5. Designing effective payments for environmental services

The effectiveness of PES programmes depends on their design and implementation. These factors must be addressed within the specific political, socio-economic and environmental context of the programme. Cost-effectiveness is a key criterion for programme design and constitutes the point of departure for this chapter. The focus is on issues involved in designing PES programmes for cost-effectiveness in meeting environmental objectives. Chapter 6 will broaden the discussion to include design issues as they relate to impacts on the poor and the possibilities for participation of the poor in PES programmes.

The preceding chapters discuss demand for environmental services and the opportunity costs associated with their provision. In addition to these factors, transaction costs associated with making an exchange between buyers and sellers need to be taken into account when designing cost-effective programmes. Transaction costs include the cost of attracting potential buyers or finding potential providers of environmental services, of working with project partners (e.g. negotiations with project participants and capacity-building) and of ensuring that parties fulfil their obligations (e.g. contract development and enforcement, legal and insurance costs, and monitoring of environmental services). These costs are partly determined by the institutions and rules that govern environmental service exchanges, whether they are publicly funded programmes or private exchanges of offsets.

The considerable uncertainties and complexities involved in measuring, monitoring and exchanging services mean that transaction costs can be significant. Moreover, the relevant institutions and rules are still being established. Indeed, transaction costs can easily exceed the cost of actually providing the environmental service. For example, one preliminary assessment suggests that transaction costs in forest carbon projects absorb more than 50 percent (and in some cases more than 90 percent) of the value of total payments made, while the forest producer receives only the residual (Niles *et al*., 2002).

Several studies have examined programme design issues and tools in the context of payments for environmental services. For example, Weinberg and Claassen (2005) and Claassen *et al.* (2001) discuss issues of effective conservation programme design in the context of United States public environmental service payment programmes, and van Noordwijk *et al*. (2007) present a conceptual framework for characterizing various types of compensation or reward mechanisms for environmental services in terms of their effectiveness, efficiency, sustainability and equity. The Rewarding Upland Poor for Environmental Services (RUPES) project in Southeast Asia has explicitly focused on the development of simplified methodologies for cost-effective measurement of the potential for payments for biodiversity and watershed services.[16]

In this chapter, the main design issues discussed are: what should payments be made for, who should be paid, how much should they be paid and in what form? It then briefly considers several issues involved in reducing transaction costs and, finally, the importance of creating an enabling environment, in the form of supporting institutions, within which PES programmes can operate.

[16] For further information, see www.worldagroforestry.org/sea/networks/rupes.

BOX 13
Payments for restoring riparian areas in São Paulo, Brazil

Paolo Toledo and Helena Carrascosa[1]

In the state of São Paulo, Brazil, there are a million hectares of riparian areas in need of rehabilitation. Restoring vegetation along margins of water bodies traps sediments and pollutants before they reach the waterways, plays an important role in flood protection and can provide habitat for wildlife and carbon sequestration. Although today these areas are protected from conversion by state law, there are no incentives for the restoration of previously degraded sections. Yet the cost of degradation in riparian zones is mounting.

For example, when the water utility serving the city of Piracicaba had to switch its main water intake from the Piracicaba River to its tributary Corumbataí because of escalating water treatment costs, great concern arose. As a consequence, in 1999 the intermunicipal consortium of the Piracicaba–Capivari–Jundiaí watersheds initiated a programme whereby R$0.01 per cubic metre was allocated to support restoration of the rivers' riparian strips. Participation of consortium members is voluntary.

The São Paulo State Riparian Forest Restoration Project (PRMC) is supporting this effort by working with farmers currently engaged in subsistence farming and low-productivity pasture management to identify alternative land uses and restore and protect riparian strips. The PRMC is sponsored by the State Environment Secretariat, with the support of the Global Environment Facility, the Nature Conservancy and the National Water Agency, in conjunction with the ongoing State Programme for Sustainable Microwatershed Management.

The management committee of the Piracicaba–Capivari–Jundiaí watersheds has approved US$280 000 per year to support a project for extending and experimenting with payments for riparian restoration. Part of these funds will be used to make payments to farmers who adopt land-use changes that restore the riparian zones and provide watershed services to downstream users. The next big step will be to secure a regular contribution from the water utility serving the city of São Paulo, a city of over 20 million people. The project is also exploring the potential for attracting buyers of carbon emission offsets and purchasers of biodiversity conservation services to support the rehabilitation programme.

In this context, the State Environment Secretariat, together with various partners, is initiating a state-level PES fund to secure a long-term, consistent, statewide restoration programme.

[1] *São Paulo State Riparian Forest Restoration Project.*

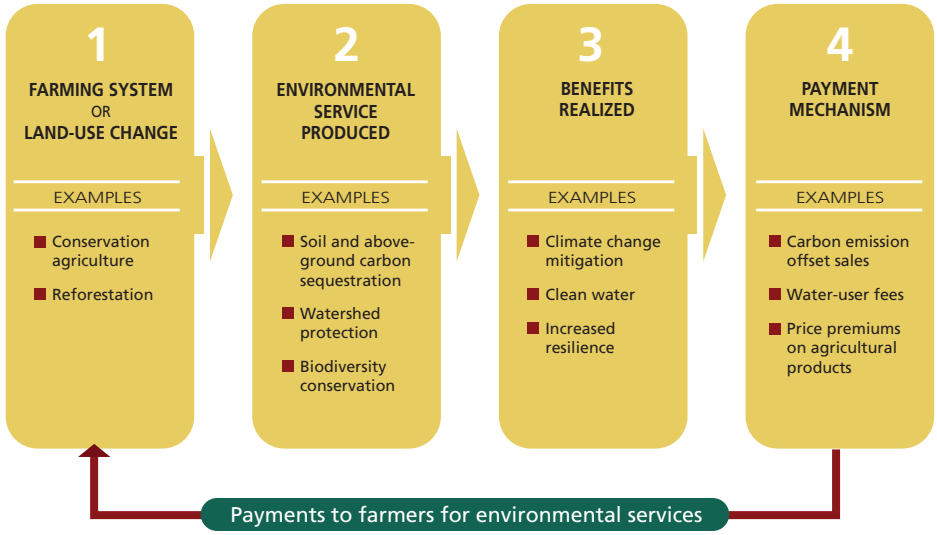
What should payments be made for?

Careful identification of the service of interest is a critical first step in designing an effective PES scheme. This requires an assessment of the potential for environmental service payments to contribute to environmental, social and economic objectives. This assessment, in turn, must be based on an understanding of the underlying biophysical science and the economic motivations of suppliers as well as an assessment of demand (Figure 13). In practice, assessing demand and supply potential are iterative processes. Box 13 gives an example of how these processes are occurring in São Paulo, Brazil.

Payments for actual services or for proxies?

Whether to pay for the service itself or for some proxy is an important design consideration. If the environmental service can be measured easily and the cause-

FIGURE 13
Key elements in PES programme design



Source: FAO.

and-effect linkages are straightforward, payments will be most effective if made directly for performance in increasing the output of the environmental service delivered. Payments for carbon sequestration are relatively simple in this regard. Payments for watershed services, on the other hand, are complicated, because the complex hydrological relationships make it difficult to establish the links between cause and effect in service provision. In these cases, payments are more easily linked to observable land-use changes that are associated with changes in the provision of the desired environmental service. For example, FAO (2002b) describes how perceptions of the linkages between land use and water resources determined the terms of a contract between the La Esperanza Hydropower Project and the Monteverde Conservation League in Costa Rica. The hydropower facility pays the upstream landowners (represented by the Monteverde Conservation League) for conserving and protecting existing forests in the expectation that this will lead to a more stable stream flow over the year and lower sedimentation, both of which reduce the costs of the hydropower operation. In the New York City example described in Box 4 (see p. 34), payments were made for changes in land use and management and not directly for water quality improvements.

When it is difficult to measure the service inexpensively or to monitor compliance, payments for quantifiable changes in agricultural practices that are likely to result in enhanced service provision can be more cost-effective. In the vast majority of PES transactions to date, payments have been associated with land-use changes rather than with service provision directly, and the buyers have borne the risk of inadequate service provision. So long as the farmers manage their property in accordance with the terms of the contract, they are paid whether the service is provided or not.

Whether payments are made for the actual service or linked to a proxy has implications for who bears the risk of an unforeseeable or uncontrollable factor affecting supply. For the seller, a contract for a specific land-management change, such as planting and maintaining a riparian buffer, involves much less risk than a contract based on payments for water purification services, which might be affected not only by land-management changes but also by a drought or a major rainfall that could wash nutrients and soil into watercourses. Insurance against variability in service supply is an important transaction cost in PES exchanges. Self-insurance, where

sellers produce more services than they have contracted (e.g. by planning extra area for carbon offsets) or buyers contract for more services than they need, is one approach. In Guatemala, for example, markets for watershed services offered payments on three times the estimated area needed to ensure delivery of contracted services to the investor. In some cases, NGOs or governments assume responsibility for absorbing the risks of both buyers and sellers (FAO, 2007c).

The use of indices

In an effort to ensure that changes in land-management practices generate the intended service, indices of environmental service provision have been developed. The challenge in selecting indicators is that of establishing an appropriate balance between accuracy and cost. One example is the scoring system used as part of the Silvopastoral Project implemented in Colombia, Costa Rica and Nicaragua described in Box 14.

BOX 14

The Regional Integrated Silvopastoral Ecosystem Management Project in Colombia, Costa Rica and Nicaragua

Muhammed Ibrahim[1]

Tropical deforestation in the Latin America and the Caribbean region is continuing at a high rate with serious consequences for the environment. In Central America, more than 9 million hectares of primary forest have been deforested for pasture expansion, and more than half of this area is degraded. Traditional pasture systems are based on clearing the land of trees, which has negative impacts on biodiversity and carbon sequestration. Furthermore, once established, such systems cause soil fertility and water resource issues, leading to diminishing grass cover and lower productivity. Lower income for producers results in continuing poverty and in pressure to clear additional areas. One alternative to traditional systems is silvopastoral systems, which combine trees with pasture. These systems can be grouped in four major categories (Murgueitio,1999):

- systems in which high densities of trees and shrubs are planted in pastures, providing shade and diet supplements while protecting the soil from packing and erosion;
- cut-and-carry systems, which replace grazing in open pasturelands with stables in which livestock are fed with the foliage of different trees and shrubs specifically planted in areas formerly used for other agricultural practices;
- systems that use fast-growing trees and shrubs for fencing and wind screens. These systems provide an inexpensive alternative to fencing and supplement livestock diets;
- systems where livestock graze in forest plantations. In these systems, grazing is used to control the invasion of native and exotic grasses, thus reducing the management costs of the plantations.

Adopting improved silvopastoral practices in degraded pasture areas is thought to provide valuable local and global environmental benefits, including carbon sequestration and biodiversity conservation. However, producers face barriers to adopting these practices, as they involve high initial costs.

Over the past five years, a project experimenting with the use of payments for environmental services as an incentive mechanism for the adoption of silvopastoral practices has been implemented in Colombia, Costa Rica and Nicaragua. The Regional Integrated Silvopastoral Ecosystem Management Project is funded by the Global Environment Facility and the multi-institutional FAO Livestock, Environment and Development initiative and implemented by the Tropical Agricultural Research and Higher Education Center in Costa Rica with the collaboration of the research and development institute Nitlapán in Nicaragua and the Colombian NGO Centro para la Investigación en

The scoring system attempts to capture the relationships among various types of land use and multiple environmental services (Pagiola *et al*., 2004). Table 11 (p. 78) shows the index value for a variety of agricultural systems. The index for carbon sequestration assigns 0.1 points per tonne of carbon sequestered, while that for biodiversity conservation ranks land uses from most unfriendly to biodiversity (degraded monoculture pasture, 0.0 points) to most friendly (primary forest, 1.0 points). For both carbon sequestration and biodiversity, specific point values were assigned by a panel of experts based on available data. The two indices were combined to create a single environmental services index. Biodiversity and carbon sequestration were monitored in all land-use types in the three pilot areas to verify that the land uses promoted under the project were actually generating the expected environmental benefits. For biodiversity,

Impact of payments on land-use change (total project area for the three countries)

Land use	2003	2006	Difference
	(ha)		*(Percentage)*
Degraded pasture	2 258.28	802.04	–64.48
Natural pasture without trees	1 122.53	368.85	–67.14
Pasture with low tree density	2 232.92	2 582.10	+15.64
Pasture with high tree density	1 074.15	2 488.60	+131.68
Fodder bank	106.30	378.85	+256.40
Forest	3 054.12	3 109.82	+1.82
TOTAL AREA	**9 848.30**	**9 730.26**	

Sistemas Sostenibles de Producción Agropecuaria.

The project seeks to monitor and evaluate environmental services generated by silvopastoral systems so as to develop a methodology for payments for environmental services in agricultural landscapes dominated by cattle production. An ecological index was developed as a tool for such payments, which incorporates the value of different land uses for carbon sequestration and conservation of biodiversity. From 2003 to 2006, cattle farmers participating in the project received between US$2 000 and US$2 400 per farm, representing 10 to 15 percent of net income. The area of degraded pastures was reduced by more than 60 percent in the three countries, and the area of silvopastoral land use (e.g. improved pastures with high density trees, fodder banks and live fences) increased significantly.

