs may be determined by alternate labor opportunities or distance between the land and the farmer's home. Heterogeneity in these and other costs may depend on the distribution of factors such as education, household size, equipment ownership, and landholdings in the relevant communities. Compared to a uniform approach, cost savings to society from

[16] Note that the cost of a PES policy, in economic terms, is measured by the underlying opportunity cost of changing land use (e.g., profit lost from converting a corn field to forest). The payment of cash to the landowner is not, by itself, a true cost of the program, since it could equally be counted as a benefit from the farmer's perspective. However, the cost of collecting and transferring payments should be counted as a cost of the policy.

a PES approach are likely to be higher where these land types and characteristics are unevenly distributed across the population.

L2.2 If agents with low opportunity costs of providing environmental outcomes are also poor, then incentive-based approaches are more likely to achieve both equity improvements and cost-effectiveness

Heterogeneity in costs has implications for whether PES policies can simultaneously achieve cost-effectiveness and equity. 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. Other activities, such as terracing for erosion control, might be more labor intensive on steeper, more marginal land, in which case poverty and cost of provision would be negatively associated. Alix-Garcia, de Janvry, and Sadoulet (2004) note that larger landholders in Mexico are better able to set aside a portion of their land for production of ecosystem services without compromising crop production or subsistence needs. Poorer landowners may also be highly risk-averse and reluctant to change land uses if there is concern about the trustworthiness of the implementing organization.

If the poorest resource owners have the lowest opportunity costs, then PES schemes have the potential to simultaneously direct payments towards the poor and towards the lowest cost providers of desired ecosystem services. If not, then PES policies might still improve the livelihoods of the poor by providing them with some payments, but at the same time increase income inequality by paying more to the already well-off.

Lesson 3: Cost-effectiveness also depends on other implementation costs, including transactions costs—particularly monitoring and enforcement costs

Experience with environmental policy evaluation highlights the importance of including both pollution abatement costs and the transaction costs of a policy for an accurate comparison of the costs of different approaches. We use the term implementation costs to refer to both of these costs. Transaction costs include the costs of developing the policy, transacting or contracting to implement the policy, and the costs of monitoring and enforcement. The implementation costs of an incentive-based mechanism could actually outweigh the savings generated by reallocating the abatement burden to low cost providers and thus should not be neglected when evaluating different policy options. Monitoring and enforcement costs can be particularly high and are thus given special consideration in this section. In general, monitoring is cheaper when the relationship between production activities and pollution levels is well understood and the number of agents is small. While the state can provide some monitoring and enforcement, in cases where state institutions are weak, PES initiatives led by non-governmental actors may be able to compensate for the lack of institutional capacity, although they are unlikely to substitute completely for the state. Whether monitoring and enforcement costs would be less under an incentive-based mechanism compared to other types of regulation is not clear, a priori. When the transaction costs are high for incentive-based mechanisms, they are often also high for other policy alternatives.

L3.1 Implementation costs are higher when many sources or suppliers are involved

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. Generally, point sources are fewer in number and therefore less costly to monitor than non-point sources. For example, tracing emissions from one factory is less costly than from hundreds of individually owned vehicles. While continual emission monitors are feasible for smokestacks in the U.S., the cost of tailpipe pollution monitors for every car on the road, if technologically possible, would likely override the benefits from precise monitoring. It is also more difficult for a firm with one smokestack to evade monitoring than it is for any given car on the road to avoid monitoring.[17] Granting emissions permits to a handful of major energy companies in the case of controlling carbon emissions is cheaper to implement than granting emissions permits for every car.

A similar distinction is evident in the literature on PES schemes. Working with a few large landholders or resource users is less costly than transacting with hundreds of smaller landholders. As a result, a program may focus on contracting with larger landholders at the expense of smaller holders. However, there will almost certainly be an important equity tradeoff between keeping transaction costs low by working with large landholders and enrolling the many smallholders, which in most cases, are also the poor (Shortle and Horan 2001).[18] Some methods have been developed to both limit costs for the implementing agency and allow smallholders to participate. Engaging groups of small landholders or working with a third party group that may be a more efficient intermediary between landowners and the payment organization may reduce overall transaction costs (Kerr et al. 2005). For example, in Indonesia, the government and RUPES are working with farmer groups for erosion control and biodiversity enhancement on private land, and in New York City, the city works directly with the Watershed Agricultural Council, which represents rural farmers.[19]

