

DESIGNING PAYMENTS FOR ECOSYSTEM SERVICES

PERC POLICY SERIES • No. 48 • 2010

BY JAMES SALZMAN

Editor Roger Meiners

M.J. Murdock Charitable Trust—Special Issue



PERC

2048 Analysis Drive, Suite A Bozeman, Montana 59718
Phone: 406-587-9591 Fax: 406-586-7555
www.perc.org perc@perc.org

RECENT ESSAYS

PERC POLICY SERIES

- PS-47 Recycling Myths Revisited**
Daniel K. Benjamin
- PS-46 Environmental Water Markets: Restoring Streams through Trade**
Brandon Scarborough
- PS-45 Two Forests under the Big Sky: Tribal v. Federal Management**
Alison Berry
- PS-44 7 Myths About Green Jobs**
Andrew P. Morriss, William T. Bogart, Andrew Dorchak, & Roger E. Meiners
- PS-43 Creating Marine Assets: Property Rights in Ocean Fisheries**
Robert T. Deacon
- PS-42 Environmental Justice: Opportunities through Markets**
H. Spencer Banzhaf
- PS-41 Do Profits Promote Pollution? The Myth of the Environmental Race to the Bottom**
Robert K. Fleck and Andrew Hanssen
- PS-40 Trading Forest Carbon: A Panacea or Pipe Dream to Address Climate Change?**
Brandon Scarborough
- PS-39 Property and the Public Trust Doctrine**
Randy T. Simmons
- PS-38 Malthus Reconsidered: Population, Natural Resources, and Markets**
Ross B. Emmett

TABLE OF CONTENTS

1	WHAT ARE ECOSYSTEM SERVICES?
	Economic Value of Ecosystem Services
	Why are Ecosystem Services Underprotected?
	Why Choose Payments?
	Types of Services Receiving Payments
17	DESIGNING PAYMENTS FOR ECOSYSTEM SERVICES
	What is the Service Being Provided?
	Who Provides the Service and Who Benefits?
	What Level of Service is Needed?
	What is the Most Effective Payment Plan?
	Are the Supporting Institutions Adequate?
38	CONCLUSION
39	NOTE
40	REFERENCES
	BOXES
10	1. A Model Watershed
11	2. Environmental Policy Toolkit in a Watershed
12	3. The PES Concept
14	4. New York City Investing in Natural Capital
18	5. Key PES Design Questions
23	6. Energía Global and Erosion Control
29	7. Payments for Evapotranspiration
35	8. Forest Stewardship Certification

TO THE READER

This *Policy Series* by James Salzman brings attention to a rapidly developing phenomenon—payments for ecosystem services (PES). Salzman, the Samuel F. Mordecai Professor of Law and the Nicholas Institute Professor of Environmental Policy at Duke University, explains when and where ecosystem services can be provided by voluntary markets rather than government actions.

The key to understanding how PES work is rooted in the basis of any voluntary market transaction—gains from trade. One party agrees to take action because another party offers an incentive. Both parties benefit. A beekeeper, for example, brings her hives to an orchard to provide pollination services for a fee. But Salzman explores the less obvious services such as forests at the top of a municipal watershed that act as a filter providing clean water to people below.

Salzman states that we receive many environmental benefits for “free,” which provides little or no incentive for people to pay for them or for entrepreneurs to provide them. Because price signals that alert individuals about scarce resources in traditional markets are absent, ecosystem services are taken for granted—until they stop providing benefits. Then the cost of remediation or building infrastructure, such as a water treatment plant, makes their value obvious.

For decades the solution to environmental protection has been government action. Today, knowledge about environmental processes combined with increased environmental sensitivity provides opportunities for entrepreneurs to find innovative ways of developing markets for ecosystem services.

This publication is part of the *PERC Policy Series* of papers on timely environmental topics. This issue was edited by Roger Meiners and Laura Huggins and was designed by Mandy-Scott Bachelier. We are grateful to the M.J. Murdock Charitable Trust for their support of this project.

DESIGNING PAYMENTS FOR ECOSYSTEM SERVICES

WHAT ARE ECOSYSTEM SERVICES?

When visiting a store, one expects to find useful goods and services such as apples to eat and the refrigerators that keep them chilled. We depend on similar goods and services in our everyday lives. Indeed, we take them for granted. Nature also provides us valuable goods and services, and we take many of those for granted as well. When we bite into a juicy apple, if we pause to think beyond the store where it was purchased, we may think of soil and water, but probably not the natural pollinators that fertilized the apple blossom so the fruit can set. When we drink a cool glass of tap water, we may think of the local reservoir, but not the source of the water quality, which lies miles upstream in the wooded watershed that filters and cleans the water as it flows downhill.

Largely taken for granted, healthy ecosystems provide a variety of critical goods and services. Created by the interactions of living

organisms with their environment, “ecosystem services” supply both the conditions and processes that sustain human life. Trees provide timber; coastal marshes provide shellfish. That’s obvious. The services underpinning these goods, though less visible, are equally important. If you doubt this, consider how to grow an apple without pollination, pest control, or soil fertility.

A specific landscape offers a range of ecosystem services. A forest at the top of a watershed, for example, provides water quality by filtering contaminants from the water as it flows through roots and soil, flood control as the water slows while moving through the watershed, pollination by those pollinators living along the edge of the forest, and biodiversity conservation if endangered plants or animals live in the woods. Or consider something as simple as soil. More than a clump of dirt, soil is a complex matrix of organic and inorganic constituents transformed by numerous tiny organisms. The level of biological activity within soil is staggering. Under a square meter of pasture soil in Denmark, for example, scientists identified more than 50,000 worms, 48,000 small insects, and 10 million nematodes. This living soil provides a range of critical ecosystem services: buffering and moderation of the hydrological cycle, physical support for plants, retention and delivery of nutrients to plants, disposal of wastes and dead organic matter, and renewal of soil fertility (Daily 1997).

While one can categorize ecosystem services any number of ways, the most common approach is that employed by the Millennium Ecosystem Assessment (2005). It divided services into four categories:

1. provisioning services (the products obtained from ecosystems—food, fiber, fresh water);
2. regulating services (the benefits obtained from the regulation of ecosystem processes—pest control, water purification, erosion control, carbon sequestration);

3. cultural services (the nonmaterial benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, recreation, and aesthetic experiences);
4. supporting services needed to maintain other services (soil formation, photosynthesis).

Ecosystem services are provided and enjoyed across a range of scales. Pollination and renewal of soil fertility are local services. Climate stabilization and genetic resources are generated locally (through carbon sequestration and biodiversity conservation) but enjoyed globally. Thus, depending on the service, a wide range of landscapes can be important service providers, from pristine, intact ecosystems such as natural forests, wetlands, and estuaries, to human-dominated landscapes such as agricultural lands.

Just as we tend not to think about everyday goods and services until the store is out of apples or the refrigerator stops working, so too, do we generally fail to appreciate the importance of ecosystem services until we suffer the impacts of their loss. One cannot easily appreciate the impact that widespread wetland destruction has had on the ecosystem service of water retention until after a flood. Nor does one fully appreciate water quality until recognizing how development in forested watersheds has degraded the service of water purification. The costs from degradation of these services are high and are suffered in rich and poor countries alike (Landell-Mills and Porras 2002). In short, ecosystem services are critical to our well-being.