The environmental benefits associated with the project include a 71 percent increase in carbon sequestered (from 27.7 million tonnes of CO_2 equivalent in 2003 to 47.6 million tonnes in 2006), increases in bird, bat and butterfly species (see Chapter 2, Figure 5) and a moderate increase in forested area. Milk production and farm income also increased, by more than 10 and 115 percent respectively. Herbicide use dropped by 60 percent, and the practice of using fire to manage pasture is now less frequent.

[1] *Tropical Agricultural Research and Higher Education Center.*

TABLE 11

Environmental service indices in the Silvopastoral Project in Colombia, Costa Rica and Nicaragua (points per hectare, unless otherwise specified)

LAND USE	Biodiversity index	Carbon sequestration index	Environmental service index
Annual crops (annual, grains, and tubers)	0.0	0.0	0.0
Degraded pasture	0.0	0.0	0.0
Natural pasture without trees	0.1	0.1	0.2
Improved pasture without trees	0.4	0.1	0.5
Semi-permanent crops (plantain, sun coffee)	0.3	0.2	0.5
Natural pasture with low tree density (< 30/ha)	0.3	0.3	0.6
Natural pasture with recently planted trees (> 200/ha)	0.3	0.3	0.6
Improved pasture with recently planted trees (> 200/ha)	0.3	0.4	0.7
Monoculture fruit crops	0.3	0.4	0.7
Fodder bank	0.3	0.5	0.8
Improved pasture with low tree density (< 30/ha)	0.3	0.6	0.9
Fodder bank with woody species	0.4	0.5	0.9
Natural pasture with high tree density (> 30/ha)	0.5	0.5	1.0
Diversified fruit crops	0.6	0.5	1.1
Diversified fodder bank	0.6	0.6	1.2
Monoculture timber plantation	0.4	0.8	1.2
Shade-grown coffee	0.6	0.7	1.3
Improved pasture with high tree density (> 30/ha)	0.6	0.7	1.3
Bamboo (*guadua*) forest	0.5	0.8	1.3
Diversified timber plantation	0.7	0.7	1.4
Scrub habitats (*tacotales*)	0.6	0.8	1.4
Riparian forest	0.8	0.7	1.5
Intensive silvopastoral system (> 5 000 trees/ha)	0.6	1.0	1.6
Disturbed secondary forest (> 10 m^2 basal area)	0.8	0.9	1.7
Secondary forest (> 10 m^2 basal area)	0.9	1.0	1.9
Primary forest	1.0	1.0	2.0
New live fence or established live fence with frequent pruning (per km)	0.3	0.3	0.6
Windbreaks (per km)	0.6	0.5	1.1

Note: The environmental service index attempts to assess the level of environmental services generated by different types of land use. It combines two indices: an index for biodiversity and an index for carbon sequestration.
The biodiversity index assigns a number from 0.0 to 1.0 from most unfriendly to biodiversity to most friendly.
The carbon sequestration index assigns 0.1 points per tonne of carbon sequestered. The two indices are added to arrive at a single environmental services index.

Source: Pagiola *et al.,* 2004.

BOX 15
Payments for environmental services and the World Trade Organization Green Box provisions

Support measures that are "decoupled" from output quantities and prices and therefore only minimally distort trade, fall under the Green Box and are exempt from reduction commitments under the current Agreement on Agriculture. In order to fall under the Green Box, support measures must be provided through a publicly funded government programme and the support in question should not have the effect of providing price support to producers. Examples for Green Box subsidies are compensation for income loss for producers located in disadvantaged regions, or for producers implementing environmental programmes. Agri-environmental programmes can be categorized into three different types: programmes focusing on the retirement of land from agricultural uses for conservation purposes; programmes focusing on improving the environmental performance and production practices on current agricultural land; and programmes focusing on maintaining specific performances or agricultural practices.

Source: excerpt from ICTSD, 2006, pp. 2–3.

counts of bird species were the main indicator used, complemented by studies of butterflies, ants and molluscs. Factors such as endemicity and rarity in the species observed were also taken into consideration.

Another example emerged from the Australian BushTender programme (see Box 19, p. 86), which used a field staff scoring system for establishing environmental service indicators. Agency officials visited farms and "scored" how land-use changes would change biodiversity service provision. The score was then divided by the bid price in order to determine "biodiversity per dollar".

Certification

In payment programmes involving certification, the payment is linked to a characteristic of the product or its production process that is associated with the supply of an environmental service. The number of ecolabel and certification programmes has risen markedly in recent years.[17] By the mid-2000s, nearly 30 national and international bodies were certifying natural resource-based products (Searle, Colby and Milway, 2004). The standards and procedures involved in obtaining certification vary considerably, although efforts are being made to consolidate and standardize certification standards (ISEAL, 2006).

International trade rules

Finally, international or regional trade agreements may affect what can be paid for and how PES programmes can be designed. In particular, World Trade Organization (WTO) rules restrict public payment programmes that directly affect production of marketed commodities. The most significant WTO provisions of relevance for payments for environmental services from agriculture are found in the Agreement on Agriculture. According to the Agreement, payments to enhance environmental services would be permitted under the Green Box provisions (Annex 2 of the Agreement) provided that they are decoupled from agricultural production, from post-base period prices and from factors of production (see Box 15). Direct payments under "environmental programmes" are specifically permitted under paragraph 12 of the Green Box, provided payments are limited to extra costs or loss of income involved in complying with the programme. In the current trade round, Green Box criteria may be reviewed

[17] For example, a United States Web site (http://www.eco-labels.org/labelIndex.cfm), lists 146 ecolabels, each differing in the products they certify, the type of environmental benefit associated with the product, and the standards they use.

and clarified with a view to ensuring that Green Box measures have no, or at most minimal, trade-distorting effects. Concerns have been raised that some current Green Box measures may not meet this criterion and that some payments under Green Box measures may indeed be trade-distorting. (UNCTAD, 2007; FAO, 2004d).

Other provisions of the Agreement on Agriculture could also be potentially relevant for PES programmes, including provisions covering structural adjustment assistance, where land could be removed from agricultural production, for example on environmental grounds, or payments under regional assistance programmes, where payments could be made to producers in "disadvantaged regions".

Other multilateral trade agreements could also be relevant for environmental service payments in agriculture, for example the Agreement on Subsidies and Countervailing Measures and the WTO General Agreement on Trade in Services. For environmentally based product certification or labelling schemes, some provisions of the WTO Agreements on the Application of Sanitary and Phytosanitary Measures (SPS) and on Technical Barriers to Trade (TBT) could also be of relevance.

Who should be paid?

The answer to the question of who should be paid to supply environmental services is highly dependent on the overall programme objectives. Perhaps the most controversial issue is whether environmental service payments should be directed to those who currently provide services or to those whose land parcels have the greatest potential for increased service provision.

To frame this dilemma more starkly, we can imagine two adjacent farmers, A and B, who raise cows for a dairy operation on gently rolling land beside a stream that flows into a reservoir. Five years ago, Farmer A constructed fencing alongside her streams, creating a 3-metre riparian buffer on either side of the bank. This change in land management significantly reduced the amount of nutrients and soil washing off her land and the eutrophication and turbidity downstream. On the other hand, Farmer B has continued to manage her land in such a way that nutrient and soil runoff after large storm events affect water quality in the downstream reservoir. Should a downstream water consumer make payments to Farmer A, Farmer B, or both? Although Farmer A provides the greatest level of current service provision, the most efficient use of payments to enhance services is likely to be to Farmer B.

"Additionality" is a key concept in PES programmes designed for efficiency. To meet an additionality requirement, payments should be for a service that would not have been supplied otherwise. Farmer A was already providing the service and thus would not qualify under an additionality standard.

Paying only for additional services can potentially present risks arising from what is known as "moral hazard". For example, some farmers might knowingly use a polluting production practice because they expect, sometime in the future, to receive payments to stop doing so. In practice, however, there are checks that limit the potential seriousness of problems resulting from moral hazard. Increasing one's attractiveness for potential service payments can carry a significant cost in terms of long-term farm productivity. Such a strategy also carries a significant risk to the farmer if payments are granted on a competitive basis, as some farmers may end up receiving no funds. Both the Australian BushTender (see Box 19 on p. 86) and the Costa Rican (see Box 16) programmes, for example, were oversubscribed. In the context of payments, risks associated with moral hazard should not present serious cause for concern unless the expected private benefits of poor land management exceed the costs dramatically.

The hypothetical example above nevertheless points to a more general problem: should farmers be paid for services that are already being provided? Given social and political realities, it may be very difficult to implement programmes based on strict efficiency and additionality criteria, especially publicly funded programmes. Programmes based on additionality may be perceived as "not fair" and as "rewarding the bad guys" (Dobbs and Pretty, 2004). As critics of the United States CRP have made clear, responsible land managers can

BOX 16
The Payments for Environmental Services programme of Costa Rica: setting the baseline

The Costa Rica PSA (Pago de Servicios Ambientales – Payments for Environmental Services) programme, one of the oldest and best known examples of a national payments for environmental services scheme in a developing country, demonstrates the need for setting a good baseline.

In 1997, the country pioneered payments for environmental services programmes based on a national forestry law that explicitly recognized four environmental services provided by forest ecosystems: climate change mitigation, biodiversity conservation, watershed protection and landscape beauty. The government contracts with landowners to maintain forest area in order to provide these services.

By the end of 2005, about 10 percent of the country's forest area was enrolled (Pagiola, 2006). The programme was initially untargeted, with participation on a "first-come, first-served" basis. This resulted in inclusion of land that was at low risk of deforestation.

As Pfaff, Robalino and Sanchez-Azofeifa (2006) describe in their evaluation of its first five years, the programme annually inhibited deforestation on only a small portion of the enrolled forest. "…[O]ver 99 percent of the PSA funds allocated did not change land use." In a separate study, Tattenbach, Obando and Rodríguez (2006) found that an area equal to about half the contracted area would have been deforested in the absence of the PSA programme. Differences in methodology, study area and study period make it hard to compare these results directly, and a consensus on the impacts of the programme has not been reached, but it is clear that only a part of the enrolled area represents actual land-use change. A more detailed discussion of the debate is given in Walker (2007).

The relatively low apparent additionality of the PSA programme should be seen in the context of an overall trend of falling livestock prices, which had made the conversion of forest to pastures much less profitable and had reversed deforestation trends even before the introduction of the PSA programme in 1997. The PSA programme has also been accompanied by the introduction of new legal restrictions on clearing land; compliance with these restrictions would likely have been much less forthcoming had they not been accompanied by payments. It also bears mention that Costa Rica's PSA programme has no additionality requirement. In principle, if the budget were sufficient, the programme would pay every land user with forest for the services that that forest is providing (Pagiola, 2006). With support from the World Bank and the Global Environment Facility, the PSA programme has been evolving towards a more targeted approach that seeks to improve its efficiency.

become dispirited if those who employ less responsible land-management practices are effectively rewarded for doing so (see Box 4). On the other hand, international markets such as the CDM require additionality. If a country wishes to access international payments for environmental services, especially for carbon credits, meeting an additionality criterion will be necessary.

Costa Rica's PSA (Pago de Servicios Ambientales – Payments for Environmental Services) programme is explicitly non-additional. In principle, given a sufficient budget, the PSA programme would pay every forest owner for the services that the forest provides (Pagiola, 2006). Of course, budgets are generally limited and thus some choices need to be made. One way of making that choice is to identify sites that present credible threats to the loss of environmental services. Wünscher, Engel and Wunder (2006) analysed the potential efficiency gains from improved targeting

for the Costa Rica programme. They show that, given a fixed budget, selecting sites according to their service delivery potential increases the amount of contracted services supplied. Even greater efficiency is gained where opportunity costs and payment levels are differentiated. Wunder (2006) compared the potential efficiency of payments in Amazonian states in Brazil having low development pressures and government support for conservation policies to areas experiencing high rates of land conversion to agriculture. He noted that payments in low-development areas are non-additional, while in areas of high conversion rates they may not be sufficient to achieve desired objectives. An important strategy for targeting suppliers of environmental services, therefore, is the identification of areas where threats are projected to emerge, and where payments for environmental services are likely to be effective in changing land use and farming practices.

Setting baselines

Identifying what would have happened under a "business as usual" (no payments) scenario is necessary to assess the effectiveness of a programme and is linked to the question of additionality. The establishment of a baseline requires consideration not just of the level of services when payments start, but also of potential changes in external factors during the period when the environmental service payments are being made.[18] For example, deforestation and reforestation rates change in response to many economic and social pressures, and an increase in forest cover may not be attributable to the payment at all, but rather to other forces, as the Costa Rica example illustrates (see Box 16).

Targeting and self-targeting

For environmental service purchasers concerned solely with the efficient supply of environmental services, the ideal programme would identify and target payments to the lowest-cost suppliers. The key information needed for effective targeting to the lowest-cost suppliers relates to the spatial distribution of land ownership and productivity. The distribution of land is a factor in determining not only who could benefit most from a PES scheme, but also what kind of PES scheme (e.g. land-use vs farming system change) is most likely to be attractive to producers (FAO, 2006e).

In recent decades, considerable field experience has been gained in targeting development projects that is relevant also for the potential targeting of PES programmes. The optimal level of targeting depends on the trade-offs between the cost and the tolerable degree of errors of exclusion and inclusion (the reduction of which is the benefit of targeting) and is constrained by administrative capacity. There are different levels and degrees of targeting. Area-based targeting criteria, for example identifying marginal regions or communities, are generally relatively inexpensive. Targeting becomes more data-intensive, and therefore expensive, when moving to a household or individual level. In general, a trade-off exists between the complexity of targeting strategy and its cost.