L3.2 Private organizations may complement public institutions in providing enrollment, monitoring, and enforcement capacity, and enhancing feasibility of the policy

Both incentive-based mechanisms and command and control regulations require enforcement, which in turn requires monitoring of compliance. Experience with incentive-based approaches to pollution abatement in both developed and developing countries demonstrates the importance of adequate state institutions for these purposes (Russell and Vaughan 1999; Greenspan-Bell and Russel 2002). Existing institutions in the country of implementation, including property rights, contract law, and law enforcement, affect the costs and feasibility of monitoring and enforcement. For example, part of the success of the SO_2 allowance trading program in the U.S. is attributed to the installation of individual monitoring devices on regulated plants and the stiff, credible fines for violation. In contrast, corruption within the enforcement of Poland's incentive-based policy to regulate airborne pollution emissions is seen to have weakened the effectiveness of the policy and allowed large, powerful emitters to evade punishment (Blackman and Harrington 2000; see also Damania 2002).

PES policies similarly rely on state institutional support for effective implementation.[20] Weak or poorly enforced contract law could lower the ability of an implementing organization to enforce PES

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[17] A branch of the literature on incentive-based mechanisms focuses exclusively on non-point sources and considers the additional difficulty in creating incentives when the sources of pollution are diffuse and difficult to monitor (Shortle and Horan 2001).

[18] These efforts may be undermined if the costs of enrollment fall largely on the landholders. In Costa Rica, landholders bear a portion of the contracting costs, which makes it harder for poorer, smaller landholders to enroll, since the costs have a high fixed component, including submission of legal documentation of title to the land and creation of a management plan (Chomitz, Brenes and Constantino 1999).

[19] Note that to lower the true costs of the program, rather than just pass them on to the intermediary or community, it must be the case that transactions costs within the group or with the intermediary are actually lower.

[20] A powerful example of the importance of institutions surrounds issues of land tenure in developing countries. Customary land-law practices in many developing countries have encouraged the settlement and cultivation of undeveloped land by favoring title claims to land that has been put to "productive use" (Alston, Libecap and Mueller 2000; Suyanto, Tomich and Otsuka 2001). Landholders with unclear title may fear that allowing land to return to a natural state, as many PES programs require, will cause them to lose ownership or control over the use of the land. Finally, eligibility requirements for some PES initiatives may involve government documentation or certification, which could present a barrier to participation for some landholders lacking formal documentation, as has been

agreements and may reduce trust between implementers and service providers. The presence of high levels of corruption can generate extremely high transaction costs, particularly where graft related to design and implementation of the policy rules affects targeting and enforcement (Ferraro 2006). Institutional support for PES programs is necessary, both for effective monitoring and enforcement, and for recruitment of and contracting with participants.

While PES programs 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.[21] 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, such the creation of trust between providers and the implementing organization. PES schemes may also be able to take advantage of existing cooperative agreements between local communities, as examples from Bolivia suggest (Wunder and Vargas 2005). Gaining trust through a participatory process may help some PES schemes to reduce long term monitoring and enforcement costs and to promote equity outcomes (McCann et al. 2005). For example, in comparing co-management with state management of natural resources, Birner and Wittmer (2004) hypothesize that the participation in decision-making that characterizes co-management will increase legitimacy of policies and thus reduce monitoring and enforcement costs. If PES projects are characterized by participation in the policy design then the higher ex ante costs may reduce ex post costs.

We conclude that while PES schemes have the potential to be lower cost than command and control alternatives, they cannot be assumed to always be cost-effective. Cost-effectiveness will be determined by the specifics of the situation, namely, the degree of heterogeneity among providers, and the magnitude of transaction costs. Furthermore, new institutions may be needed to reduce tradeoffs between cost-effectiveness and equity.