Economic Value of Ecosystem Services

Awareness of ecosystem services' importance is not new. Plato wrote about the service of soil retention more than 2,500 years ago (Daily 1997). But efforts to identify and calculate these services' valuable contributions are surprisingly recent. Research demonstrates the high costs of replacing such services if they fail. Con-

sider a specific service, such as soil providing nitrogen to plants. Nitrogen is naturally supplied to plants through both nitrogen fixing organisms and the recycling of nutrients in the soil. If nitrogen were provided by commercial fertilizers rather than natural processes, the lowest cost estimate for crops in the United States would be \$45 billion, and the figure for all land plants would be \$320 billion (Daily 1997). Such estimates are inherently uncertain, of course, but the extraordinary costs required to substitute for such services by artificial means are clear.

While the estimated dollar value of these services is impressive, these estimates have significant limitations. First, because most ecosystem services are not exchanged in robust markets (such as buying apples), there are no obvious prices to calculate their values. Economists have different ways to measure their economic value, all of which require extrapolation or assumptions. For example, a wetland ecosystem may be characterized either through its features (site-specific characteristics such as landscape context, vegetation type, salinity), goods (vegetation, mollusks, fish), services (nutrient cycling, water retention), or amenities (recreation, bird-watching).

These goods, services, and amenities can be divided into separate categories. The most obvious includes consumable goods such as cranberries and crabs that are exchanged in markets and easily priced (*direct market uses*). Activities such as hiking and fishing (*direct nonmarket uses*) as well as more intangible existence and option values (*nonmarket, nonuse*) are generally not exchanged in markets. As a result, their values must be determined indirectly. Many ecosystem services are categorized as *indirect nonmarket uses*, for while they provide clear benefits to humans, they are neither directly “consumed” nor exchanged in markets (Barbier, Acreman, and Knowler 1997).

The second challenge is that an ecosystem service’s value is landscape-specific. The benefit to humans is not a straightforward

biophysical measure, identical ecosystems in different locations will have very different values. The value of a wetland's nutrient trapping service, for instance, depends on the location of its outflow. Does it flow to shellfish beds (high value) or to a fast-flowing ocean current (low value)?

Third, policy makers must concern themselves with two different types of valuation. The first is the *absolute value* of the ecosystem service. Methods to determine this have been noted above. These values may prove important for political or advocacy purposes. Knowing that wetlands provide billions of dollars of services to local communities may make it easier to adopt regulations or other protective measures for wetlands. The second type of measure is *marginal value*. The fact that pollinators annually provide Americans up to \$1.6 billion of service or that soil fertility is worth \$45 billion is important to know for general policy direction, but it does not help to inform specific land use or pollution permitting decisions. One cannot divide the \$45 billion value of soil fertility by the nation's total agricultural acreage to determine the value of the services on five acres of land threatened by a specific development. Land use decisions are made on the margins, for example, whether to allow development of 10 hectares in a 70-hectare wetland. Thus, the greatest need for ecosystem service valuation may be at the margins, determining how much service provision is worth *in this particular location*.

Fourth, often times we do not need to know the absolute value of a service, so long as it is obviously important. In deciding whether or not to invest in an ecosystem service or a technological service provider, the key question is relative cost. If it costs \$10 million to build a treatment plant and \$5 million to institute land-use changes with the same resulting improvement in water quality, then investing in an ecosystem service makes financial sense. That is, valuing the costs of substitutes may be more important than valuing the absolute service.

In sum, ecosystem services make critically important contributions to human welfare and valuation can make this clear. Marginal valuation will generally provide the most useful guide to decisions as such services are brought into markets.

Why Are Ecosystem Services Underprotected?

Despite their central role in provision of important benefits, ecosystem services are rarely protected by the law (Salzman 1997). Nor, in the past, have significant markets arisen that capitalize the commercial value of these services. The reason for this relative neglect is threefold: ignorance, institutions, and immature markets.

Ignorance

Perhaps the most basic reason we do not pay more attention to the provision of ecosystem services is that we take them for granted. We are often ignorant of the sources of goods and services we depend on. To efficiently provide services, at a minimum we must be able to identify services on a local ecological scale—detailing how they are generated and how they are delivered. We can make empirically sound predictions that actions on a gross scale, such as clear-cutting, will affect nutrient flows and services or that a significant loss of animal and plant populations will reduce ecosystem resiliency. In the aggregate, improved knowledge provides better guidance in warning against destructive practices. But landscape context matters. In most cases, our scientific knowledge is still inadequate to undertake meaningful marginal analysis. For example, it is difficult to predict how developing 30 percent of *this* wetland will impact water quality, flooding events, or local bird populations.

Institutions

A second obstacle to the protection of services is institutional. Political jurisdictions are rarely aligned with ecologically significant

areas such as watersheds; instead, they exercise authority over areas defined by state, provincial, or municipal borders. Environmental problems do not track political boundaries, and it is difficult for multiple political actors to agree on a constructive course of action. Even more challenging, the costs and benefits of conserving ecosystem services may be separated across jurisdictions. Thus, for example, upstream and downstream jurisdictions will have very different views about the value of upstream forest conservation when it comes to water quality. As a result, consistent efforts to manage landscapes to ensure service provision are easily confounded by political action problems. Additionally, while private property in the United States and some other nations tends to have strong protection against invasion, this is not true in much of the world, where the ability of a land possessor to protect property is weak.

Immature Markets

While some ecosystem services are clearly valuable to the general welfare, they may have little or even no current market value. We have no shortage of markets for many ecosystem goods (such as apples or fish). People pay money for apples every day at the grocery store without a second's thought. But the ecosystem services underpinning these goods are often treated as if they are free. This does *not* mean that they have no value. Rather, services may have no *market* value for the simple reason that no markets exist in which they can be bought or sold. As a result, there are no direct price mechanisms to signal the scarcity or degradation until they fail, at which point their nonmarket value becomes obvious because of the costs to restore or replace them (Heal et al. 2001).

Many ecosystem services are often described as "*public goods*." This is a term economists use to describe a good that is nonrival (consumption of the good by one does not reduce the amount left for others) and non-excludable (individuals cannot be excluded from consuming the good). Unlike an apple that can be bought

and consumed by one person, all those who live in a country with secure borders and low crime rates benefit from these public goods, whether they pay taxes or not. Similarly, those who live downstream from wetlands benefit from the role wetlands play in slowing floodwaters, whether they paid to conserve the wetlands or not.

In fact, many ecosystem services, ranging from flood control to climate stability, provide nonrival and non-excludable benefits. Because these services have no market price, they appear to be free and, as a result, are taken for granted (until their importance is recognized after their loss).

Take the example of wetlands and their role as a nursery for young fish. The wetland's owner provides a benefit to anglers and those who like to eat fish by providing habitat for fish to grow and reach maturity. But these benefits are uncompensated. The market value of the wetlands depends on its location, the pressure for coastal development, and the scarcity of alternative development sites. The benefits it provides simply are not part of the current calculation. If the wetland is developed, the nursery benefits will be lost. There are no market signals to suggest they should be considered in the transaction. Because we can easily value ecosystem goods such as timber or fish, we tend to invest in extracting these goods even if it means degrading certain services related to their production.