Applying targeting criteria is particularly challenging in developing countries with poor data availability and low institutional capacity, as is the case in a number of African countries. Self-targeting, where programmes offer benefits that appeal only to a selected group, has been used by some project designers to try and attract the participants with the desired characteristics. This approach can be problematic, however, as it may exclude the most vulnerable and is only appropriate in certain circumstances. A recent global study on poverty targeting methods (Coady, Grosh and Hoddinott, 2004) found that more-developed countries tend to use means-testing while less-developed countries use self-selection or characteristics-targeting, which are often easier to implement. However, given the wide variation in results across countries and programmes, the study concludes that the most important determinant of targeting success, regardless of the methodology, is the implementation capacity specific to a given programme.

As environmental service supply is inherently linked to location, the use of geographical criteria represents a low-cost means of targeting programmes. For

[18] See, for example, UNEP (2005) for a discussion of baseline methodologies for the CDM.

BOX 17
China's Grain for Green programme

Pushed into action by a series of devastating floods in 1998, the Government of China launched the Grain for Green programme in 1999. One of the largest conservation set-aside programmes in the world, its main objective is to increase forest cover on sloped cropland in the upper reaches of the Yangtze and Yellow River Basins to prevent soil erosion. When possible in their community, households set aside all or parts of certain types of land and plant seedlings to grow trees. In return, the government compensated the participants with grain, cash payments and free seedlings. By the end of 2002, officials had expanded the programme to some 15 million farmers in more than 2 000 counties in 25 provinces and municipalities in China (Xu *et al.*, 2004). If the programme meets its original goals, by 2010 nearly 15 million hectares of cropland will have been set aside, affecting the land of more than 50 million households.

Source: Uchida, Rozelle and Xu, 2007.

example, because the main objective of the China Grain for Green programme (Box 17) is to prevent soil erosion, steepness of slope is one of the main criteria by which plots are selected (Uchida, Rozelle and Xu, 2007). The programme targets lands with slopes of 25 degrees or higher in southwest China and 15 degrees in the northwest. As slope is easy to measure, this is a relatively low-cost targeting tool (Uchida, Rozelle and Xu, 2007), although several studies have found the programme's targeting to have been less than optimal in certain regions, where, indeed, a number of productive and low-sloped plots were retired when less productive and high-sloped plots were still available (Xu *et al*., 2004; Uchida, Xu and Rozelle, 2005).

Mapping locations with high potential environmental service benefits and low opportunity costs of supply (see, for example, Maps 5 and 6) is a further means of geographic targeting, and is becoming progressively less expensive as increasing amounts of geographically referenced information become available.

One approach to self-selected targeting is the use of a reverse auction system as described in the Australian BushTender programme (see Box 19). In this system, landholders provide sealed bids for the amount they are willing to accept for changes in land-use management. Funding is provided in the order of the bidders providing the greatest service provision at the lowest cost, and the process continues until the funds run out. This approach has two major benefits compared with direct grants. First, communication is more efficient: under a reverse auction, farmers weigh the costs and benefits of their own land-use changes and inform the government of their willingness to accept in order to institute these changes. The government, for its part, decides which of the proposed land-use changes will be most effective for meeting its overall service provision goal. Reverse auctions are also well suited to situations in which there is only one buyer and many sellers. This is often the case with water quality services, for example, when a utility seeks to change the behaviour of many landowners.

Targeting is complicated by the potential for "holdouts" – individuals who try to exploit their location or choose not to participate in a programme but capture the benefits of actions of others. The effectiveness of holdouts depends on the degree to which environmental service provision requires coordination among suppliers. This is most easily illustrated in the context of biodiversity conservation. The functional value of a reserve design or wildlife corridor usually depends on contiguous land parcels. If successful, the benefits from the sum of the connected parcels managed for biodiversity conservation are greater than those of its parts. Success can be frustrated by the actions

of a very small number of landholders of key parcels who hold out for prices well above market rates. Without their participation, it may be impossible to create effective habitats.

Equity and efficiency

Decisions on how to set and implement targeting criteria are, of course, strongly related to the overall programme objectives. Alix-Garcia, de Janvry and Sadoulet (forthcoming) compared two hypothetical PES schemes – one with a flat payment and a cap on the amount of land that could be enrolled by any one participant and another that took deforestation risk and land productivity into account. In their simulations, targeted payments were far more efficient in terms of generating environmental services, but the flat payment scheme was more egalitarian. Their results indicate the importance of considering trade-offs between efficiency and equity. These issues are revisited in Chapter 6.

Setting programme objectives and targeting strategies in order to balance equity and efficiency goals is inherently a political process, and the balance may change over the course of programme design and implementation (see Box 18).

How much should be paid?

The amount of an environmental service provided will depend on the level of payments. In general, how much should be paid depends on the options available to buyers and sellers of environmental services, along with other factors that determine their supply and demand. For a transaction to take place, the maximum amount the buyer would be willing to pay for the services must be at least as much as the minimum that the seller would be willing to accept to provide them. The amount the buyer is willing to pay is affected by factors such as the cost of alternatives to the services in question and the financial resources available. The amount the seller is willing to accept depends on the cost of adopting new practices to provide the services.

Historically, some public programmes have set a flat payment rate per hectare for a land-management practice. These programmes did not distinguish between varying service supply potentials and often set prices significantly above what farmers would have been willing to accept,[19] either because of inadequate analysis of supply–demand dynamics because the programmes had income-support objectives in addition to environmental objectives, or because it was administratively too costly to determine farmer-specific payment rates (or politically infeasible to implement them).

In some cases, pressure to maintain flat payments arise out of equity concerns. For example, in the case of the Nairobi National Park Ecosystem Wildlife Conservation Lease programme, the Maasai community, who were the intended recipients of the payments, objected (at least initially) to differentiated payments on social grounds, even though environmental service values and opportunity costs did vary by location.

In most programmes to date, prices for environmental services have been set close to the minimum amount that farmers would accept, although the reasons for this outcome differ by service (Pagiola and Platais, 2007). In carbon markets, the supply of potentially salable carbon credits from land-use change and forestry projects exceeds current demand, thus giving buyers the upper hand in setting prices (Bayon, Hawn and Hamilton, 2007). In markets for watershed and biodiversity services, potential sellers are rarely able to exclude any of the potential buyers from benefiting from the resources, which gives them little leverage in setting prices (Landell-Mills and Porras, 2002).

Publicly funded payment systems face pressure to maximize programme cost-effectiveness. This can be achieved by setting payment levels close to the amount farmers would accept or through a reverse auction system.

Reverse auction approaches, while a potentially useful means of improving the efficiency of supply, can be expensive and difficult to implement, especially with the limited institutional capacity in many developing countries and where producers have low levels of information and formal education. The Silvopastoral Project in Costa

[19] An example was Costa Rica's PSA programme, see Ferraro, 2001.

BOX 18

The political economy of targeting: the Payment for Hydrological Services Programme in Mexico

The design of payments for environmental services programmes, including the areas they target and their recipients, can be strongly influenced by ongoing political debates and institutional arrangements. A payments for environmental services programme in Mexico to conserve water services is an example of how political realities shape programme outcomes.

At its inception in 2003, the programme had both environmental and anti-poverty goals. Because of water scarcity in many areas with high population density, and because the potential seemed highest for developing local markets for the service, it developed into a programme focused on hydrological services.

The programme faced challenges in obtaining funding and management changes. Instead of a 2.5 percent levy on municipal water fees, a fixed amount per year was applied. Initially, the programme was implemented only in priority watersheds, but final implementation was nationwide. The focus on poor communities was abandoned. The scheme was classified as a subsidy and not as a payment, which created a host of additional problems. The rules had to be publicly debated, and the money could not be targeted in a decentralized manner.

Changes in targeting rules from the first proposal to the final scheme can be seen in the table. Other important changes included the removal of the originally planned pilot programme, the elimination of the focus on marginalized communities, the inclusion of commercial forests and private properties and the decision to give payments based on percentage of forest rather than on forest density.

An evaluation (FAO, 2005b) of the first two years of the programme showed that most of the payments had gone to protect forests outside of critical watersheds and were too fragmented in their distribution to provide a measurable improvement in water services. In addition, payments were made mainly for forests that were not at risk of being lost.

Changes in targeting rules for Mexico's PES scheme to protect water services

Original targeting rules (SEMARNAT/INE)	Final targeting rules (SEMARNAT/CONAFOR)
■ Pilot programme with an experimental design	■ Nationwide programme: – Rules of operation – Establishment of a Trust Fund
■ Beneficiaries', *ejidos*[1] and indigenous communities located in priority watersheds: – Overexploited – Serving large populations	■ Beneficiaries augmented to include private owners
■ Other selection criteria: – Forest cover – Clear property rights – Ecosystem type – Marginalization	■ Added selection criteria: – Priority mountains – Availability of satellite image – Protected areas
■ Priority given to forest with high deforestation	■ Subtracted selection criteria: – Marginalization – Deforestation risk

Notes:
SEMARNAT = Secretaría de Medio Ambiente y Recursos Naturales (Secretariat for the Environment, Natural Resources); INE = Instituto Nacional de Ecología (National Ecology Institute); CONAFOR = Comisión Nacional Forestal (National Forestry Commission).
[1] *Ejidos* are a special form of land tenure in Mexico resulting from the land reform process that started after the Mexican revolution in 1910. *Ejidos* are composed of two different kinds of property rights over land: individual parcels and common lands

Source: FAO, 2005b.

BOX 19

Measurement and targeting issues: the BushTender programme of Australia

In Australia, the State of Victoria's Department of Natural Resources and Environment (NRE) has developed a pilot programme to conserve native vegetation remnants on private property. In exchange for payments from the state government, landholders commit to fencing off and managing an agreed amount of native vegetation for a set period. The first BushTender trial was completed in 2002 in the north central and northeast regions of the state. The programme is based on the Conservation Reserve Program in the United States of America. The innovation of the BushTender programme is its reliance on a robust assessment methodology and reverse auction mechanism to set the price of the contracts.

With the assistance of farmers' associations, NRE publicized that it might be willing to pay farmers to conserve native vegetation. Interested landholders contacted NRE, which sent out field staff to inspect the sites, explaining to landholders which of their native vegetation was most significant and the most effective conservation activities.

The field staff assessed the value of each site's native vegetation on two scales of value. One was called the Biodiversity Significance Score, which rated the site's conservation value according to scarcity of remnant types. The other was the Habitat Services Score, which assessed the contribution of the proposed management action, such as fencing or weeding, to biodiversity improvement. Landholders were informed of the Habitat Services Score but, not of the Biodiversity Significance Score. Interested landholders could then choose to submit bids, detailing in a management plan developed with the field officer which remnant vegetation (and how much) they would be willing to conserve, as well as the management regime for the remnants. The proposed management actions ranged from excluding livestock, retaining large trees and controlling rabbits to controlling weeds and

Rica, Colombia and Nicaragua (Box 14, p. 76), for example, opted to offer fixed payments for eligible land uses because the reverse auction approach was deemed too complex for the setting.

The potential of auctions in a developing country context is being explored in the Sumberjaya subdistrict in Sumatra for the purchase of erosion abatement services from coffee farmers. Researchers have found that extending the auction approach to a developing country setting required several adaptations in their design and implementation, including the use of a uniform price rule to minimize risks of social conflict created by discriminatory pricing in small communities. The prices achieved at the auction allowed the purchase of 30–70 percent more conservation services than would have been the case at the estimated labour cost for contract implementation, and bidding behaviour across rounds indicated that farmers adjusted their bids in response to previous outcomes in ways that indicated an understanding of the mechanism (Leimona, 2007).

Direct negotiation between service users and providers – another approach for price-setting – results in individually crafted agreements that reflect the different levels of service that different landholders can provide and the specific conditions faced by each landholder. This was the approach adopted by Vittel in France and in the New York City case (Box 4, p. 34). This approach can result in highly optimized contracts, but can also incur high transaction costs. A variant of this approach is used in the Silvopastoral Project in Costa Rica, Colombia and Nicaragua. Recognizing that different land uses can provide different levels of the desired services, payments are based on the increase in services generated by the specific mix of land uses adopted by each landholder, measured using an index (see Table 11, p. 78). While this approach has lower

revegetation. In the end, 98 landholders submitted 148 bids for 186 sites.

Since NRE had an estimate of potential biodiversity importance for each of these sites, they were able to calculate the best value for money (i.e. by identifying those bids that offered greatest biodiversity value for least cost per hectare). Given a limited funding budget, only the most cost-effective bids were funded. In the end, NRE accepted 97 bids, with landholders committing to conserve and manage roughly 3 200 hectares of native vegetation under three-year BushTender Management Agreements for a total cost of approximately $A400 000. Compliance monitoring occurs through random site inspections.

Beyond the fact that the scheme was well received and oversubscribed, the environmental benefits seem significant. NRE field staff concluded that most of the successful bids contained sites of high or very high conservation significance, including 24 new populations of rare or threatened plant species. Perhaps the most unexpected finding was that many of the bids were for less money than the NRE would have been willing to pay, had they negotiated directly with landholders. It is not clear whether the lower price was a result of market pressures of competitive bidding, the NRE underestimating landholders' willingness to accept, or the fact that once landholders understood the non-market value of their native vegetation they were willing to internalize some of the perceived costs of conservation. It is an open question whether persuasion instruments, such as brochures or educational visits from conservation staff, would have achieved the same result. At first glance, this seems unlikely because the landholders would not have been forced to consider the true value of their willingness to accept land changes.