Lesson 4: Incentive-based mechanisms may create incentives for unanticipated undesirable side effects or be undermined by existing subsidies

Incentive-based mechanisms work by changing relative prices—making environmentally beneficial activities more profitable and environmentally harmful activities more costly. These price changes are fundamental to policy success, but they can also generate unwanted side effects. Among the suite of incentive-based mechanisms, subsidies are often seen as particularly problematic (Bramhall and Mills 1966; Dewees and Sims 1976; Baumol and Oates 1988). Two major concerns with subsidies are new entry (or slippage) and "ransom" behaviors. PES programs, like other environmental policies, may result in the relocation of environmentally harmful activities beyond the reach of the policy. Finally, the existence of other existing subsidies can undermine the desired effect of the mechanism. The secondary

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suggested in Meico's PES program (Muñoz-Piña et al. 2005). The model used in Alix-Garcia et al. (2004) demonstrates the importance of property rights for equity outcomes. If landowners tend to be wealthy, and the project targets owners but not sharecroppers, then the elite will gain from the policy. If, however, the policy targets labor as a "working lands" program, the poor may also benefit. Where land tenure is insecure, landholders may be less willing to make investments in the land because of uncertainty over future tenure (Suyanto, Tomich and Otsuka 2001).

[21] Withholding payments might be more effective for inducing compliance than threatening punishment. However, enforcement of reward systems may also be problematic. For instance, it may not be possible to separate land use changes caused by extreme natural events from those caused by deliberate, human-induced alteration.

policy effects discussed in this lesson should be taken into account when designing or reviewing PES policies, just as with any environmental policy.

L4.1 Rewarding environmentally beneficial behavior may induce new entry or ransom behaviors

Subsidies are rarely advocated by environmental economists for pollution reduction. A subsidy that provides firms with incentives not to pollute will also make it more profitable for some firms to enter the industry or to stay in the industry when they otherwise would not have (Feng et al. 2003). These firms produce additional pollution, reducing the environmental-effectiveness of the subsidy.

PES policies also face the possibility that new entry will compromise environmental benefits. For example, paying farmers to keep land in forest on some plots might increase the profitability of farming, leading to the clearing of additional plots.[22] If landowners 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. In some instances, new entry is unlikely to be a problem, or could actually be beneficial. In the New York City watershed case, for example, farming is preferred to residential and commercial development, so higher profitability associated with farming, and the possibility of new entry, is preferred to the development alternative (Appleton 2002). Even in cases where new entry is a concern, to the extent that PES programs are small and do not change regional prices, or if there is a fixed factor of production, then slippage or new entry is less likely to occur.[23]

Incentive-based mechanisms can also create the conditions for “ransom” behavior: threats or undesirable actions aimed at leveraging additional compensation. Incentives are often defined relative to a baseline state. If the baseline is not established from historical data, then firms may deliberately increase pollution emissions to manipulate their baseline, making abatement under the incentive-based policy cheaper or allowing the firm to demand additional compensation.

Ransom behavior is a major concern for PES programs. For instance, a PES policy that explicitly targets “high-risk” forest to enhance environmental benefits creates an incentive for individuals to threaten to cut down or preemptively clear forest to qualify as “high risk” and become eligible for payments. A program that subsidizes a switch in practices, such payments for adoption of shade grown coffee, creates an incentive for farmers already growing shade-grown coffee to clear the shade trees to become eligible for payments to replant the trees. The problem of “ransom” can be alleviated by basing policies on a clear historical baseline that cannot be manipulated in advance of the program, 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 would have occurred in the absence of the program, reducing cost-effectiveness.

L4.2 Environmental-effectiveness may be compromised if undesirable activities move to another location or if positive behaviors would have occurred in the absence of payments

Environmental economists have devoted considerable research to determining whether environmental policies cause polluting industries and activities to relocate to less regulated jurisdictions (Markusen, Morey and Olewiler 1993; Rauscher 1997). Since regulation raises the price of a polluting

[22] There is a debate in the literature about whether the US Conservation Reserve program is causing substantial “slippage” through the entry of new farmland into production (Wu 2000; Roberts and Bucholtz 2005; Wu 2005; Roberts and Bucholtz 2006).
[23] According to Feng, Kling et al. (2003), if there is a fixed factor (such as the stock of land targeted under a PES program) associated with production of the externality-generating industry, then the value of the subsidy will be capitalized in to the fixed factor’s price, making new entry less likely.

activity, it creates incentives for firms to relocate to unregulated areas. If firms simply move away from the area of regulation and continue to pollute, then the environmental-effectiveness of the policy is compromised. This problem is, however, not specific to incentive-based approaches.