These are not isolated examples. Because landowners generally are not paid for the services their land provides to others, it should come as no surprise that they see few incentives to conserve or enhance the uncompensated services they generate, nor are there obvious reasons why they should take service provision into account when making land-use decisions. The landowners' focus will be on the current maximum net value of the alternative uses of the land (Farrier 1995).

Ignorance and public goods—barriers to market creation—are related. Markets create knowledge. We have advanced un-

derstanding of how to manage farmland to maximize production of cash crops for the simple reason that *they are cash crops*. It pays to manage land efficiently for crop production. We have a much poorer understanding of how to manage land for ecosystem service provision, not because these services have no value but because landowners cannot capture the value of the services their landscape provides. Agricultural markets provide clear signals to farmers of the value of clearing wetlands to grow more crops; but there are few markets for biodiversity, water quality, or flood control to reflect the loss in benefits once the land is cleared.

Why Choose Payments?

Consider the example of water quality. Imagine that a municipal water supplier owns the upland forest, which naturally filters and cleans water as it flows through the upper watershed. Property owners in the farmlands are dairy farmers, grazing cows on their fields beside the stream that flows into the reservoir. The farmers could manage their land to provide an improved service of water purification by planting riparian vegetation buffers (e.g., erecting fences to protect plants alongside the stream from grazing). Such vegetative buffers capture nutrients and provide the ecosystem service of reducing silt before it reaches the watercourse. Downstream water consumers benefit from these actions, which provide clean drinking water that does not require extensive pre-treatment. Farmers might benefit from reduced stream bank erosion (see Box 1, page 10).

Traditionally, few landowners would plant riparian buffers. Farmers may have been informed of the benefits of this practice for themselves and for downstream users, but it is unlikely that they would change their behavior due to the time and cost of fencing and the concerns over the loss of productivity from setting aside pasture. Those who fenced off their streams would bear all the costs, with no contributions from those downstream who benefit from the cleaner water.

Box 1: A Model Watershed



Credit: © Sarah B. Lauterbach, reprinted with permission from River Network, www.rivernetwork.org.

So how could the downstream users ensure clean drinking water? One might rely on engineering and build a pretreatment plant. An ecosystem service approach of riparian buffers, however, may be less expensive. The traditional governmental approach would likely impose prescriptive regulations to require farmers to plant riparian buffers. One could equally rely on financial penalties, levying a tax on farmers who do not have buffers, or trying to persuade farmers to put in buffers. These are set out in Box 2, page 11.

One could, however, view the issue from a different perspective. Why not simply recognize this situation for what it is—the provision of valuable services to consumers—and realize this through an



Box 2: Environmental Policy Toolkit in a Watershed

Prescription	Institute regulations requiring riparian buffers
Property rights	Combine regulations with tradable right of buffers
Penalty	Tax farmers who do not have buffers
Persuasion	Demonstrate the benefits of buffers with pilot projects
Payment	Pay for planting of buffers

explicit arrangement of payments for services rendered? Why not treat farmers' provision of ecosystem services as no different from their provision of other marketable goods? Farmers are accustomed to contractual arrangements for their agricultural products. Dairy farmers sign contracts to sell their milk; potato farmers do the same. Water filtration services may also be treated as a business transaction, where farmers manage their land through riparian buffers and grass swales to "grow the crop of water quality" much the same as dairy and potato farmers do for their cash crops.

In many respects, the provision of ecosystem services would be no different than supplying traditional farm produce, with the level of compensation dependent on the quality and level of ser-

vices provided. Such exchanges would be arm's-length payments for services rendered, creating an incentive for the landholder to manage the property so that service provision is ensured. The concept behind payments for ecosystem services (PES) is simple and is set out in Box 3, below. Through this perspective, environmental protection can more closely resemble contracts between service providers and service beneficiaries than the object of governmental regulations.



Box 3: The PES Concept

The environment provides critically important services. Some of these are captured by markets, but many are not. They are environmental benefits that may currently be received for nothing and so regarded as “free.” As a result, many ecosystem services tend to be both underconserved and undervalued. If beneficiaries had to pay for explicit service provision, however, property owners would think differently about sustainable land management practices. Payments for ecosystem services seek to “get the incentives right” by capturing the benefits as well as by providing accurate signals to service providers and users that reflect the value that ecosystem services deliver.¹

The first insight of an ecosystem services perspective is that investing in natural capital can prove more efficient than using built capital to deliver key services. As an example, consider the case of flood control. One can address floodwaters through built capital, such as engineered works (e.g., construction and maintenance of dikes and levees) or through natural capital, such as landscape management (e.g., restoration of wetlands in flood plains). In some instances, landscape management may prove a better public and private investment strategy for providing flood control once one accounts for the many benefits of improved water quality, wildlife habitat, and recreational amenities (see Box 4, page 14).

Payments for ecosystem services refer to voluntary transactions where a service provider is paid by or on behalf of service beneficiaries for land, coastal, or marine management practices that are expected to result in continued or improved service provision. The payment may be monetary or barter and is intended to defray or compensate the costs of service provision. PES can include many different types of parties—from farmers, communities, and taxpayers to consumers and corporations. PES schemes can occur over very different scales—from pollination of local farms to “shade-grown” coffee beans that are sold half a world from where they are grown. PES also spans a wide range of transaction types, from one-off payments for a biodiversity offset to arm’s-length market transactions for carbon credits.

Consider how a PES can emerge. There is no doubt that landowners know their property better than the service beneficiaries do. Landholders know the opportunity cost of a specific land-use change and can determine the price they are willing to accept to implement a change. For its part, the beneficiary knows how much it is willing to pay and, in some cases (particularly when the government is the purchaser) which types of land-use changes would be most valuable for service provision. The PES design challenge is how most efficiently to transfer *both* types of information—(1)



Box 4: New York City Investing in Natural Capital

In the early 1990s, a combination of federal regulation and cost realities drove New York City to reconsider its water supply strategy. New York City's water system provides about 1.2 billion gallons of drinking water to almost nine million New Yorkers every day. Ninety percent of the water is drawn from the Catskill/Delaware watershed, which extends 125 miles north and west of the city. Under amendments to the federal Safe Drinking Water Act, municipal and other water suppliers were required to filter their surface water supplies unless they could demonstrate that they had taken other steps, including watershed protection measures, to protect their customers from harmful water contamination.

Presented with a choice between provision of clean water through building a filtration plant or managing the watershed, New York City managers concluded that an ecosystem services approach was more cost effective. It was estimated that a filtration plant would cost between \$6 and \$8 billion to build. By contrast, watershed protection efforts, which would include not only the acquisition of critical watershed lands but also a variety of other programs designed to reduce contamination sources in the watershed, would cost only about \$1.5 billion. Through a stakeholder consultation process, after two years and more than 150 meetings, a Memorandum of Agreement was signed by 60 towns, 10 villages, seven counties, and various environmental groups. Acting on behalf of the beneficiaries of the Catskills' water purification services, New York City chose to invest in natural rather than built capital.

Source: Daily and Ellison (2002).

willingness to pay/accept, and (2) service provision resulting from a land use change—from one party to another in a mutually reinforcing fashion.