Source: FAO, 2007d.

negotiation costs, it still has relatively high monitoring costs (Pagiola *et al.*, 2004).

How should payments be made?

Three main issues must be addressed in determining the form payments should take:

1. Should payments be in cash or in another form?
2. How should payments be timed?
3. What payment mechanism should be used?

Cash versus in-kind payments

Other types of payments than cash can be envisaged. Wunder (2005) describes the perceived advantages and disadvantages of cash versus the use of beehives as payment for watershed services in Bolivia. The in-kind payment involved providing farmers with beehives and technical assistance in bee-keeping. This form of payment was perceived as creating a lasting benefit, while cash would more likely have been spent right away. One way to address this concern is by targeting payments towards women, which has been shown to be particularly effective in increasing spending on education, health and nutrition (Davis, 2003; Haddad, Hoddinott and Alderman, 1997). One objection to in-kind payments is that they allow less flexibility for meeting fluctuating labour and skill requirements. Moreover, they can also be seen as paternalistic – i.e. it is an outsider who determines what is best for suppliers, rather than allowing them to choose how to invest or dispose of their cash payments. Offering a variety of payment modes, if the administrative costs of doing so are not too high, could be one way to overcome these objections (Wunder, 2005).

Timing and duration

The timing and duration of payments are critical issues from both a buyer's and seller's

point of view. In many cases, environmental services are only generated years after the supplier actually makes the required land-use changes (and bears the costs). Obtaining investment credit is often difficult and expensive for developing country farmers, further strengthening the need for payments in the short term. Whether payments should be made in a single instalment or periodically also needs to be considered.

Referring back to Figures 7 and 8 in Chapter 4 (pp. 52–3), we can see that different arrangements for the timing of payments may be required when considering a farmer in scenario B in Figure 8, who faces an investment barrier to adoption and thus a temporary decline in income, versus those in scenarios A and B in Figure 7, who face a permanent decrease in income from the land by adopting the land-use system that generates environmental services. In the former case, payments can allow the farmer to overcome the investment barrier through short-term funds to facilitate the transfer to new production systems that will be more profitable in the long run, even without the payment.

This is the strategy used in the Silvopastoral Project in Colombia, Costa Rica and Nicaragua (Box 14), where payments are explicitly short-term. Indeed, despite their long-term benefits, silvopastoral practices tend to be unattractive to farmers primarily because of the substantial initial investment and the time lag between the investment and returns. The project assumed that, given this situation, relatively small payments provided in the early stages could "tip the balance" between current and silvopastoral practices by increasing the net present value of investments in silvopastoral practices and by reducing the initial period in which these practices impose net costs on farmers. The payments also alleviate the liquidity problems faced by many farmers and help them finance the required investments (Pagiola *et al.*, 2004).

When the land-use change needed to generate environmental services results in a permanent decrease in income, payments for the environmental service must be maintained indefinitely to preserve the incentive to supply it. Farmers continue to receive payments every season for the agricultural products they generate from their lands; receiving a continuing payment for the environmental services they generate is analogous to receiving continuous payments for the crops they produce each year.

Payment forms

Three main types of mechanism for environmental service payments can be identified:

- direct payments (public and private);
- offsets (both voluntary and mandatory);
- agricultural product certification programmes (ecolabels).

Each involves different sets of stakeholders among the buyers and sellers, as well as intermediaries involved in making the transaction. In the following paragraphs, we summarize the main features of each of these mechanisms and identify key actors in the transaction chain.

Direct payments. This category includes direct payments from public programmes, such as the China Grain for Green programme, as well as public programmes in Australia (Box 19), Costa Rica (Box 16), Mexico (Box 18) and the United States of America (Box 12). Private payments may also fall into this category, including cases of hydropower companies paying for watershed services (FAO, 2002a) and payments made by NGOs for biodiversity conservation services. Currently, this mechanism accounts for the largest share of payments.

Sources of funds in this category range from general tax revenues to specific taxes or charges on beneficiaries. International funds (e.g. the GEF) are a further source, and in some cases public and private funding sources are combined. In Costa Rica, in the Rio Segundo watershed, for example, payments to landholders are financed in part with payments from a private bottler, Florida Ice & Farm, and in part by the local town's public service utility ESPH (Empresa de Servicios Publicos de Heredia) (Pagiola, 2006). An important distinction in these cases is the extent to which funds come directly from service users or through intermediaries. When payments are made directly by service users, a good case can be made that payments are likely to be efficient and sustainable, as the financing source has both a direct incentive to pay and the

power to insist on an efficient use of their monies; where payments are made through intermediaries, such as government agencies, as in the case of the United States CRP, Mexico's Payment for Hydrological Services Programme (PSAH) and Costa Rica's PSA, it can be argued that this efficiency is muted (Pagiola and Platais, 2007).

Mandatory and voluntary offsets. Mandatory offsets are the medium of exchange in regulated cap-and-trade markets, such as the Kyoto flexible trading mechanisms and United States wetlands mitigation banking (see Box 12 on p. 62). Private- or public-sector entities wanting to meet regulatory compliance through offsets are the ultimate purchasers in this exchange, although there are usually one or more intermediaries involved. These include NGOs as well as private-sector firms specializing in carbon market exchanges. (See Box 20 for a more detailed description of the process of certification under the CDM.) There also exists a significant and growing sector concerned with voluntary carbon offset payments. The certification standards and procedures vary between voluntary and mandatory offset schemes. Several actors are present in the transaction chain between buyer and sellers for both.

Agricultural product certification programmes. When consumers buy certified products, they are paying not just for the product itself, but also for the manner in which it was produced and brought to the market. The source of funds is from within the private sector and the payment mechanism is via price premiums and/or market access. These programmes establish a set of standards for particular categories of goods or services and, for a payment, certify whether the producer has met these requirements. If so, they may use an identifying label on their product and in their advertising to distinguish their products from others in the marketplace and, presumably, benefit from increased prices or market share by serving the "green" consumer niche.

Certified products involve three sets of buyers along the supply chain. The most obvious is the point-of-sale buyer – the green consumer. Moving up the supply chain, the second is the retailer – Home Depot, Carrefour or other companies buying wholesale before selling to the consumer. The third buyer is, ironically, the supplier of the green product, who must pay the certification organization for use of the label and sometimes separate certifiers. The transaction costs associated with the certification process and the need to streamline marketing value chains to provide producers with sufficient incentives to participate in the certification schemes can prove to be a formidable barrier, especially for small and low-income producers (Searle, Colby and Milway, 2004). Some efforts have been made to facilitate the participation of such groups through the introduction of simplified procedures or promotion of group certification schemes.

There is also a trade-off in terms of market growth between setting highly stringent and more flexible standards. Highly stringent standards can result in fairly small "luxury good" market niches that may be inaccessible to most producers, whereas more flexible standards could involve a much broader market segment but may not deliver any real environmental benefits. A hybrid solution that involves a dynamic process of standard setting to promote continuous improvement is an option being used by the Marine Stewardship Council (see Box 21).

Payments for any one service may fall into any one of these three categories of mechanisms. This is illustrated in Table 12, which presents a variety of specific payment mechanisms for biodiversity conservation services. There is also potential to combine payment mechanisms. One strategy being implemented is the use of public payment programmes to initiate PES programmes, with the eventual intention of transitioning to private-sector and/or offsets payments. PES programmes with funding from the GEF typify this strategy. Here, public funds are being used to establish capacity and mechanisms and to illustrate the potential for these types of mechanisms, in the expectation that private-sector purchasers of services will participate once they have been convinced of the benefits they could reap. Establishing strong public–private partnerships in the implementation of PES programmes is a key part of a new strategy

BOX 20

Rules and modalities for afforestation and reforestation payments under the Clean Development Mechanism of the Kyoto Protocol

Under the Clean Development Mechanism (CDM) of the Kyoto Protocol, industrialized countries can meet a part of their greenhouse gas reduction obligations through offset projects in developing countries. CDM projects must also promote sustainable development in host countries. Emission offsets can be generated either by reducing emissions or by removing carbon from the atmosphere (sequestration). Afforestation and reforestation (A&R) projects are the only type of carbon sequestration projects currently allowed under the CDM. Emission offsets are measured in metric tonnes of carbon dioxide equivalents and are traded as certified emission reductions (CERs).

Rules and modalities

Baseline. Baselines for A&R projects are calculated based on the changes in carbon stocks in above- and below-ground biomass that would have reasonably occurred without the project. Baselines are calculated using an approved CDM methodology, or a new methodology may be proposed for approval along with the project.

Additionality. A strict additionality criterion is applied for projects. A project may be additional if it overcomes barriers related to investment or technology constraints.

Leakage. Any increase in greenhouse gas emissions that occurs outside the project area and is measurable and attributable to the project must be minimized, monitored and subtracted from project carbon sequestration credits.

Credits. Two types of credits have been developed for A&R projects, based on the possibility that forests can eventually release carbon (i.e. sequestration may not be permanent):

- temporary credits that expire at the end of the commitment period for which they were issued and must be replaced by the buyer to ensure continuing carbon storage. This type of credit commands a low price, but the producer faces no risk if the carbon sequestration is lost as a result of calamity (e.g. fire) or harvesting.
- long-term credits that expire at the end of the project's crediting period, a time span of up to 60 years.

proposed by the GEF. The partnerships are intended to encourage the development and scaling up of voluntary PES payments, and reduce the transaction costs of such instruments (GEF, 2007b).

Reducing transaction costs

The need to reduce transaction costs, subject to achieving a defined level of service provision, is an overarching issue in all the exchange mechanisms discussed above. In the early stage of PES programme development, when institutions and participants are inexperienced and projects are small, transaction costs per unit of service tend to be relatively high, but they can be expected to decline over time. However, unless institutions exist to manage and coordinate transactions among large numbers of smallholders and unless economies of scale in monitoring and payment systems can be found, such costs can render PES initiatives unworkable. Three main approaches to reducing transaction costs in developing country PES schemes can be identified:

- **Simplify the rules**. A rule of thumb is to use the simplest rules possible and the simplest compliance mechanisms that will satisfy the buyers and beneficiaries in the contract. For example, for determining baselines and monitoring carbon outcomes, standardized measures can be developed and scientifically evaluated to serve as proxies for detailed measures. Independent bodies would determine the reference rates, and

The project cycle

The first step of the CDM project cycle is the preparation of a Project Design Document. In the document, the project developer must:

- identify a suitable region with areas not covered by forests since at least 1990;
- gather land-use, social and economic information about the project area to develop the baseline;
- identify suitable forms of A&R and estimate their carbon sequestration potential;
- contact and establish relationships with the local people;
- negotiate the terms of the project and the schedule of payments for carbon sequestration services; and
- analyse possible environmental and social impacts.

After the document is prepared, it must be approved by the Designated National Authority of the host country, validated by a Designated Operational Entity accredited by the CDM Executive Board and registered with the Executive Board. Once the CDM Executive Board issues the appropriate number of CERs for a project, the project developer becomes a seller in the international carbon market.

Once the project is approved and under way, the next part of the CDM cycle is monitoring the carbon dioxide abatement actually achieved by the project, including certification and verification by the Designated Operational Entity. Monitoring costs are incurred every time a new batch of carbon is submitted for CER credits.

Project management costs include the establishment of a local project office and the training of staff, the cost of keeping records of project participants and administration of payments to sellers, as well as salaries and transportation costs of project employees. Enforcement and insurance costs arise from the risk of project failure or underperformance, which might be caused by fire, slow tree growth or leakage.

Source: FAO Forest Resource Division Fact Sheet (FAO, n.d.).

verification would only involve a third party confirming that the activities had been undertaken (Sandor, 2000, cited in Landell-Mills and Porras, 2002).

- **Facilitate buyer–seller linkages**. Most PES programmes involve buyers and sellers who are geographically and socially distant from one another. To reduce search costs, some countries have established "one-stop shops" for potential buyers of carbon emission offsets, where they can find out all the relevant rules, identify pre-screened sellers and learn about locally knowledgeable market intermediaries.

- **Exploit economies of scale**. Costs such as project design, management and certification are characterized by economies of scale; consequently, project size has an important effect on unit costs. Transaction costs can be greatly reduced by developing projects in communities where active local organizations and participatory development programmes are already in place, with representatives already selected and authorized to negotiate with outsiders. For example, organized indigenous communities in El Salvador have undertaken their own diagnostic studies of local needs and priorities and are actively marketing specific ecosystem services from specific areas that would contribute to meeting those priorities (Rosa *et al.*, 2003). Because carbon can be sequestered in almost

BOX 21
Ecolabelling in fisheries

William Emerson[1]

With trade in fishery products at an all-time high and concern over the status of wild marine stocks growing, ecolabelling offers a way to promote responsible fish trade while preserving natural resources for future generations. In 2005, the FAO Committee on Fisheries adopted a set of voluntary guidelines for the ecolabelling of marine capture fisheries products. They provide guidance to governments and organizations that already maintain, or are considering establishing, labelling schemes to certify and promote fish and fishery products from well-managed marine capture fisheries. The guidelines outline general principles that should govern ecolabelling schemes, including the need for reliable, independent auditing, transparency of standards-setting and accountability, and the need for standards to be based on good science. They also lay down minimum requirements and criteria for assessing whether a fishery should be certified and whether an ecolabel should be awarded.