A program of payments for ecosystem services could also result in relocation. For example, logging becomes relatively less profitable when alternative land uses, such as maintenance of forest cover, are eligible for payment. As a result, logging may simply shift to areas where no PES scheme is in place. In addition, a PES policy may reduce the supply of timber, driving up regional prices and further encouraging logging in nearby areas. If all activities move to another jurisdiction, the policy provides no net benefits. This problem suggests that PES programs will be more effective if they work with neighboring regions to reduce relocation of harmful activities—although there is clearly a limit to this approach.

An accurate evaluation of the environmental benefits of any environmental policy should compare what happened under the policy to what would have occurred in the absence of the policy (Ferraro and Pattanayak 2006). With PES programs, a major concern involves payments made to landholders who would have undertaken the same activity in the absence of the program. For example, Mexico's national program for payments for hydrological services inadvertently targets areas where deforestation risks are low, which suggests landowners receive payments although they would not have cut down their trees without the program (Muñoz-Piña et al. 2005). Since it is impossible to observe the counterfactual directly, the best possible alternative involves creation of a control group for comparison or scenarios modeling. Given the many factors that change production in different locations, it may be difficult to assess whether a PES program is directly or indirectly responsible for changes. A recent article by Ferraro and Pattanayak (2006) lists several possible methods for rigorous program evaluation.

L4.3 Incentive-based mechanisms may be undermined by environmentally harmful subsidies

Existing subsidies can also alter the effectiveness of an incentive-based mechanism. For instance, subsidies to coal producers in industrialized countries undermine policies aimed at reductions in greenhouse gas emissions. 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 (Anderson and McKibbin 2000).

The same logic holds for PES policies, which may be undermined by existing subsidy programs. Many developing countries actively support land use changes or environmentally-harmful behavior through subsidies for agricultural credit, infrastructure, fuel, or outlying settlements. 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 (Kartodihardjo and Supriono 2000). Removing the government subsidy for rubber might increase service levels more than implementing a PES policy on top of the harmful subsidy.

L4.4 New entry, ransom, and conflicting subsidies may reduce a policy's ability to help the poor

While positive incentive programs may be designed to benefit small landholders or to relieve poverty, the benefits from these incentives or subsidies may be captured by more powerful actors. New, larger market players may enter the market after the implementation of a policy, distorting the original intentions and possibly capitalizing upon economies of scale in collecting subsidies. In addition, better-off landholders may be able to relocate more easily, taking advantage of policy changes for individual profit. Reducing other subsidies that undermine the effectiveness of a PES policy might undermine poverty alleviation goals if the other subsidies were designed to assist poor producers. Ransom behavior might, perversely, improve equity outcomes if those who hold the implementing organization for ransom are poor providers. If targeting is design to focus on high conversion risks, which increases environmental-effectiveness, poor landholders in remote areas at little risk for development may be ineligible (Alix-Garcia et al. 2004). In each of these situations, a policy may face tradeoffs between environmental-effectiveness and poverty alleviation goals.

Lesson 5: Effective solutions today may not be effective solutions tomorrow: design should consider the possibility of change

The costs of undertaking environmentally beneficial activities are dynamic. As a result, a policy that is cost-effective or environmentally-effective during the policy design phase may not be so in the future. With respect to technological change, incentive-based mechanisms can create additional long-term cost savings by inducing dynamic technological change if they provide incentives for continuous improvements in reducing abatement costs (Jaffe and Stavins 1995). PES policies have the potential to do the same, and are more likely to do so when incentives are directly tied to flows of ecosystem services. With respect to price changes that affect the costs of alternative methods for meeting environmental targets, allowing flexibility in methods is key to maintaining cost-effectiveness. Price changes that increase the overall costs of the policy will have distributional consequences and could compromise the environmental-effectiveness of the program. Awareness of these possibilities and their equity consequences may help design policies that appropriately incorporate these possible changes.