Prescriptive measures are inefficient at information exchange for the simple reason that they are primarily a one-way discussion—the government telling regulated parties what they can or cannot do. The farmer’s knowledge of which land-use changes are least costly is ignored. Financial penalties suffer the same shortcoming. It falls entirely on the government to determine not only which actions to encourage or discourage, but also how much financial penalty is needed to induce the appropriate behavior.

At their core, markets are an exchange of information about willingness to pay and willingness to accept. The market mechanism necessitates that each side reveal information to the other. Indeed, if set up carefully, payment schemes can shift the information burden to the landowners.

While the principle of PES is simply stated—those who benefit from service provision should pay the providers—this is far easier said than done, for the equally simple reason that ecosystem services are taken for granted. Because it is difficult to prevent someone who did not pay for an ecosystem service from benefiting from it, it is equally difficult to get people to volunteer now to pay for provision of these services. Why pay for something when you have always gotten it for free? As a result, a key challenge in a PES lies in creating a market that may not now exist—in capturing the value of the service by compensating the providers for the services they provide. This approach views environmental protection much as a business transaction between willing parties.

When successful, PES creates positive economic incentives for landowners to conserve or improve the function of their lands for a variety of ecosystem services. In the process, PES may bring new resources and new incentives to conservation, a particularly important development when funding for conservation is scarce.

Types of Services Receiving Payments

As noted before, there is a broad range of ecosystem services. Not all of these, however, are amenable to PES. If one looks at the PES schemes operating or in pilot phases, payments cluster around four broad types of services.

The first is watershed protection. This includes the ecosystem services of water purification, ensuring water quantity, flood control, erosion control, and others. In general, downstream beneficiaries pay upstream landowners either for adopting particular land uses or maintaining current land uses. Payments for water services benefit from the advantage that it is relatively easy to identify both the providers and the users of these services and, equally important, the users are generally discrete (e.g., private operations such as hydroelectric facilities and industrial users) or institutions that represent groups of users such as municipal water authorities (who act on behalf of the public) or irrigation districts (who act on behalf of the irrigation farmers). All of these parties have an obvious and direct interest in service provision. Moreover, the beneficiaries, particularly water users, are accustomed to paying for water already. Indeed, water services are the most common PES (Landell-Mills and Porras 2002).

The second type of service is carbon sequestration. Depending on how the climate negotiations conclude, the sequestration of carbon by reforestation and land use may come to dominate other PES schemes in total value. The classic example of such a PES scheme is a large emitter of carbon dioxide in a country that regulates greenhouse gas emissions paying a landowner to plant additional trees. In exchange for the additional carbon now sequestered, the company obtains credits it can use to offset its greenhouse gas emissions. In contrast to watershed services, carbon sequestration can operate at the regional, national, or global scale, though the trend seems to be increasingly toward national and global markets.

The third service receiving payments is biodiversity conservation. Because biodiversity is a classic public good, the PES here are smaller and more discrete. While there are isolated examples of species habitat banks, biodiversity payments can take a wide range of forms, including purchase of conservation easements, payment for bioprospecting rights or research permits, hunting and fishing licenses, and leasing water for instream flows to protect fish (Scarborough and Lund 2007). Not surprisingly, most of these payments operate at the local or regional level.

The last service category is landscape amenities. The most obvious example is ecotourism, where tourism operators pay local landowners or communities to not hunt in certain areas or to engage in particular land management activities. This approach has run into the criticism that few meaningful payments from ecotourism actually end up in the hands of locals. Nonetheless, as development pressures increase, the value of natural places will increase, raising the potential for greater revenue flows toward ecotourism.

DESIGNING PAYMENTS FOR ECOSYSTEM SERVICES

Five basic questions must be considered in PES transactions (see Box 5, page 18). The first concerns what specific service needs to be provided and whether landscape management can provide this service. The second question focuses on the providers and beneficiaries. Unless the sellers and buyers of these services are discrete, then PES will be very difficult. The third question addresses the level of service that needs to be provided and whether this can be adequately monitored. If the linkage between landscape management and service provision is poorly understood, then the buyer will have little confidence he is receiving value for



Box 5: Key PES Design Questions

1. What is the service being provided and can landscape management efficiently provide the service?
2. Who provides the service and who benefits? Are there discrete groups of providers and beneficiaries?
3. What level of service is needed and can this be adequately monitored?
4. What is the most effective payment mechanism: direct payment, mitigation and offsets, or certification?
5. Are the supporting institutions adequate?

his payments. The fourth question asks which type of payment mechanism is most appropriate. This will depend on a range of factors, starting with the nature of the service, the scale of service provision, the buyers, and the sellers. The fifth question asks if key institutions, such as the law and the courts, are sufficient to help enforce PES.

What is the Service Being Provided?

In crafting payments to ensure ecosystem service provision, one first considers which service matters or whether the problem to be addressed can effectively be handled by land management. If land management either cannot provide adequate service provision or cannot do so cost-effectively, then PES may prove ineffective.

This seems easy to determine in the case of local biodiversity, as it is best provided through conservation of remnant native habitat. If the problem is erosion, the ecosystem service of soil retention can be supplied through plants' root systems. If the problem is water quality, ecosystem services may create a cost-effective source of provision, as well. Recall that New York City water authorities determined that water quality could be achieved more cheaply through land management than through construction of a water treatment facility (see Box 4, page 14).

Some services are easier to model than others. The relationship between deforestation and erosion or biodiversity conservation, for example, is better understood than its effect on hydrology. At the outset, therefore, PES designers need to explicitly challenge their assumptions about service provision. It is hard to think of a worse outcome for a PES than supporters making unfounded claims that payments for land management will result in particular levels of service provision.

Similarly, PES designers need to be clear at the outset about trade-offs. Land management practices to maximize one type of service may result in reduction of another service. A classic example in this regard is the relationship between afforestation and water levels. Plantations of fast-growing trees such as eucalyptus may increase carbon sequestration, but they can also harm biodiversity, lower water availability, and reduce streamflows because of evapotranspiration and a lower water table (Jackson et al. 2005). The provision of some services can also increase others; the maintenance of natural areas can enhance both biodiversity and pollination services.

Who Provides the Service and Who Benefits?

A precondition for market exchange is willing buyers and sellers. The primary concern of service buyers is a perceived current or future threat to their service provision. This may seem obvious, but it is an important point. For example, unless water consumers recognize a real and impending threat to their supply of clean water (e.g., through increased development of the forested upper watershed), there is no reason to pay the upper watershed landowners to keep the forest intact. If the forest were not threatened by development, PES would seem nonsensical since the consumers would continue to receive the service of water provision with or without payments. They can simply continue to act as free riders, enjoying the benefits provided by the upper watershed owners.

Another precondition for functioning markets is the presence of discrete providers and beneficiaries. Economists describe this as a problem of collective action. Unless a relatively small number of providers and beneficiaries can get together, transaction costs may become too high for contract formation. The public goods nature of many services makes this a real concern. Biodiversity, for example, benefits agriculture through service of genetic diversity. We all gain from these benefits, yet there is no sufficiently discrete class of beneficiaries with whom landholders can negotiate, and the transaction costs of gathering enough beneficiaries together to negotiate for the service may be too high.

Thus it is no surprise that private purchasers of biodiversity's benefits are hard to find. For the same reason, one can understand why so many examples of PES are found in the area of water quality. Most water consumers are not only accustomed to paying for potable water but can be collectively represented in a transaction by a single public body such as a water utility or local government. Put simply, if a land use provides valuable ecosystem services but they are widely enjoyed by diffuse beneficiaries, it

is unlikely that a market for services will arise in the absence of government intervention.