The FAO guidelines acknowledge the hurdles that developing countries face in responsibly managing their fisheries. These result from a lack of financial and technical resources, as well as the particular challenges posed by the small-scale fisheries common in many developing nations. The guidelines, therefore, call for financial and technical support for developing countries to help them implement and benefit from ecolabelling schemes.

Over the past 15 years, a number of countries and private organizations have put ecolabelling programmes into place for a wide range of products. The proliferation of ecolabels has created a number of challenges, as well as confusion among producers and consumers. There have also been concerns that ecolabelling schemes could result in unfair competition. The purpose of the FAO guidelines is to create a framework for the development of responsible and trustworthy ecolabelling schemes.

The main fishery certification and ecolabelling programme is currently run by the Marine Stewardship Council (MSC), an independent non-profit organization that promotes responsible fishing practices. A number of major seafood retailers carry MSC-certified products. For example, Wal-Mart, a retail chain in the United States of America, has committed itself to sourcing all its fresh and frozen fish products from MSC-certified fisheries within three to five years. There are currently more than 50 fisheries that are certified by the MSC or under assessment. Only three MSC-certified fisheries are, however, from developing countries (South African hake, Mexican Baja California spiny lobster and Patagonian scallop fisheries).

[1] *FAO Fisheries and Aquaculture Department.*

any site (unlike the more site-specific biodiversity and watershed services), area-based projects can be designed in which an entire jurisdiction commits to a defined increase in forest cover or area of forest protected. This increases land-use flexibility and is especially useful for heterogeneous landscapes (Smith and Scherr, 2002).

Establishing an enabling environment

No transactions – ranging from the informal to the highly regulated – take place in the absence of supporting institutions. Even the simplest contracts between buyers and sellers rely on legal institutions to protect property

TABLE 12
Types of payments for biodiversity protection

PURCHASE OF HIGH-VALUE HABITAT
■ Private land acquisition (purchase by private buyers or NGOs explicitly for biodiversity conservation)
■ Public land acquisition (purchase by a government agency explicitly for biodiversity conservation)
PAYMENT FOR ACCESS TO SPECIES OR HABITAT
■ Bioprospecting rights (rights to collect, test and use genetic material from a designated area)
■ Research permits (rights to collect specimens, take measurements in an area)
■ Hunting, fishing or gathering permits for wild species
■ Ecotourism use (rights to enter an area, observe wildlife, camp or hike)
PAYMENT FOR BIODIVERSITY-CONSERVING MANAGEMENT
■ Conservation easements (owner paid to use and manage a defined piece of land only for conservation purposes; restrictions are usually in perpetuity and transferable upon sale of the land)
■ Conservation land lease (owner paid to use and manage a defined piece of land for conservation purposes, for defined period of time)
■ Conservation concession (public forest agency is paid to maintain a defined area under conservation uses only – comparable to a forest logging concession)
■ Community concession in public protected areas (individuals or communities are allocated use rights to a defined area of forest or grassland, in return for commitment to protect the area from practices that harm biodiversity)
■ Management contracts for habitat or species conservation on private farms, forests, grazing lands (contract that details biodiversity management activities, and payments linked to the achievement of specified objectives)
TRADABLE RIGHTS UNDER CAP-AND-TRADE REGULATIONS
■ Tradable wetland mitigation credits (credits from wetland conservation or restoration that can be used to offset obligations of developers to maintain a minimum area of natural wetlands in a defined region)
■ Tradable development rights (rights allocated to develop only a limited total area of natural habitat within a defined region)
■ Tradable biodiversity credits (credits representing areas of biodiversity protection or enhancement that can be purchased by developers to ensure they meet a minimum standard of biodiversity protection)
SUPPORT TO BIODIVERSITY-CONSERVING BUSINESSES AND PRODUCTION PROCESSES
■ Business shares in enterprises that manage for biodiversity conservation
■ Biodiversity-friendly products (ecolabelling)
■ Niche market development for products with valuable agricultural biodiversity

Source: Scherr, White and Khare, 2004.

rights and adjudicate disputes, when they arise, and on law enforcement to ensure the legal judgments are carried out. Property rights, institutions to support collective management of resources, capacity-building needs and coherence of the overall policy framework are key aspects of establishing an enabling environment.

Effective ownership of resources is often a prerequisite for entering into PES programmes (Landell-Mills and Porras, 2002; Grieg-Gran, Porras and Wunder, 2005), but ownership need not be on an individual private basis. There are already a number of PES programmes that target community groups (Muñoz-Piña *et al*., 2005; Scherr, White and Kaimowitz, 2002; Swallow, Meinzen-Dick and van Noordwijk, 2005; van Noordwijk, Chandler and Tomich, 2004).

Property rights to land- and water-based resources in many developing countries are often complex, incorporating multiple layers of claims for access, use, exclusion and management rights among both well- and poorly defined groups. If individuals, a community or its members cannot document their ownership, structuring a PES transaction will be difficult.

Several countries, including Brazil and Ghana, have proposed or implemented laws to facilitate PES programmes. 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 resold by third parties. A number of countries have created the equivalent of a national carbon office that keeps track of carbon emission reduction and carbon sequestration projects, and private certification organizations now ensure that carbon sequestration projects report accurately on their activities.

It is often necessary to coordinate actions within a group in order to achieve effective supply of the environmental service. Examples include managing watersheds, communal lands and fisheries. A supporting institutional environment is needed here also. For example, consider a payment scheme to rehabilitate upstream areas to reduce soil erosion and improve water quality and flow downstream. If the land is held in common and the environmental service buyer is concerned that all claimants are adequately compensated, the buyer needs to establish certainty over the primary, secondary and tertiary claims to various resources – a potentially difficult task. Both public and private groups can serve as intermediaries or brokers to overcome collective action problems. For example, The Nature Conservancy has played a central role in brokering forest carbon projects in Belize, Bolivia and Brazil (Wunder, The and Ibarra, 2005), and small farmers in the Macquarie River Valley in Australia have relied on their local organization (Macquarie River Fruit and Fibre) to negotiate with upper watershed ranchers.

Devising enforcement schemes and penalty mechanisms poses additional difficulties in common property regimes. Should the entire group be punished for one individual's infraction, following the group-credit rationale? Unlike credit groups, where members choose to work together, communities have members with existing rights to resources. Thus, membership is likely to be more heterogeneous and power relations are far more important. It remains an open question whether and how PES mechanisms would increase self-monitoring and enforcement rather than engender conflicts and hasten a breakdown in collective management.

Empirical work by Alix-Garcia, de Janvry and Sadoulet (2005, forthcoming) in Mexico provides insights for the design of payment mechanisms in areas where many resources are held communally. They find that, in order to generate appropriate incentives, PES programmes should be based on an understanding of the traditional rules and institutions that govern land use. They argue that payment schemes should be based on variables that cannot be manipulated by the recipient. They also stress the importance of identifying both environmental outcomes and distributional outcomes.

Participation in some types of environmental service exchanges can require a fairly high level of production, marketing or information management skills. Smallholders who are potential environmental service suppliers need business skills to negotiate private deals effectively. To facilitate an equal participation of smallholders in PES schemes, there is a clear need for stronger investment in building human and institutional capacity among these groups (FAO, 2007c).

Thus far, however, PES capacity-building efforts in developing countries have remained fragmentary, with little practical guidance for implementation and with most resources being absorbed by agency staff costs. The limited experience available internationally suggests that existing farmer organizations and technical assistance programmes already effectively serving smallholders are best placed to build PES capacity among smallholders. In addition, interesting success stories have resulted from "learning by doing", where secondary community-based organizations developed

internal capacity in conjunction with pilot projects (Waage, 2005).[20] The Katoomba Group began, in 2006, to develop resource materials for community capacity-building, but these have not yet addressed issues specific to farmers.[21] Experience has indicated that local communities play a critical role in the process of setting and adapting the "rules of the game", at both policy and programme levels. For example, through civil society engagement in the International Tropical Timber Organization, community-based forestry organizations have contributed to policy dialogue on payments for environmental services. Resources are required, however, to enable community groups to organize themselves, prepare for meetings and attend them. Organizations of smallholder farmers could play a similar role in local, national and international policy dialogues on payments for environmental services (FAO, 2007c; van Noordwijk *et al*., 2007).

In addition to establishing policies and institutions directly related to PES programmes, coherence in the overall policy structure that may have indirect impacts on programme effectiveness is critical. For example, programmes to encourage farmers to reduce water pollution from agricultural chemical runoff will be less effective in the presence of a policy providing pesticide subsidies. Cross-sectoral policy coherence is an important issue requiring coordination between agricultural, environmental, financial, trade and other policy sectors.

Conclusions

The process of designing an effective payment programme involves four important and challenging steps: identifying what should be paid for; who should be paid; how much should be paid; and what payments mechanisms should be used.

Cost-effectiveness is an important overall criterion for programme design because public budgets are generally constrained. Minimizing the transaction costs associated with making payments for services, while ensuring at least a minimal level of service provision, is a key element of cost-effectiveness. Transaction costs include the cost of attracting potential buyers, identifying potential sellers of services, working with project partners, ensuring compliance and monitoring of service provision. They are affected by the availability of information and the institutional capacity for managing exchanges, both of which vary by country as well as by environmental service. There is often a direct relationship between the transaction costs associated with a programme design and its effectiveness in achieving the desired environmental outcomes. Thus, choosing the most cost-effective payment design may not be straightforward.

Payments schemes will be easier to develop for some services, countries and locations than for others because better information is available. Indeed, understanding the underlying biological science as well as the economic motivation of farmers is critical. The success of a PES scheme hinges on the accuracy and cost of such assessments and, by extension, on the creation of cost-effective assessment methodologies for use in the field.

A variety of payment mechanisms are currently in use. Where environmental services are easily measured, payments should be linked directly to the service itself. However, more frequently payments are linked to some proxy associated with changes in the provision of services, as this may minimize transaction and measurement costs. The most common payments are made for changes in land use (e.g. from agriculture to forestry), but payments are also common for changes in farmers' practices on land that remains in agricultural production.

If changes in production practices are to be adopted, payments to providers must exceed the opportunity costs they face in making the change. To maximize cost-effectiveness, payments must be targeted to locations where the biggest gain can be

[20] Examples include ACICAFOC (Asociación Coordinadora Indígena y Campesina de Agroforestería Comunitaria de Centroamérica) in Central America, the Sierra Gorda Biosphere Reserve in Mexico and EcoTrust-Uganda.
[21] For further information, see the Katoomba Group Web site at www.katoombagroup.org.

obtained per unit of payment. Targeting also involves costs, however, and the ideal strategy must be based on the best trade-offs between these costs and the added efficiency achieved. Because environmental service provision is linked to location, strategies aimed at areas with relatively low costs of provision offer a promising solution. Some payment programmes may address multiple objectives (for example environmental service provision and poverty reduction); this will generally involve some degree of trade-off between the objectives or an increase in the cost of providing the environmental service.

Transaction costs can swamp effective payments if a programme is ill-designed. Although reducing transaction costs is an overarching concern for effective programme design, some specific additional measures can be taken with a view to minimizing them: simplifying the rules, where possible, facilitating buyer–seller linkages and looking for ways to capture economies of scale.

An enabling environment is critical for payment programmes. Indeed, no transactions can take place in the absence of supporting institutions, which can range from informal to highly regulated in nature. Capacity building, in particular, is an essential component of efforts to broaden the use of the PES approach in developing countries. Working with local communities can play a key role in developing PES programmes. A final, but crucial, issue is the need for coherence between the objectives of PES programmes, the overall national policy framework and multilateral commitments.

6. Implications for poverty

There are considerable expectations that PES programmes can contribute to poverty reduction as well as to improved environmental management. These expectations are largely based on actual or perceived links between poverty and environmental management. If poverty – which may be defined as lack of income or assets, vulnerability or powerlessness – is a major cause of environmental degradation, then paying poor producers to adopt more environmentally friendly systems of production would appear likely to generate a "win–win" outcome resulting in both poverty reduction and environmental benefits. There are, indeed, many situations in which this is likely to be the case.

However, reducing poverty and increasing the supply of environmental services are two distinct policy objectives. Using one policy instrument, for example payments for environmental services, to reach both objectives can reduce its effectiveness in achieving either. This is clearly undesirable from the standpoint of either poverty reduction or environmental services. Blanket assumptions that PES programmes will or should also benefit the poor are thus problematic. This is particularly true for PES programmes that are strongly market-oriented. However, the reality may be quite different for public-sector funded projects; indeed, almost all public investments have multiple objectives. Public investments need to pass ethical standards of fairness and justice as well as environmental impact assessments and thus some combination of policy objectives and instruments is inevitable. The Working for Water programme in South Africa is a good example of a programme that combines poverty reduction and environmental service provision (see Box 22).

PES programmes can affect the poor, either positively or negatively, and this is undoubtedly a major consideration when assessing the role of payment programmes in developing countries. Much of the discussion on the links between PES programmes and poverty reduction focuses on the role of the poor as potential suppliers of environmental services; yet the indirect impacts on non-suppliers may be as, if not more, important. Iftikhar *et al*. (2007) suggest three levels of criteria should be considered in assessing the impact of PES programmes

BOX 22
The Working for Water Programme in South Africa

The Working for Water Programme is a public-sector-funded programme that supports rural employment programmes that involve the removal of alien invasive species from riparian zones, as well as mountainous areas, in South Africa. The programme is based on the premise that alien vegetation uses higher quantities of water than indigenous vegetation; this phenomenon is even more pronounced where alien vegetation falls within upper catchment areas and along riparian zones (Herling and King, 2005). The programme has 350 sites covering approximately 1.2 million hectares of riparian areas and 11 million hectares of mountain areas. The programme employs over 25 000 people who were previously unemployed. The main focus of the programme is employment generation; however, the programme combines the provision of improved watershed services with its main social objectives (Turpie and Blignaut, 2005).