L5.1 Incentive-based mechanisms are more likely to induce dynamic technological change if rewards are closely tied to environmental benefits and policies are perceived to be long term

Incentive-based mechanisms provide an incentive for firms to look for and adopt new technologies or practices that lower the costs of compliance. Under an incentive-based mechanism, any innovation that lowers compliance costs produces costs savings for the firm—presuming sufficiently inexpensive technology can be found and adopted (Jaffe and Stavins 1995). Command and control regulation, on the other hand, does not usually reward firms for reducing emissions beyond the target and therefore fosters less innovation (Jaffe, Newell and Stavins 2002). Different types of incentive-based mechanisms create stronger or weaker incentives for innovation; environmental economists have devoted attention to the analysis of optimal policy design for inducing technological innovation.[24] This literature points out that innovation and investment in new technology are most likely to occur when rewards are associated with outcomes instead of proxies. Taxes and tradable permits are most effective when they reward marginal improvements in environmental outputs and when flexibility is allowed in techniques and timing (Jaffe 2003), which allows firms to choose from a wider set of possible technologies.

Compared to command and control approaches, payments for ecosystem services can also offer incentives to adopt or invent innovative approaches to providing ecosystem services at lower cost. However, since most PES policies reward proxy actions rather than production of final ecosystem services, the incentive to innovate over the desired outcome is weakened. 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 techniques for the activities but does not encourage innovative approaches for reducing erosion beyond those compensated under the PES program. Allowing flexibility in methods by basing rewards on reductions in sediment loads would encourage additional innovation.

[24] On pollution abatement and the inducement of technological change, see: Jaffe (2003) and Jaffe (1995). On technological change related to agriculture and natural resources, see: Sunding and Zilberman (2001), Zilberman (1997), and Ruttan (2001).

In addition, the extent to which innovation occurs is likely to depend on agents' perceptions of the longevity of the incentive instrument (Hahn and Stavins 1992). If firms believe the policy will be in effect well into the future, finding a lower cost way of complying generates larger benefits than if the policy is perceived to be short lived. Similarly, PES projects are more likely to encourage innovation if there is the perception that they will be recurring and are funded for the long term.

L5.2 Policies that allow flexibility in proxies will be more resilient to price changes that affect a particular method of increasing environmental quality

Just as flexibility in methods for achieving environmental objectives can promote innovation, it can also mean that firms or ecosystem producers are more able to adapt to changes in prices, usually of inputs or technologies, that affect the cost of a particular method for pollution control. Allowing power plants in the U.S. to choose between scrubber technology and switching to low-sulfur coal to meet Clean Air Act requirements meant that a decrease in the price of low-sulfur coal due to lower transportation costs could be taken advantage of by regulated firms to generate significant savings (Ellerman and Montero 1998). This type of flexibility in methods has been more common under incentive-based regulatory schemes than under command and control alternatives.

Similarly, PES policies (or other policies) that allow flexibility in the activity proxies for the environmental service will be more likely to withstand changes to the relative prices of technologies to provide ecosystem services. 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.

L5.3 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 also change in a way that makes the costs of providing the environmental good more expensive with any possible method. In a system of pollution taxes, if the level of the tax stays the same, the cost increase would decrease reductions by firms and lead to less overall pollution control. [25] In a system of tradable permits with a fixed cap, the price of the permits would rise and firms would bear a higher cost but the total amount of pollution control would remain the same.

Potential changes in prices, particularly agricultural output prices, can have similar effects on PES schemes. Increases in agricultural output prices raise the opportunity cost of keeping land in vegetation. Both the budgetary costs (to the organization) and the true costs (the opportunity cost) may increase beyond original expectations. The distributional effects depend on how the PES program is structured: if landowners are locked into long-term contracts then they will bear the increase in costs; if contracts are short term then a budget increase may be necessary to sustain the project. If payments cannot rise because of a fixed program budget, such price changes would threaten the environmental-effectiveness of the program. A command and control mandate or long-term contracts could potentially avoid this problem, though the costs of enforcement might go up because of the increased incentive to cheat if compliance becomes more costly.

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[25] In China, pollution levies on industry have decreased in effectiveness as the value of industrial output has increased while charges remain constant (U.S. EPA 2004).

PES programs may also be susceptible to other sources of external change that undermine project feasibility. Scenarios involving the emergence of less costly built infrastructure alternatives to environmental services would lower the potential benefits of the ecosystem services, possibly making the source of funds for the payments less willing to provide financing. 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 (Engel and Palmer 2005).