Potential Buyers

Depending on the ecosystem service, there are a wide range of potential buyers. These are briefly set out below.

Government bodies. When services are public goods or there are diffuse beneficiaries, it may be necessary for the government to step in and act on behalf of those benefiting from the services. The appropriate level of government depends on the scale of service provision. This might include government payments to landowners for the services of water quality (local government), flood control (regional government), or carbon sequestration and biodiversity conservation (national government).

Corporations. When services are provided to discrete beneficiaries, private PES buyers may be willing to pay providers to ensure continuous provision. A hydroelectric company may be willing to pay upper watershed landowners to keep their forests intact in order to maintain the service of erosion control (so the lake behind the dam does not silt up). Corporations may be motivated by market concerns. Pressure from environmentally conscious consumers, for example, may cause a company to source its products or raw materials from supplies that have been certified as sustainably harvested. They may pay for service provision because of pressure from shareholders or consumers demanding improved corporate social responsibility. A company engaged in land development may voluntarily offset its harm to local biodiversity by voluntarily restoring habitat elsewhere.

Consumers. A category of consumers may wish to direct its purchases toward companies and products that act in what they view as an environmentally responsible manner. Eco-labels and certification programs can provide information to guide the purchasing behavior of these “green consumers.” If enough

consumers wish to buy certified products, then suppliers and retailers will respond to this market demand. Hunters and anglers eager for access to land managed for game or to streams maintained for fishing may be willing to pay for this service as well.

Nonprofits. Conservation groups and land trusts routinely pay landowners to conserve biodiversity as part of the groups' central missions. Similarly, philanthropies may fund service providers to ensure continued provision of a PES believed to be worthy.

Potential sellers

When the current land use is more profitable than an alternative that provides greater services, a PES approach will be ineffective unless it can make up for the lost profits. It is at the margins, comparing the marginal gain or loss from shifting land uses, that PES operate.

One can usefully divide service providers into two broad categories. The first is sellers who are paid for changes. That is, payments are made to landowners willing to change their land use so that it provides greater services. For example, buyers interested in biodiversity conservation may pay landowners to remove invasive species from their property and put in fencing to keep out predators. Without these payments, land use changes may not occur.

The second category of sellers is paid for maintaining the status quo in a manner similar to insurance. It includes those who currently provide services. Thus, for example, in Costa Rica, Energia Global, a hydroelectric power company, has been paying landowners in the upper watershed to keep their lands forested, described in Box 6, page 23.

In simple terms, Energía Global is concerned with sedimentation of the lake behind their hydroelectric dam. The service of sediment retention provided through forest conservation prevents the lake from filling up with silt. Hence the goal of these payments



Box 6: Energía Global and Erosion Control

Energía Global, a private hydropower company located in the Sarapiquí watershed of Costa Rica, provides electricity for about 400,000 consumers. The company wanted to protect the watershed in order to increase the reliability of streamflow throughout the year and to reduce sedimentation. Through FONAFIFO (a government institution established to bring together ecosystem service buyers and sellers), Energía Global pays owners of upstream private land to reforest their land, engage in sustainable forestry, or conserve forest cover. Landowners who have recently cleared their land or landowners planning to replace natural forest with plantations are not eligible for compensation. Energía Global pays US\$18 per hectare to FONAFIFO, which then adds an additional US\$30 per hectare. FONAFIFO makes cash payments to landowners who have signed contracts with Energía Global. Total payments of US\$48 per hectare per year are related to the opportunity costs of reforestation or forest conservation, such as potential revenues from cattle ranching. A local non-governmental organization oversees the implementation of the conservation activities, carries out technical studies, and administers the scheme.

Source: Smith et al. (2006).

is explicitly not to change the land use but, rather, to *maintain* current practices. The payments ensure the flow of services will continue into the future.

The same marginal analysis occurs as described above, except in this case the comparison is between profitability from the current use versus profitability of future uses that would degrade service provision. Thus, for example, anglers are beneficiaries of a wetlands' role as a nursery for immature fish. If the wetland's owner were considering destroying the wetland for a housing development, anglers might be willing to pay owners to maintain the wetland *in its current state*. Therefore, the buyers must be willing to pay at least the marginal profit of what the landowner would have received by the development (i.e., the lost opportunity cost).

In either case, whether changing current land uses or maintaining them, PES will be most effective when the payments make land uses *marginally more profitable* than alternative land use activities. At the same time, it is important not to focus exclusively on marginal profits. A number of PES schemes have found that landowners may be willing to bear some of the costs for service provision themselves because, for example, they take pride in their property's biodiversity (Stoneham 2002). As with buyers, there is a range of sellers of ecosystem services, depending on the service.

Private Landowners. In many countries, most ecosystem services are provided by private lands. These are often agricultural lands, including crops, grazing, and silviculture. While one-to-one exchanges between buyers and private landowners are possible, collective action problems are significant. There are high transaction costs to single negotiations, and gathering together enough sellers to achieve a significant level of service provision may be difficult. This is particularly challenging for small-scale and low-income landowners in many rural areas (particularly in developing countries) who face an information constraint and may lack clear legal title to the land.

To overcome some of these problems, landowners may organize into a private association to negotiate with a single voice, better protect their interests, and increase the overall level of service provision for sale. Such collective organization also allows sellers to “bundle” different services together (Asquith 2006).

Public landowners. Public bodies control large amounts of land and may negotiate for service payments. Similarly, a community group may sell services from communally held land or from land where community members have specific property rights such as grazing or cropping.

Mitigation providers. In countries with offset requirements for development, private parties may create mitigation banks and sell “credits.” This happens in the United States with wetlands mitigation and in some states with endangered species habitat.

Certification organizations. It is worth noting that those who are directly paid may not be the provider of services. In certification systems, for example, the certifying body is often paid a licensing fee by the supplier for use of its eco-label. The certification indicates that the seller is operating in a sustainable manner (e.g., shade-grown coffee) and this, in turn, signals to consumers that they should buy this product rather than others that are lacking the label.

Perverse Incentives

Turning back to the watershed example in Box 1, page 10, recall that farmers graze cows on their fields beside the stream that flows into the drinking water reservoir. The farmers could manage their land to provide an improved service of water purification by planting riparian vegetation buffers. Such vegetative buffers capture nutrients and reduce silt before they reach the watercourse. Water consumers downstream benefit from these actions when drinking clean water that does not require extensive pre-treatment. The PES creates an incentive for farmers to put in riparian fencing because

they can now capture the benefits of the water purification services provided to downstream water drinkers.

If one enquires more closely, though, paying for these services suggests a number of tensions. To start with, those farmers who have already put in riparian fencing no longer have a significant potential for increased service provision and, as a result, are unlikely to be paid. Should every landholder who provides environmental services be paid? Given a finite budget, the answer to this would seemingly have to be “no.” It is hard to imagine a practical scheme, for example, that pays everyone whose vegetation reduces nutrient flow in the watershed. If one seeks to pay for discrete cases of ecosystem service provision, clearly some land uses are more important than others. But how should one decide who gets paid and who does not?