TABLE 13
People living on fragile land

REGION	Population on fragile land *(Millions)*	Share of total population *(Percentage)*
East Asia and the Pacific	469	25
Latin America and the Caribbean	68	13
Middle East and North Africa	110	38
South Asia	330	24
Sub-Saharan Africa	258	39

Note: Fragile lands are defined as lands with limited ability to sustain growing populations and include arid lands, significantly sloped land, lands with poor soils, and forest lands. See World Bank, 2003a, Table 4.1.
Source: adapted from World Bank, 2003a, Table 4.2.

on the poor. Programmes should: (i) leave the poor at least as well off as they were before; (ii) explicitly involve the poor in the streams of benefits; and (iii) ensure that the poor gain disproportionate benefits. The first two criteria can usually be met with minimal loss of efficiency, while the third can be met only in certain circumstances.

This chapter takes a closer look at the potential implications of PES programmes for poverty, starting with an analysis of the potential for the poor to benefit as suppliers in PES programmes. It then expands the discussion to consider the possible indirect impacts of PES programmes on the poor and the role of the poor as consumers of environmental services. Finally, some conclusions are drawn on how PES programmes can be designed so as to facilitate participation of poor producers.

The poor as suppliers of environmental services

Three main dimensions govern the ability of poor agricultural producers to participate in, and benefit from, PES programmes: their location, their access to the productive assets needed to generate environmental services, and the characteristics of their livelihood systems. Each is considered in turn. The discussion also focuses on the significance of transaction costs for participation of the poor and summarizes the conditions under which the poor are most likely to benefit.

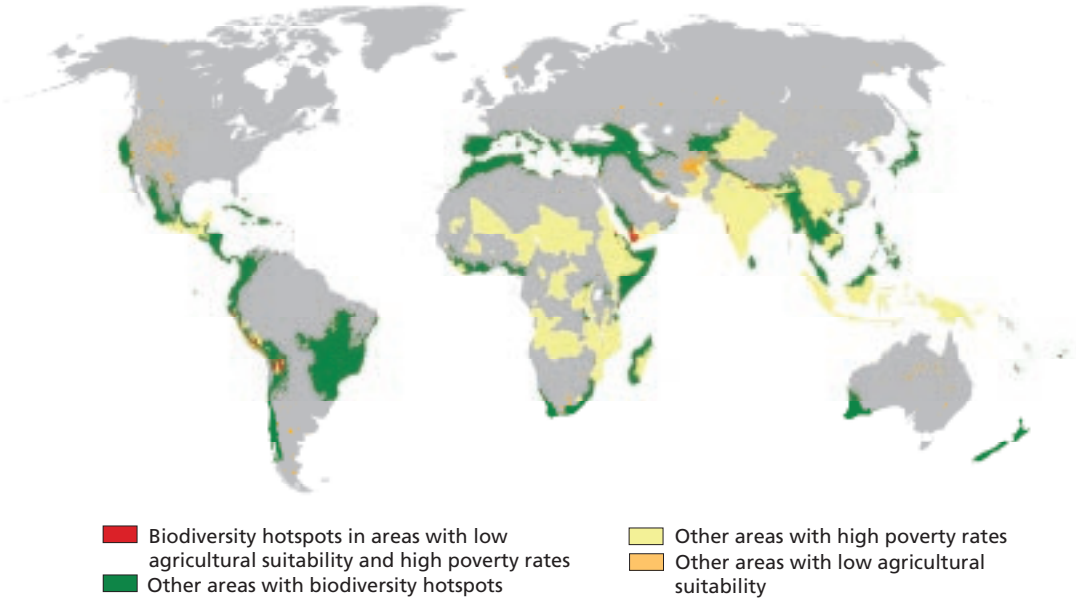
Where are the poor located?

As we have seen, location is a key factor affecting the potential returns to the provision of an environmental service as well as the cost in terms of foregone agricultural production, which agricultural producers face when participating in PES programmes.

The rural poor tend to live and work in ecologically fragile, economically marginal and environmentally degraded areas. The World Bank estimates that more than one billion people in developing countries live in fragile ecosystems covering more than 70 percent of the Earth's land surface (Table 13). Half a billion of these people reside in fragile arid regions; 400 million occupy land with soils unsuitable for agriculture; 200 million have their homes in slope-dominated regions; and more than 130 million live in fragile forest ecosystems (World Bank, 2003a). Poverty maps reveal that the poor tend to reside in areas with one or more environmentally problematic feature, such as degraded land, naturally low soil fertility, air and water pollution, and limited access to water (UNDP, 2005). These areas generally have low agricultural productivity, which is one of the most important constraints against improving incomes among the poor.

When looking at where the poor are located, it is important to distinguish between poverty rates and poverty density (Chomitz, 2007). The former is a measure of the proportion of inhabitants who are poor, while the latter is a measure of the number of poor people per unit of land area. The two measures can show strikingly different results: for example, the Brazilian Amazon has high poverty rates but low poverty densities, because overall population densities are low (Chomitz, 2007). Using poverty rate measures to locate the poor can yield an indication of the extent to which

MAP 7
Biodiversity hotspots in areas poorly suited to rainfed agriculture and with high poverty rates



Note: available at http://www.fao.org/geonetwork/srv/en/google.kml?id=31156&layers=biodiversity_hotspots_high_poverty_rates
Source: FAO.

people living in an area that could supply environmental services are poor; however, it gives no indication of the number of people involved or the extent to which environmental service supply could be a major means of reducing poverty in a given country or region (see Box 23).

Map 7 builds on Map 5 (see p. 65), which shows biodiversity hotspots with low suitability for rainfed agricultural production, by adding a poverty dimension. The map shows areas where the prevalence[22] of stunting among children under the age of five exceeds 40 percent. The stunting indicator is based on an estimate of the distribution of chronic undernutrition at national and subnational levels using stunting in growth among children under five years of age.[23] This indicator reflects the long-term cumulative effects of inadequate food intake and poor health conditions resulting from lack of hygiene and recurrent illness in poor and unhealthy environments. This prevalence measure is used here as an indicator of regions where the poor are likely to be affected by land-use changes, noting that in many cases these are areas with low population densities where the number of people involved may be small.

As can be seen in the map (shown in red), relatively few areas of high poverty prevalence overlap with biodiversity hotspots with poor agricultural suitability. Clearly, the scale of the map is insufficient to arrive at any definitive assessments of the spatial intersection of poverty, low agricultural

[22] The 40 percent prevalence criterion is based on the World Health Organization (WHO) classification for very high prevalence of malnutrition (for further information, see http://www.who.int/nutgrowthdb/about/introduction/en/index5.html).

[23] Stunting is defined as height-for-age below –2 standard deviations from the National Center for Health Statistics/WHO International Growth Reference Standard. New standards have been issued based on regional averages; however, actual data based on these are not yet available. The analyses in this report are therefore based on the old standards.

BOX 23

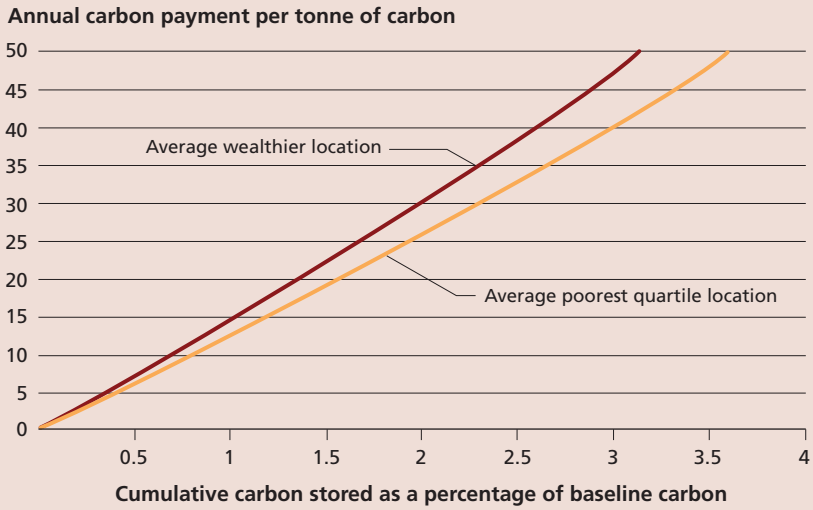
Will the poor respond to payments for avoided carbon emissions? Evidence from Costa Rica

Will the poor respond to payments for reducing deforestation (and thus carbon emissions)? If so, more or less than others? These were the questions posed in a study of the potential supply response of the poor to carbon payments in Costa Rica. The study used district-level data on poverty, as well as returns to crop and livestock production and agro-ecological indicators, to predict the rates of deforestation for each of various possible levels of carbon payments.

The results indicated that landowners would respond to payments by reducing deforestation and thus emissions but also that there were no significant differences in response between poorer and less poor districts. However, as the poorer areas have more forest, payments could help both forests and the poor. As the figure indicates, those areas could receive a larger share of carbon payments. The results suggested neither gains nor losses in efficiency from having poor land users in carbon payments programmes. Because this study used district-level estimates of poverty incidence, caution is needed in interpreting the results. It may be that, in poor areas, though a large fraction of people are poor, those who own the land are not. If services and payments were proportional to landholdings, payments to poor areas would not necessarily go to poor people.

Source: Pfaff *et al.*, 2007.

Carbon supply in 2020 for poorest and less poor districts

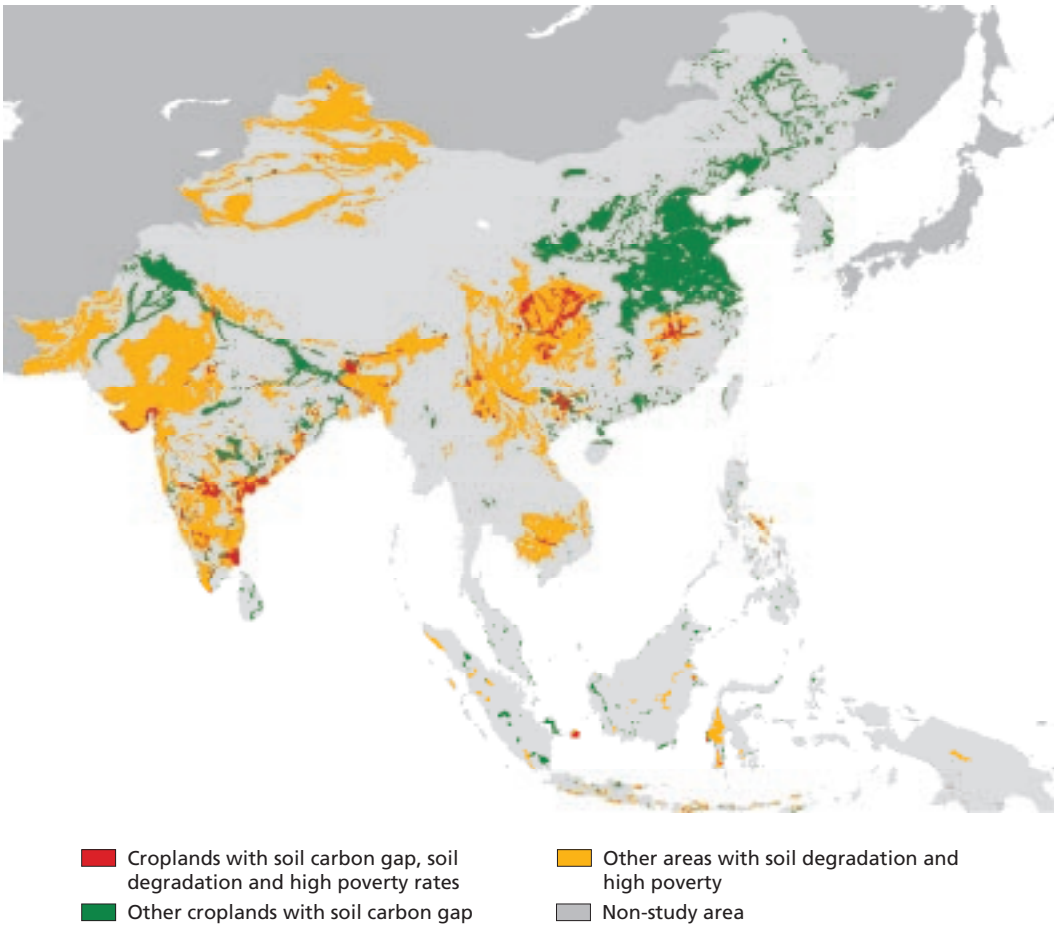


Source: Pfaff, Robalino and Sanchez-Azofeifa, 2006 and Kerr *et al.*, 2004.

suitability and biodiversity conservation; however, it suggests that the overlap between the three may be smaller than is often assumed. Lowering the cut-off point for prevalence of stunting in children below five years of age to 20 percent results in only a very modest increase in the overlap.