L5.4 The use of proxies suggests tradeoffs among equity, feasibility and environmental-effectiveness

A policy design that induces technological innovation may create negative equity impacts if those with greater resources are better able to invest in innovative approaches and compete for additional contracts. On the other hand, the cheaper technologies resulting from the innovation process may also benefit less well-off members of society.

As discussed above, policies that allow flexibility in methods or directly reward environmental outcomes can increase the incentives for innovation and technology adoption and may make policies more resilient to input price fluctuations, providing significant cost savings. [26] However, paying landholders based on ecosystem services outcomes rather than actions also shifts some of the burden of risk from the implementing organization to the landholders, which may be undesirable from an equity standpoint. If providers of ecosystem services are poor, they may also be more risk averse and would not participate unless the implementing organization shoulders the risk. In addition, having a variety of proxies or measuring final ecosystem services will make monitoring and enforcement more expensive, as previously discussed. A tradeoff between preferable risk allocation and straightforward monitoring and enforcement on the one hand and adaptable, environmentally effective policy on the other hand may be difficult to avoid.

Changes in technology and prices will create equity impacts independent of the existence of a PES policy. To the extent that the incentives or compensation provided by a PES scheme can buffer the poor from the negative impacts of changes, for example by guaranteeing a stream of payments in exchange for on-farm activities, these policies will enhance equity.

Lesson 6: Political feasibility depends on both design and institutional context

Decades of experience with incentive-based instruments have illustrated how environmental policies are shaped by the political process (Keohane, Revesz and Stavins 1998; Horan and Shortle 1999; Oates and Portney 2003; Aidt and Dutta 2004). Political economy models suggest that policy outcomes are influenced by competition among groups with a stake in policy outcomes. The political and financial strength of these groups and the institutional rules of the political "game" determine the extent to which they shape policies to their advantage.[27] Thus, depending on the design of an incentive-based mechanism, the political context, and who wins and loses from the policy, it may be more or less feasible than other policy approaches. Similarly, PES policies have the potential to be politically feasible

[26] For example, Antle et al. (2003) find that contracts for carbon sequestration based on crude proxies of land use versus contracts based on more detailed information about a farmer's specific production system may be as much as five times less efficient, although the answer depends strongly on the degree of spatial heterogeneity.
[27] If the gains are concentrated among a small number of people while the costs are borne by a large number, the smaller number is more likely to overcome barriers to collective action and lobby successfully (Olson 1965). However, if all constituents are informed about the program and it is sufficiently important to affect their vote, the larger group may have an advantage.

solutions to improving ecosystem services, particularly when they provide benefits to those with political influence.

L6.1 The political feasibility of incentive-based approaches depends on the political influence of the winners and losers

Despite the potential cost-effectiveness of taxes and tradable permits for society as a whole, the adoption of major environmental legislation using incentive-based approaches has been slow. In the United States, freely allocated tradable permits have been an exception. These permits are particularly politically feasible because the burden paid by industry is substantially lower than under a tax system. In addition, 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 existing firms support the barrier to entry created by awarding permits only to existing firms (Keohane, Revesz and Stavins 1998). In Europe, taxes have been relatively more feasible, perhaps because of the different political context, in which environmental lobbies are stronger than in the United States and the multi-party political systems change the rules of influence.

Payments for ecosystem services policies may have gained in popularity in part due to their political feasibility. Ecosystem service providers are likely to prefer a PES policy over traditional regulation because a PES approach provides compensation for environmental improvements. In the state of Georgia, for instance, a program to suspend irrigation permits during drought years met with political resistance when proposed as a command and control policy but was able to move forward through an auction mechanism where farmers were compensated for retiring irrigation permits (Cummings, Holt and Laury 2004). In addition, since PES schemes are voluntary, only those who are made better off through participation will join. Costa Rica’s program generates demand for contracts in excess of the program budget, suggesting that many landholders perceive that they will be made better off by the policy.

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 relevant stakeholders including policymakers, financiers, citizens, program administrators, and other institutions affected by the program. These groups can influence whether a policy is adopted and the form it takes. In Mexico, a set share of water revenues has been set aside for a PES program in a highly politicized process. Initially, the National Water Commission was reluctant to view ecosystems as providing hydrological services and the Ministry of Finance had to be convinced the policy was financially viable (Muñoz-Piña et al. 2005). In another example, PES projects in Bolivia have met with opposition from both those who see it as preventing Bolivia’s future development, and those who see it as a privatization of nature. A PES scheme for carbon sequestration was derided in the local media as “selling oxygen to the gringos” (Robertson and Wunder 2005).