To frame this dilemma more generally, consider which landholders should be supported by ecosystem service payments—those who currently provide services or those whose properties pose the greatest nutrient or sediment problems (and hence the greatest potential for increased service provision)? If we say people are being paid to provide a service, then how can PES ignore those who already provide it? Is it not essentially paying off the bad actors and thereby encouraging undesirable behavior? More generally, how do PES schemes equitably account for the baseline that is already out there? Those farmers who have already made the investments and managed their land responsibly may not receive any payments. If only those who have been less responsible will benefit, the argument goes, this creates a disincentive to land stewardship. This decision will be a challenge for many service markets.

Other concerns have been raised over the problems of *hold-outs* and *free riders*. These are most easily seen in the context of biodiversity conservation. The functional value of a reserve design or wildlife corridor depends critically on contiguous par-

cels. If successful, the benefits from the sum of connected land parcels managed for biodiversity conservation should be greater than its parts. This can be frustrated, though, by the actions of a very small number of landholders who can hold out for prices well above market rates. Without their participation, it may be impossible to create effective habitats. Moreover, neighbors of those who dedicate their lands to biodiversity conservation may choose not to conserve biodiversity on their own land but, instead, free ride on the wildlife amenities on adjacent land. Given these two obstacles to competitive markets, one can understand the calls for coercive instruments. This is conceptually similar to the challenge in controversial Supreme Court cases such as *Kelo v. City of New London*, where the city imposed eminent domain on holdouts to urban development. PES can help avoid pressure for such regulatory controls on property.

What Level of Service Is Needed?

So far this essay has identified the service to be provided, how it is provided, and who the providers and beneficiaries are, but what about the level of service provision? At the end of the day, the two most important aspects of any transaction are what you are paying for and how much you pay. In a PES program, we need more precision than simply identifying potential polluters and service providers. We need to know not only whom to pay, but also how much to pay them.

It is not enough to know that riparian fencing throughout a watershed is a good thing because it will improve water quality. Given the reality of limited resources, the key question becomes *which* riparian stretches need to be fenced off to provide the greatest level of water purification. In other words, given the many potential service providers, PES programs need to determine whom to pay and, equally, whom not to pay. This can raise a number of challenging issues.

Landscape context matters. For most services, provision is heterogeneous. Certain properties provide greater service levels than others because of where they are located. A farm bordering a river will be more important in providing water purification than a distant farm. Determining the level of service requires identifying the biophysical pathways of service provision. Consider, for example, the pilot program to combat salinity along the Macquarie River in Australia described in Box 7, page 29.

For a PES program to succeed over the long term, the buyers must be confident that the landscape management they pay for will, in fact, lead to either improved or continued service provision. This is fundamentally a scientific question, requiring a clear understanding of the biophysical pathway between landscape activity, service provision, and service delivery. The success of a PES scheme depends critically on the accuracy and cost of such assessments and, by extension, the creation of assessment methodologies for use in the field. This underscores the importance of modeling and monitoring.

While an obvious assumption in PES schemes, it is worth emphasizing that the buyers need assurances that the payments they have made will, in fact, lead to the service provision they desire. To gain this assurance requires both adequate modeling and monitoring. Effective modeling shows the biophysical pathway of a service provision, identifying metrics that should be monitored in order to assess service provision such as a farm's proximity to a watercourse. Effective monitoring serves two purposes. First, it creates a baseline. One cannot determine if there has been a change in service provision unless a baseline exists. This is a fundamental issue in the "additionality" debate over the role of forests in carbon markets. Second, monitoring provides the data to assess compliance and service provision once performance has begun.

Monitoring is easier in certain cases than others. PES schemes based on inputs are easier to monitor than those based

Box 7: Payments for Evapotranspiration

Underneath much of Australia the groundwater is saline, a remnant of the sea that used to sit atop the continent. Early settlers were often required to clear the native vegetation before they could claim title to the land. As a result, the ecosystem service of evapotranspiration that had served as a water pump to keep rainwater from reaching the groundwater was seriously weakened. Large expanses of agricultural areas now face salinity—saline groundwater rising to the root zone of plants and stunting their growth. One area that is feeling this effect is the Macquarie River valley.

In 1999, New South Wales State Forests signed a contract with Macquarie River Fruit and Fibre (MRFF), an organization that represents more than 600 Macquarie Valley irrigation farmers, to purchase “salinity control credits.” Rather than mechanically pumping groundwater to keep the water table below the root zone of cash crops, MRFF purchased the ecosystem service of evapotranspiration by paying grazers to plant 100 hectares of native forest in the upper Macquarie River catchments, which should lead to a reduction in groundwater levels in the lower catchments. The project improved relations between the irrigation farmers (who had been making money) and the sheep farmers (who had not). This scheme could provide the extra income that would make timber production a profitable undertaking in traditional grazing areas and provide a steady income stream during lean crop years.

The challenge in the project has been uncertainty over the link between upstream revegetation efforts and downstream salinity reduction. The trees were planted in “salinity hot spots” and estimated to transpire 53.5 megalitres per hectare over 10 years. It was not known whether this change would lead to any reduction in salinity downstream or even how much land use change was needed for significant salinity changes. Given the poor understanding of how the service is provided and the time lags involved, MRFF chose not to expand the pilot project until it had more information.

Source: Salzman 2005

on outputs. If one is mandating or paying for specific land use practices or changes, such as in the MRFF scheme, compliance monitoring need only examine the land management change. The buyer simply visits the piece of land and checks if the fences have been properly constructed in the right place, for example, or the correct number of trees has been planted. Once one moves from services such as carbon sequestration, where relatively simple relationships can be estimated between ground vegetation and carbon sequestered, it becomes both more difficult and costly to measure actual provision from a specific landowner of such services as water purification, pollination, or flood control. Equally, as the MRFF case study demonstrated, certain services are easier to model than others. As with other market transactions, PES works best when the rules are simple and compliance monitoring mechanisms remain inexpensive. Yet this may result in less information than buyers want. In general, the more accurate the modeling and monitoring, the better buyers understand whether land use changes will improve service provision but, equally, the more expensive the transaction.

The net result is that it will be easier to develop markets for some services than for others for the simple reason that those buying services will be more confident that they are receiving value for their money. How difficult, for example, is linking the contributions of individual land management decisions to water quality in a water supplier's subcatchment? The success of an ecosystem services approach for water quality depends on the accuracy and cost of such assessments and, by extension, the creation of assessment methodologies for use in the field.

What Is the Most Effective Payment Plan?

While it has become commonplace to speak of "PES markets," in fact, few true markets for PES exist. With the exception of carbon credits, it is rarely the case that multiple buyers and

sellers exchange the same good on an open market. Rather, as described above, most PES schemes consist of a single buyer purchasing service provision from one or multiple sellers.

While one can divide the types of PES mechanisms into many different categories, at a broad level there are three basic types—direct payment (general subsidy, scored subsidy, reverse auction, and negotiation), mitigation and offset payments (clean development mechanism, wetlands mitigation banking, and biodiversity offsets), and certification (eco-labels and forestry certification). Which mechanism is most appropriate will depend on a number of factors, including the type of service, the legal setting, whether the parties are public or private, the difficulty and cost of obtaining information, the availability of funds, the supporting institutions, etc.