Map 8 uses the Soil Degradation in South and Southeast Asia (ASSOD) database (ISRIC, 2007) to investigate the potential synergies between soil carbon sequestration, improvements in soil fertility and poverty reduction. The map identifies locations in agricultural production that are highly

MAP 8
Highly degraded croplands with soil carbon sequestration potential and high poverty rates



Note: available at http://www.fao.org/geonetwork/srv/en/google.kml?id=31159&layers=highly_degraded_croplands
Source: FAO.

degraded as well highly degraded areas that also have medium-to-high soil carbon sequestration potential. In the latter areas, adoption of soil carbon sequestration may generate both an agricultural and an environmental benefit in the form of improved soil quality and carbon sequestration. These areas are overlaid with areas that have a high percentage of stunted children under the age of five. The red areas indicate where supplying soil carbon sequestration might generate a further benefit in the form of poverty reduction. The map suggests that areas in central and western China and central and eastern India are potentially good sites for programmes that combine environmental service and poverty reduction objectives. However, analysis with data at a higher degree of resolution and more detailed information about farming systems and access of the poor to the land will be needed to verify this potential.

Poverty and access to productive resources

Poverty, by its very nature, is associated with a lack of access to, and control over, productive resources – including land, water, investment capital and human capital. This lack of access is a major barrier also for participation of the poor in PES programmes.

Moreover, a gender bias is often found to exist, and rural women, who constitute a significant share of the rural poor, encounter particular difficulties in accessing resources (FAO, 2006g).

Many of the obstacles impeding participation of the poor in PES programmes are the same ones that inhibit their adoption of more productive and sustainable management practices and prevent them from rising out of poverty. Chapter 4 identifies several constraints to the adoption of farming and forestry production systems that would benefit the producers themselves in addition to generating higher levels of environmental services. Lack of information, property rights and financing, as well as risk, were all identified as barriers that can inhibit desirable changes in production systems.

Even when the poor do have access to land and other productive resources, the control and rights they have over the resource are often weak and poorly defined. This can also be an important barrier to participation in PES programmes as well as to undertaking any type of investment for sustainable management (Lipper, 2001; Dasgupta, 1996). Moreover, there is a risk that the poor may lose out from PES programmes by being excluded from lands to which they have only tenuous rights by wealthier or more politically powerful groups, as land values increase with such payments (Pagiola, Arcenas and Platais, 2005).

In practice, "ownership" of resources is often a prerequisite for entering into contracts for the provision of environmental services (Grieg-Gran, Porras and Wunder, 2005). In Costa Rica, both Thacher, Lee and Schelhas (1996) and Zbinden and Lee (2005) found tenure-related variables to be highly significant in explaining participation in the country's current and preceding PES programmes. In some cases, the barrier of tenure insecurity has been overcome by allowing holders of non-formal kinds of tenure to enter into contracts. In Costa Rica, for example, participants were initially required to have land titles; this requirement has since been eliminated but while in force it served to exclude poorer land users (Pagiola, Arcenas and Platais, 2005).

Where the poor do hold rights over resources, they often take the form of common property rights, with resultant implications for their ability to respond to PES programmes. Changes in natural resource management of commonly held resources, such as pastures or waterways, require group coordination, which is costly to the producers and in many cases difficult to achieve. The experience of the Mexican PSAH (see Box 18), which was implemented targeting indigenous communities and *ejidos* (both communally held land and individually controlled plots), serves as an enlightening example. For the *ejidos*, payments were made to the entire community, which could then either distribute them among individuals or make investments for the benefit of the community. The effectiveness of this type of communal payment scheme in providing incentives for changing land use is under review (Muñoz-Piña *et al.*, 2005). The distribution of costs and benefits of programme participation among participants has also been raised as a concern (Alix-Garcia, de Janvry and Sadoulet, forthcoming).

Lack of access to financial resources can be another major barrier to participation of the poor in PES programmes (see Chapter 4). Frequently, the land-use changes needed to generate environmental services require an up-front investment, with returns occurring only later in the future. In many parts of the developing world, rural financial markets function poorly, resulting in lack of access to external finance. The poor may be unable to finance the changes from their own assets, unlike wealthier PES programme participants. For example, the owner of a 20-hectare farm in Nicaragua wishing to introduce a variety of silvopastoral practices to receive payments under the Silvopastoral Project might have to invest, in the first year, about US$500 (equivalent to about 70 percent of net income under current practices), in addition to forgoing part of the farm's normal income in that year. These are heavy costs for poor households. Savings, remittances or off-farm income may help some households make the necessary investments, but poorer households will tend to have fewer such alternatives – and a greater likelihood of needing such supplements for subsistence requirements. Front-loading payments or credit may be necessary in such cases (Pagiola, Rios and Arcenas, forthcoming).

TABLE 14
Who are the poor?

CATEGORY	REGION				
	West and Central Africa	East and southern Africa	Asia and the Pacific	Latin America and the Caribbean	Near East and North Africa
Rainfed farmers				■	■
Smallholder farmers	■	■	■	■	
Pastoralists			■	■	■
Artisanal fishers		■	■	■	■
Wage labourers/landless		■	■	■	■
Indigenous people; scheduled castes/tribes			■	■	■
Female-headed households			■	■	■
Displaced people			■	■	■

Source: IFAD, 2001.

Where a PES project entails adopting new practices that are complex, difficult or unfamiliar, households may need technical assistance from extension services. However, poor households are less likely to have access to extension than better-off households, and this factor, too, may prohibit their participation in the programme.

Livelihood systems of the poor

Even if the poor are located in areas that are likely to be economically viable sources of environmental service supply and have access to the productive resources needed for participation, their ability to participate in, and benefit from, PES programmes will depend on how well the changes required by the PES programme fit into their overall livelihood strategy. A key consideration is the overall rural nature of poverty. Of the world's 1.1 billion extremely poor people, 75 percent live in rural areas and depend on agriculture, forestry, fisheries and related activities for survival. Increasing the return to natural resource management, be it through agricultural production or environmental service supply, is thus a critical means of reducing poverty (FAO, 2007e).

As discussed in Chapter 2, there are many ways in which agricultural producers may shift land-management systems towards producing environmental services, ranging from a complete change of land use to minor modifications in a current system.

Table 14 gives some insight into the primary production activities of the rural poor by region. Smallholder farmers constitute a major segment of the rural poor in several regions, including Asia and the Pacific, East and southern Africa, West and Central Africa and Latin America and the Caribbean. In addition, the rural poor in Latin America and the Caribbean and in the Near East and North Africa are often rainfed farmers or pastoralists (IFAD, 2001).

A clearer understanding of the potential of environmental services to fit into these strategies can be obtained by closer examination of the types of changes to farming systems required within the framework of the decision-making process of poor farmers. The nature of the change is of particular importance for poor farmers, who are more likely to face market failures for food, credit, insurance and labour. Consequently, food-security and food-access concerns, including through their own production, are more likely to be determining factors in their decisions regarding participation in PES programmes. Naturally, if a PES programme restricts or bars traditional land uses, such as unsustainable grazing

TABLE 15
Relative importance of different poverty reduction strategies by resource potential

STRATEGY	Agricultural resource potential	
	High[1]	Low[1]
Intensification	1.9	0. 9
Diversification	3.1	1.4
Increased farm size	1.2	0.9
Increased off-farm income	2.5	2.4
Exit from agriculture	1.2	4.4

Note: This table is from an FAO study prepared as a contribution to the World Bank Rural Development Strategy, *Reaching the rural poor* (World Bank, 2003b). Over 20 case studies were prepared to support the analyses, which investigated innovative approaches to small farm or pastoral development. The material in the World Bank publication draws upon this study as well as on expertise from years of specialized work on the topic at FAO and the World Bank.

[1] Scores add to 10.

Source: Dixon and Gulliver with Gibbon, 2001.

and cropping, it must provide acceptable alternatives; otherwise it is unlikely that the poor will be able to participate. Use-restriction rules count among the main conditions that discourage or exclude smallholder participation. In contrast, PES programmes allowing mix-use activities that provide diversified sources of income (e.g. agroforestry and silvopastoral systems) play a positive role in facilitating participation of the poor (WRI in collaboration with UNDP, UNEP and World Bank, 2005; Grieg-Gran, Porras and Wunder, 2005).

Risk, too, is a critical dimension for poor farmers. When PES programmes promote a change in resource management and perhaps input use (e.g. switching from pesticides to an integrated pest management strategy, or from conventional tillage to reduced or no tillage), adopters may face increased risks while they are learning about these new practices. Because the poor are generally more risk-averse than the well-off and have fewer options for managing risk, their supply response to risk-increasing activities is likely to be lower. Thus, poor farmers may be less inclined to participate in a PES programme if an enhanced supply of environmental services is accompanied by reduced food production, especially if food markets are functioning poorly. However, PES programmes can also contribute to *reducing* risk when the payments represent a stable source of reliable income.

A 2001 FAO/World Bank study on farming systems and poverty gives some insights into the types of changes in livelihood strategies in general and farming system management specifically, that may benefit the poor (Dixon and Gulliver with Gibbon, 2001). Table 15 shows the degree of relevance of different strategies for poor farmers to exit from poverty for areas of high and low agricultural-resource potential, respectively. In the high-potential areas, the most important strategies are diversification of production activities and increased off-farm income; in the areas of low agricultural potential, the highest benefits are obtained by exiting from agriculture and increasing off-farm income.

PES programmes could contribute to such poverty reduction strategies to the extent that they can support diversification of agricultural production in high-potential areas or facilitate exiting agriculture in low-potential areas. Indeed, farmers could conceivably diversify the output from their agro-ecosystems to include environmental services along with agricultural products. Payment schemes could also represent a de facto means of exiting from agriculture, at least at a specific site, in cases where environmental service provision involves changing land use away from agriculture. The study found increased off-farm income and exiting from agriculture to be important poverty reduction strategies, given that improving agricultural productivity in the agro-ecosystems managed by the poor is costly and in some cases impossible. However, increasing the returns to such ecosystems by

switching to environmental service provision may offer a viable alternative.

Transaction costs and participation of the poor in PES programmes

Transaction costs may constitute the biggest impediment to participation of poor households in PES programmes (FAO, 2003c; Zilberman, Lipper and McCarthy, forthcoming; Antle and Valdivia, 2006; Landell-Mills and Porras, 2002; Pagiola, Arcenas and Platais, 2005; Wunder, 2005). As discussed in Chapter 4, transaction costs can be a determining factor for the feasibility of PES exchanges in general. When the potential suppliers of the service are poor farmers, the issue of transaction costs becomes more critical. Fixed costs, such as developing a project proposal, setting a baseline and identifying a buyer, account for a large share of the transaction costs. In the case of a very small transaction – say for carbon sequestration at a site of less than 1 hectare in size – transaction costs per hectare will be prohibitively high. The larger the transaction costs, the more attractive it will be for PES programmes to focus on large land holdings. As farm size tends to be highly correlated with income, in practice this means focusing on better-off households.

FAO (2006f) found that one of the most important ways of improving the feasibility of smallholder carbon sequestration projects is to reduce the *ex-ante* fixed transaction costs faced by the buyers. They identify three broad strategies to this effect:

1. increasing project size by fostering/building upon collective action among suppliers;
2. reducing contracting costs by utilizing existing management structures;
3. reducing information costs through public provision of data, templates and guidelines.

The three strategies are not mutually exclusive and, in many cases, can be complementary.

Examples of the first strategy, with projects involving smallholder coordination in the supply of carbon services, have been documented by FAO (2003c), Smith and Scherr (2002) and Orlando *et al.* (2002). In these projects, the costs to buyers of identifying, contracting and enforcing viable carbon sequestration opportunities among smallholders are reduced through the presence of an intermediary representing the suppliers. This intermediary can be an NGO, a community group or a government agency. However, such group schemes may lead to the participating sellers facing greater transaction costs; these costs, however, must not exceed the benefits they derive from participation. Several of the carbon smallholder projects were built upon pre-existing community projects, such as ongoing community-based natural resource management projects (particularly community forestry projects) or farmers' groups.

The second way of reducing transaction costs in projects involving small- and low-income suppliers is to utilize management structures and lessons from existing projects. For example, important lessons on how to design and administer PES schemes for poor producers can be obtained from the experience with conditional cash transfers (see Box 24).

Making information available on situations where the poor could potentially become significant providers of environmental services – via the use of maps such as those presented in this chapter – together with more detailed analysis of the type of programme design needed to facilitate the participation of the poor is the third strategy to reduce transaction costs facing low-income suppliers. This strategy is being pursued by a wide range of international and national public agencies, and NGOs.

Finally, the possibility of marketing environmental services that are explicitly linked to poverty reduction merits consideration. If buyers of environmental services are willing to pay a premium for environmental services provided by the poor, higher levels of transaction costs could be supported (FAO, 2006f). Is there any evidence of this type of market demand? Several examples of carbon buyers specifically interested in livelihoods and poverty reduction benefits are given in Box 25. The projects referred to in the box indicate some development of a poverty-focused market niche for carbon offsets in the voluntary market. Even in regulatory markets such as the CDM, sustainable development is a mandatory aspect of certifying the eligibility of offsets. The definition of sustainability is left to the implementing countries, and

BOX 24

Reaching the poor with cash? Lessons from conditional cash transfers

Benjamin Davis[1]

Cash payments are often considered the most flexible, and thus the preferable, mode to pay for environmental services. However, there are concerns about both the capacity to reach poor producers with cash payments and the effectiveness of these payments. Important insights into this debate can be obtained from the experience of conditional cash transfers.