L6.2 A focus on equity may affect the political feasibility of a policy

The political economy process will have an impact on whether policies can be implemented to achieve poverty alleviation goals. Since better-off beneficiaries tend to have greater political influence, policy benefits may tend to accrue to these groups. The implementation of a PES project by a non-governmental entity offers a potential solution this problem. The use of funding from outside of the circle of political stakeholders relieves local communities, taxpayers, and the government from the burden of funding the scheme, and thus may present a feasible alternative to a government-led program. While pro-poor project design may be more feasible under a NGO led initiative, non-governmental actors still must abide by the demands and interests of donors, managers, and constituents. On the other hand, an emphasis on equity may enhance the political feasibility of PES policies, particularly in countries and with non-governmental actors that prioritize poverty alleviation over environmental concerns. Political feasibility may be improved, and greater synergies between environmental-effectiveness and equity achieved by framing PES projects as both pro-poor and pro-environment.

4. Conclusion

Payments for ecosystem services represent a growing trend in conservation circles. By altering incentives to induce desired outcomes, PES schemes offer a more direct and possibly more equitable approach to achieving environmental outcomes than is often employed by conservation practitioners. However, the link between policy instrument and outcomes has not been rigorously examined. How is the environmental outcome related to behavior and how can incentives be used to change behavior? Will these changes in behavior deliver the desired ecosystem services? Is the PES approach the most cost-effective alternative for meeting environmental goals? How will the program affect equity? Though the questions that should be considered in designing a PES scheme are daunting, the preceding pages have pointed to a substantial body of existing literature that can help point the way, both for practitioners designing or evaluating PES projects and for academics embarking on PES-related research projects.

In this paper, we have attempted to distill these findings into a set of lessons that can be applied to PES policies and to offer tentative implications for the choice of where, when, and how a PES approach might best be applied. With regard to the environmental-effectiveness and cost-effectiveness of PES programs, we suggest that (1) environmental-effectiveness is possible but will require more complex incentive mechanisms when marginal benefits differ greatly based on space or existing levels of services; (2) cost-effectiveness will depend on how effectively the program allocates production to those with low costs; (3) cost-effectiveness will also depend on the magnitude of transaction costs, particularly monitoring and enforcement; (4) evaluation of benefits should consider secondary policy effects and use baselines to prevent ransom behavior; (5) PES policies are more likely to induce technological innovation and adapt to changes in technology prices when payments are based on final services and methods are flexible; and (6) the political feasibility of a PES approach will depend on who stands to lose and who stands to gain from the policy. Comparing PES policies to other forms of regulation, overall, we agree with the assessment that "[t]he bottom line is that no particular form of government intervention, no individual policy instrument … is appropriate for all environmental problems" (Stavins 2004).

We also suggest that possible tradeoffs exist between poverty alleviation goals and environmental- and cost-effectiveness. A PES approach will not always provide gains across all three objectives, so in some cases tradeoffs must be made. These tradeoffs can be assessed, to some extent, by considering the correlation between characteristics of poor landholders and their land, and characteristics of the costs and benefits of providing ecosystem services or political feasibility. As with all of the issues raised in the paper, equity tradeoffs will be determined largely by the specific context in which the policy is implemented.

These lessons indicate the need for additional understanding of the ecosystem service goals, the participants, the politics, and the institutional context of potential PES policies. While many of these considerations are highly site-specific, additional evaluative research can improve understanding of the challenges and opportunities associated with a PES approach. Several PES projects that have been running in developing countries for some time are starting to offer provocative findings about the success of the PES approach (Rosa 2003; Pfaff, Robalino and Sanchez-Azofeifa 2006). New projects will only be able to learn from the successes and failures of their predecessors if serious efforts are made to understand the complexities of design and implementation, and to evaluate the impacts of existing policies. Though we make a case for the similarities between incentive-based mechanisms and PES policies, and thus the relevance of applying these lessons, the differences also deserve consideration. Additional research is needed to understand how these differences affect design and implementation considerations.

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