Direct Payment

The simplest form of payment is a direct subsidy. Thus, for example, a government program concerned with soil erosion may provide funds for farmers to plant crops or till their lands in a manner that reduces erosion. This may be on a “first come-first served” basis, with the first applicants receiving funds until the money runs out. The major benefit of this approach is low information requirements and administrative costs. It may also allow for a period of experimentation to see what sorts of land management changes provide the most benefit. It may also satisfy political pressure to provide a subsidy to a particular land-owning interest group. General subsidies, however, may prove inefficient for they cannot meaningfully distinguish between those parties who can provide high-value services and those who may provide low-value services. So long as the land is located in a qualifying area and the owner commits to a particular land use practice, he or she is eligible for a payment.

Another common approach involves direct negotiation with providers by either public or private parties. This approach starts

with the assumption that different landholders can provide different levels of service and should be compensated accordingly. The service beneficiary sits down with the service provider and strikes a deal. While the transaction costs can be higher than with other mechanisms, it may be preferable when there are few market participants or there are significant uncertainties over service provision or willingness to accept.

Direct negotiation has the advantage of allowing individually crafted agreements but can be labor intensive if carried out with a large number of landholders. It also lacks the mechanism of farmers competing against one another to provide services and requires the purchaser to assess accurately the landholder's willingness to accept.

Mitigation and Offset Payments

Mitigation and offset markets are based on regulations that prohibit certain behaviors. For this reason, they are sometimes called “compliance markets.” Regulations also create an exemption to its prohibition if the party can offset or mitigate its harm elsewhere. If a developer builds a road that destroys wetlands, for example, it must either create wetlands elsewhere to offset or mitigate its harms or, as is more often the case, purchase “credits” from a third party who has already created wetlands for this purpose. The government plays a central role in setting the rules for these trades—what types of wetlands qualify, how many more acres of wetlands must be created than those destroyed, and how one measures the trade (hectares, wetlands function, etc.). Wetlands regulations in the United States, for example, are based on the premise of “no net loss.” If a hectare of wetlands is filled for development, then this harm must be mitigated by the creation of a hectare or more of wetlands somewhere else. Only when the mitigation requirements have been satisfied may a permit for wetlands development be issued.

A similar, though smaller, market exists for biodiversity offsets. In exchange for permission to develop in a species habitat, the developer must mitigate the harm by restoring species habitat elsewhere. As described below, some mitigation markets are voluntary, with companies choosing to restore habitat on their own. The challenge for such markets lies in comparability. Unlike a molecule of carbon dioxide, which is the same no matter where emitted or sequestered in the world, biodiversity is both heterogeneous and location specific, making trades difficult.

Offset markets operate in a similar manner with pollutants. In the context of climate change, some regulatory markets permit those emitting greenhouse gases to offset their emissions by purchasing credits for sequestered carbon. Because planting trees can remove carbon dioxide from the atmosphere, the market designers assume that a ton of sequestered carbon dioxide is equivalent to a ton of reduced carbon dioxide emissions. The Kyoto Protocol, for example, created the Clean Development Mechanism. This provides for reduction credits from carbon sequestered by land management. Negotiations are currently underway for the next climate treaty, and many believe that a similar offset provision, known as REDD (Reduced Emissions from Deforestation and Forest Degradation), will be included in the final draft. In simple terms, REDD would pay countries for reducing emissions that would have occurred if deforestation had continued at its historic rates. REDD provides payments for improving the ecosystem service of carbon sequestration. Voluntary markets—carbon trades that operate outside the Kyoto framework and national laws—have also been on the rise, primarily driven by corporate social responsibility concerns (Hamilton et al. 2010).

Constructing smoothly functioning offset and mitigation markets is not simple. There must be a sufficient and well-defined marketplace as well as a community of market participants. There also must be a refined currency of trade, one that is fungible and reflects the desired environmental quality. For example, it would

be a stretch to consider allowing coastal developers in one state to “trade” wetland values they eliminate for reductions in phosphorous emissions in another state.

Certification

Growing in importance since the 1990s, certification schemes focus on the importance of consumption in degrading ecosystem services. As previously noted, a lack of information is a significant barrier to environmental protection. Consumers and corporations wishing to promote environmentally responsible practices through their purchasing behavior cannot do so unless they have information on the attributes of the products they wish to buy or the behavior of their suppliers. Certification and eco-labels attempt to provide this information. The premise of these programs is that a significant percentage of consumers and companies will prefer to purchase goods and services that are environmentally preferable if there is a reliable means of identifying them. This, in turn, will provide these goods and services a competitive advantage in the marketplace.

To address this information need, eco-labels and certification schemes have grown rapidly over the past two decades across a range of sectors, including sustainably harvested timber, coffee, fisheries, agriculture, and even financial companies and eco-tourism. These certification initiatives’ goal is to provide consumers with an objective basis for selecting environmentally responsible products (see Box 8, page 35).

Are the Supporting Institutions Adequate?

Very few transactions take place in the absence of supporting institutions. Even the simplest contracts between buyers and sellers rely on institutions (formal or informal) to adjudicate disputes when they arise and on enforcement to ensure the judgments are carried out. A range of specialized institutions, both public and private, can promote PES transactions. Consider, for example, the role of institu-



Box 8: Forest Stewardship Certification

Founded in 1993, the Forest Stewardship Certification (FSC) has created a mechanism to set standards, certify, and label forest products that have been managed in an environmentally, socially, and economically sustainable manner. FSC certification is voluntary. Forest owners who wish to use the FSC label in marketing their products must satisfy the relevant FSC standards developed for particular types of forests and conditions. Common principles include compliance with laws, clear tenure and use rights, recognition and respect for indigenous rights to the forest, etc. Compliance is certified by an FSC-accredited body that audits and then approves individual forest management.

Because timber is a global market, chain of custody becomes important. It is necessary to ensure that FSC-certified timber can be tracked throughout the supply chain from harvest to point of sale. This is accomplished through Chain of Custody certification, a system that ensures controls are in place to track certified wood products throughout the supply chain. Importantly, FSC does not itself conduct any certification activities of forest management or the supply chain. These are conducted by accredited certification organizations (currently twelve around the globe). The forest product producers are responsible for the certification costs.

As of December 2008, roughly 107 million hectares of forest in 78 countries were FSC-certified. Approximately 12,000 FSC Chain of Custody certificates have been issued in 81 countries.

Source: Forest Stewardship Council (2009).

tions in the case of payments for carbon sequestration. To facilitate exchange of carbon sequestration credits, the Australian state of New South Wales has statutorily created an alienable property right in sequestered carbon. Thus, a forest landowner can sell credits for carbon stored in his or her trees, and this can then be sold again by third parties. Carbon registries have been created, as well, to record obligations and credits. In the United States, the Chicago Climate Exchange provides a marketplace for buyers and sellers of carbon credits to exchange with one another. A number of countries have created the equivalent of a national carbon office that keeps track of carbon emissions and reduction projects, and private certification organizations now provide the service of certifying that carbon sequestration projects accurately report on their activities.

There are many different types of institutions that can support PES and, importantly, these need not be formal government bodies. Indeed, in many parts of the world formal institutions are ineffective, and parties cannot assume that laws will be complied with or enforced. In such cases, informal local institutions, based on customary practices, can provide the support needed for PES schemes to operate.

Because payment is generally premised on specific land use activities, a basic obligation of the provider is to demonstrate sufficient ownership or control of the land to ensure service provision. The buyers need to know whom to pay and have some assurance that the seller can undertake the land management or service provision to which they have agreed. In broad terms, this is an issue of property rights. Unless property rights are well defined and protected, people have limited ability and incentive to care for property over time. Compared to most countries, the United States has strong institutions that provide relatively secure legal rights to property owners. It is a common value for people to want to leave the land for the next generation in better condition than when received. As wealth has increased, property values have

risen, which, in turn, may now increase efforts to restore land and waterways to quality conditions.

There are many different types of property rights. These include the right to occupy, the right to use, the right to derive income, the right to sell, and the right to exclude, among others. Obviously, depending on the circumstances, some of these rights will be more important for service provision than others. In an ideal situation, the provider would hold all of these property rights and could easily prove ownership of the land. This is often the case in developed countries. In much of the world, however, this can prove a major challenge.

Supporting institutions are particularly important in the context of property rights. In a developed system, owners need a land registry where they can record their title and where buyers can search titles. There also must be adequate contract law and legal institutions to adjudicate disputes as well as adequate authorities to enforce judgments. These supporting institutions, however, are not always present, particularly in parts of some developing countries. This does not, however, mean that PES schemes cannot successfully operate there.

Because clear title is not always available and the cost of establishing clear title may not be justified by the size of the service payments, PES must often consider both *de jure* and *de facto* legal title. *De jure* title describes the legally recognized ownership status; *de facto* describes the actual practice on the ground. Individuals or communities may effectively control land so that service provision can be ensured even though they may not have clear legal title. Those on the land may even be squatters. In such a case, *de facto* status may be more important than *de jure* status. This is particularly significant when supporting institutions such as government monitoring and enforcement are weak. Indeed, in some cases service payments are particularly attractive because they are seen as a way to legitimize unclear land title by giving the land manager greater credibility (Greiber 2009).

CONCLUSION

Payments for ecosystem services represent a promising development not only in terms of conservation mechanisms but, more generally, in how we think about conservation. By identifying the critical role that landscape management plays in providing valued services, PES frames environmental protection explicitly as a matter of private ordering between suppliers and beneficiaries. In some cases, this can provide an attractive and more effective alternative to traditional regulations. This arrangement also encourages landowners to view their property in a different way. PES can identify new streams of income that may not have been recognized or optimized before, creating incentives for landowners to manage their properties specifically for the provision of clean water, biodiversity, or other amenities.

This arrangement, of course, is not a silver bullet. This *Policy Series* has identified the necessary preconditions for successful PES. Absent perceived scarcity of the service, discrete buyers and sellers, secure property rights, and other conditions, it is unlikely that PES will emerge. That being said, PES represents a promising development of voluntary exchanges through markets that enhance environmental asset development. As we learn more about the values of the complex resources provided by an ecosystem, we become more willing to invest in husbanding those resources.

NOTE

1. PES refers to voluntary transactions where a service provider is paid by or on behalf of service beneficiaries for land, coastal, or marine management practices that are expected to result in continued or improved service provision. Sven Wunder (2005) defines PES as having five attributes: (1) a voluntary transaction where (2) a well-defined ES—or a land-use likely to secure that service (3) is being

“bought” by an ES buyer (4) from an ES provider (5) if, and only if, the ES provider secures ES provision (conditionality).

The shortcoming of this definition is that only a small percentage of PES schemes satisfy condition five. Most PES are based on inputs (i.e., land management practices) rather than outputs (i.e., a measurable change in service provision), whether this increases the service provision or not.

REFERENCES

- Asquith, Nigel. 2006. Bees and Barbed Wire for Water on the Bolivian Frontier. *PERC Reports*, Winter: 3–6.
- Barbier, Edward B., Michael C. Acreman, and Duncan Knowler. 1997. *Economic Valuation of Wetlands: A Guide for Policy Makers and Planners*. Gland, Switzerland: Ramsar Convention Bureau.
- Daily, Gretchen C. 1997. *Nature's Services: Societal Dependence on Natural Ecosystems*. Washington, DC: Island Press.
- Daily, Gretchen C., and Katherine Ellison. 2002. *The New Economy of Nature: The Quest to Make Conservation Profitable*. Washington, DC: Island Press.
- Farrier, David. 1995. Conserving Biodiversity on Private Land: Incentives for Management or Compensation for Lost Expectations? *Harvard Environmental Law Review* 19 (2): 303–408.
- Forest Stewardship Council. 2009. Available at: www.fscus.org.
- Greiber, Thomas, ed. 2009. Payments for Ecosystem Services: Legal and Institutional Frameworks. IUCN Environmental Law and Policy Paper No. 78. Gland, Switzerland: IUCN.
- Hamilton, Kate, Molly Peters-Stanley, and Thomas Marcello. 2010. Building Bridges: State of the Voluntary Carbon Markets 2010. Washington, DC: Forest Trends.
- Heal, Geoffrey, Gretchen C. Daily, Paul R. Ehrlich, James Salzman, Carol Boggs, Jessica Hellman, Jennifer Hughes, Claire Kremen, and Taylor Ricketts. 2001. Protecting Natural Capital through Ecosystem Service Districts. *Stanford Environmental Law Journal* 20: 333–364.
- Jackson, Robert B., Esteba G. Jobbágy, Roni Avissar, Somnath Baidya

- Roy, Damian J. Barrett, Charles W. Cook, Kathleen A. Farley, David C. Le Maitre, Bruce A. McCarl, and Brian C. Murray. 2005. Trading Water for Carbon with Biological Carbon Sequestration. *Science* 310: 1944–1947.
- Landell-Mills, Natasha, and Ina T. Porras. 2002. *Silver Bullet or Fools' Gold?: A Global Review of Markets for Forest Environmental Services and Their Impacts on the Poor*. Instruments for Sustainable Private Sector Forestry Series. London: International Institute for Environment and Development.
- Millennium Ecosystem Assessment (MEA). 2005. *Ecosystems and Human Well-Being: Synthesis*. Washington, Island Press.
- Salzman, James. 1997. Valuing Ecosystem Services, *Ecology Law Quarterly* 24: 887–903.
- . 2005. Creating Markets for Ecosystem Services: Notes from the Field. *NYU Law Review* 80: 870–961.
- Scarborough, Brandon, and Hertha Lund. 2007. *Saving Our Streams: Harnessing Water Markets*. Practical Guide Series. Bozeman, MT: PERC. Available at: www.perc.org/pdf/SOS_Full_Text.pdf.
- Smith, Mark, Dolf de Groot, Danièle Perrot-Maitre, and Ger Bergkamp. 2006. *Pay: Establishing Payments for Watershed Services*. Gland, Switzerland: IUCN.
- Stoneham, Gary, Vivek Chaudhri, Arthur Ha, and Loris Strappazzon 2002. Auctions for Conservation Contracts: An Empirical Examination of Victoria's BushTender Trial. *Australian Journal of Agricultural and Resource Economics* 47: 477–500. Available at: www.hdl.handle.net/1885/40973.
- Wunder, Sven. 2005. Payments for Environmental Services: Some Nuts and Bolts. CIFOR Occasional Paper No. 42. Jakarta, Indonesia: Center for International Forestry Research.