Conditional cash transfers (CCTs) are a form of social assistance that has come to dominate the social protection sector in the Latin America and the Caribbean region over the past decade and is increasingly being considered for use in other parts of the world, including Africa. CCTs are linked directly to human capital development by making receipt of the transfer conditional on school attendance and a variety of health- and nutrition-related activities. In most cases, CCTs are provided directly to mothers on the assumption, substantiated in the literature, that they are more likely to use the resources for the benefit of their children.

The experience of CCTs in Latin America has shown this type of cash transfer to be very effective in obtaining its objectives. The conditional aspect of CCTs is one of the most attractive (and controversial) features of the programme, and also one of the most complicated to execute. The administrative burden of monitoring conditionality, particularly in countries with weaker institutional structures, leads to the question of whether conditionality is feasible or necessary and, if so, the type of monitoring mechanism that is most appropriate.

Despite this concern, countries from Mexico to Nicaragua, at opposite ends of the spectrum of wealth, development and administrative capacity in the region, have successfully implemented CCT conditionality.

One important dimension of the CCT experience is that of the professionalization of administrative practices. Beginning particularly with the Oportunidades (formerly the Education, Health, and Nutrition Program of Mexico [PROGRESA]) programme of the Government of Mexico, and improving over time in other programmes in the region, CCTs have modernized the public administration of social assistance. CCTs have established modern information and management systems for beneficiary selection, registration and payment, as well as the monitoring of conditionality, assuring more transparency and efficiency in implementation (de la Brière and Rawlings, 2006).

Despite the complex nature of these programmes, they have been shown to be relatively cost efficient (Caldés, Coady and Maluccio, 2006). While many challenges remain, including how to institutionalize and formalize effective community participation, as well as the coordination of the provision of services, the administrative setups of CCTs have done much to promote transparency and counter problems in the application of social spending. A core element in this professionalization has been the concerted effort to conduct independent evaluations of CCT programmes.

[1] *FAO Economic and Social Development Department.*

thus a wide range of definitions have been proposed, some of which include a poverty reduction dimension. Nevertheless, only limited evidence is available, to date, on the willingness to pay a premium for environmental services that explicitly include a poverty benefit.

When are the poor likely to benefit from PES programmes?

Summarizing the discussion in the above sections, the spatial distribution of poverty, property rights to land, and the productivity of the land for the provision of agriculture and environmental services are key

BOX 25
A market for carbon offsets from the poor? Evidence from the Plan Vivo System

Plan Vivo has established standards for carbon emission offsets with explicit poverty reduction aspects. The Plan Vivo System is managed by BioClimate Research and Development (BR&D), which is a non-profit organization. BR&D is responsible for development and maintenance of the Plan Vivo System and "contracts" the Edinburgh Centre for Carbon Management (ECCM) to provide the systems maintenance resources needed for the continued development of Plan Vivo.

Plan Vivo has three operational projects that are producing carbon for the sale of Plan Vivo carbon offsets: the Scolel Té project in Chiapas, Mexico, the Trees for Global Benefit project in Uganda and and the N'hambita Community Carbon Project in Mozambique.

At present, purchasers of the carbon offsets generated by the Scolel Té project include the FIA Foundation, to offset carbon emissions from Formula 1 and World Rally championships, The CarbonNeutral Company, on behalf of a number of companies, the World Bank International Bank for Reconstruction and Development and the United Kingdom Department for International Development.

Source: Plan Vivo, 2007.

determinants of where and when the poor could benefit from supplying environmental services, as well as the type of change required to generate the service.

The poor are most likely to benefit from participation in PES programmes where land distribution is relatively equitable and where the poor are found on lands of poor quality for agricultural production but high quality for environmental service supply. They are most likely to benefit from programmes involving a change of farming system, rather than land use, because the small size of the land holdings, combined with food security concerns, will limit their ability and inclination to take land totally out of agricultural production.

Indirect impacts of PES programmes on the poor

Separate from the issue of the poor as potential participants in the programmes, PES programmes may also have indirect impacts on the poor via land price, wage and food price effects (Zilberman, Lipper and McCarthy, forthcoming). It is useful to consider three different groups which may be affected by PES programmes: consumers of food products, wage labourers and consumers of environmental services. For example, payment programmes that lead to a significant reduction in food production could have impacts on food prices. If food markets are functioning poorly and food supplies are largely locally procured, even a small reduction in local food production could have significant negative impacts on poor food consumers. Impacts on rural consumers are likely to be more or less localized, depending on the degree of integration of rural areas with urban markets.

Changes in farming systems or land use may also involve changes in labour use. For example, converting land from agricultural production to forestry will release labour, while moving to silvopastoral production systems from conventional systems is likely to absorb labour. This, in turn, will affect local wage rates, either upwards or downwards, depending on how the PES programme affects labour demand. Effects on wage rates could have a significant impact, for better or worse, on the poor, who are generally highly dependent on wage labour for their income (Zilberman, Lipper and McCarthy forthcoming). As with food markets, the overall effect of a PES programme depends not only on the magnitude and direction of the changes in labour use, but also the degree to which labour markets are isolated or integrated into national or international markets. Uchida, Rozelle and Xu (2007) find

that one of the most important benefits for the poor of China's Grain for Green programme has been an increase in off-farm income. The programme provides cash funds that allow participants to overcome a liquidity constraint against entering the labour market.

Finally, PES programmes could provide benefits to the poor as consumers of an environmental service. A prominent example would be services related to water quality and quantity, where studies have shown that even poor consumers are willing to pay for good water quality. In any of the watershed protection programmes where water quality or quantity has been improved, poor consumers have benefited also, even though many of them do not pay for water. There may also be a significant gender dimension to benefits from environmental services. Rural women are often the household members in charge of collecting water, fuelwood and other natural resources needed for household consumption and could therefore be major beneficiaries. Other environmental services for which there may be demand from the poor include access to crop genetic resources or pollinator services. Of course, the question remains whether the poor will be willing and able to pay for these services.

Payments for environmental services and poverty reduction: where are the synergies?

As noted in Chapter 4, a wide range of land-use and farming system changes that, in the long run, will be more profitable for farmers are not adopted owing to problems such as lack of credit, property rights and technical information. Poor farmers face these types of barriers disproportionately. Where a privately profitable practice is not adopted for these reasons, the solution should aim at removing the barrier concerned. However, in many cases, addressing these barriers is fraught with difficulty. Assuming that the main objective of PES programmes is to increase the provision of environmental services, would it be reasonable to use such programmes to help farmers overcome the barriers to change?

First, it is important to note that for location-specific services, such as watershed management and biodiversity conservation, the poor may be located in exactly the areas identified as having high potential for environmental service provision, making their participation necessary in order to meet the environmental objective. But location alone is not enough. Pagiola, Arcenas and Platais (2005) noted that the requirement of formal title for participation in the Costa Rica PES programme reduced the efficiency of the programme by excluding poor landowners. Addressing barriers preventing the poor from participating is essential when the poor are in key locations for environmental service supply. Evidence to date does indicate that those who do participate as suppliers in PES programmes are likely to become better off (Pagiola, Rios and Arcenas, forthcoming).

The maps presented in this chapter show several locations where a combination of high poverty rates, low agricultural productivity and high potential for environmental service supply suggest a potential for poor producers to benefit from PES programmes. This type of mapping can be helpful as an indication of where PES programmes could result in both environmental service supply and poverty reduction. However, such maps can only be indicative, and careful investigation into land tenure, farming systems and land-use patterns is needed in order to confirm the real potential.

Innovative PES programme designs may be needed to ensure the participation of the poor. For example, providing up-front or early payments (e.g. large payments within the first year of a project, rather than spreading the total amount over several years) may be desirable in PES projects requiring initial investments in areas with many poor households. Also, while full title or private ownership of land or resources may be preferable in some PES programmes, it does not have to be a prerequisite. There are other ways to increase security of tenure for the poor, including legally sanctioned use of key resources, the right to exclude and the right to manage the resource for optimum benefit. In conservancies in Namibia, for example, the devolution of wildlife rights on communal lands was sufficient to allow local communities to

BOX 26

Can the poor benefit from payments for environmental services programmes? Evidence from the Silvopastoral Project in Nicaragua

Can poorer households participate in PES programmes? A recent study of the experience of the Regional Integrated Silvopastoral Ecosystem Management Project (see Box 14) in Matiguás-Río Blanco indicates that they can. Not only did poorer households participate quite extensively, but by some measures they participated to a greater extent than better-off households. Extremely poor households do appear to have had somewhat greater difficulty in participating, but even in their case the difference is solely a relative one. Extremely poor households not only were not shut out, but participated at high rates in the project. Their participation was not limited only to the simpler and cheaper practices, but included the full spectrum of land uses.

These results are particularly strong in that the Silvopastoral Project imposes much greater burdens on participants than most PES programmes. Nevertheless, one should not jump to the conclusion that all poor farm households everywhere will always be able to participate in such programmes. Both the programmes and local conditions differ from case to case, and there may well be cases where otherwise eligible poor households may find it difficult or impossible to participate. Indeed, the results show that extremely poor households do appear to have had greater difficulty in participating as intensively as other households.

The study helps identify several factors that tend to affect participation. Lack of credit may be an important constraint for poorer households. This constraint will not always be critical in PES programmes, for example in programmes that maintain an existing land use. However, financing constraints are likely to be important when land-use changes are required for participation, as in Costa Rica's reforestation or agroforestry contracts. Providing some initial financing (such as the baseline payment made by the Silvopastoral Project) may be desirable for PES programmes that involve initial investments in areas with many poor households. The importance of technical assistance emerges far less clearly from the study results. The practices being promoted by the project were relatively complex, but were also relatively well known in the area.

The availability of multiple options in the Silvopastoral Project may well have contributed to high participation by the poor, as they were able to choose the options that worked best for them in the light of their particular requirements. When a given service can be provided in different ways (or at different levels), it makes sense to offer multiple ways in which households can participate, as long as transaction costs do not increase unduly. It is worth noting, however, that at Matiguás-Río Blanco the poorer households did not predominantly choose the cheaper and easier land uses – in fact, the better-off households were more likely to do so.

Source: Pagiola, Rios and Arcenas, forthcoming.

earn income from managing the wildlife even though they could not exclude others from using the land (FAO, 2007f). Another option is to distribute payments to larger community associations, which can then attempt to identify and implement an appropriate solution. Box 26 describes the participation of the poor in one innovative programme in Nicaragua.

Conclusions

Reducing poverty and increasing the supply of environmental services are two separate and distinct policy objectives that would normally need to be addressed by separate policy instruments. Blanket assumptions that PES programmes will, or should, also benefit

the poor are thus problematic. However, public-sector-funded projects and many voluntary sources of payments are interested in both environmental and socio-economic objectives, thus leading to multi-objective PES programmes. PES programmes can affect the poor – either positively or negatively. The poor may be affected directly, as potential suppliers or consumers of environmental services, but there may also be an indirect impact on non-participants through effects on local wages, food prices or land values. PES programmes could hurt the poor, particularly the landless, by driving down wages or increasing food prices. Likewise, they may result in pressures to exclude the poor from lands to which they have only informal rights if the value of the land increases.

The discussion above has identified situations where there may be strong potential for poor farmers to supply environmental services. For location-specific services, such as watershed management and biodiversity conservation, the presence of the poor in areas of importance for environmental service provision makes their participation necessary. In these situations, addressing the barriers preventing the poor from participating is indispensable.

Environmentally beneficial land-use and farming-system changes that will be more profitable for the farmer in the long run are not always adopted owing to problems such as lack of credit, property rights or technical information. Often, it is the poor producers who face these types of barriers, in which case PES programmes may offer some opportunities.

The maps in this chapter suggest that the poor could benefit from PES programmes, particularly in areas characterized by a combination of high poverty rates, low agricultural productivity and high potential for environmental service supply. However, such maps are only indicative. Further research on land tenure, farming systems and land-use patterns is needed to identify the actual potential. Evidence from PES programmes to date has shown that the poor can participate and benefit from PES programmes.

A critical problem is that of the transaction costs of PES programmes, which may be prohibitive in the case of poor producers, unless strategies are adopted to minimize them as far as possible.

Innovative PES programme designs are needed to ensure the ability of the poor to participate as suppliers of environmental services. Two important examples are the timing of the payment to help address credit and investment constraints farmers may have, and making provisions to work with producers who have only informal title to lands.

7. Conclusions

This issue of *The State of Food and Agriculture* has examined the role of agriculture in the provision of ecosystem services. These include all outputs from agricultural activities, ranging from food production to climate regulation. Many of these services are provided only as externalities; that is, they are unintended consequences of the production of food or fibre. These services, which we refer to as environmental services, are normally not compensated for. Therefore farmers lack incentives to supply them in the desired quantity.

In exploring the potential of agriculture to provide enhanced levels of environmental services and how these can be achieved, the discussion has focused on one relatively novel approach that aims to provide positive incentives to farmers for their provision: payments for environmental services. The three types of environmental services that have seen the most significant growth in PES programmes have been emphasized: climate change mitigation, improved water supply and quality, and biodiversity conservation. Five main messages emerge from the report.

Demand for environmental services from agriculture will increase.

Two forces are generating a growing demand for environmental services: greater awareness of their value and their increasing scarcity, arising from mounting pressures on the Earth's ecosystems. The growing demand for these services has led to a significant increase in the number of PES programmes in recent years. The overall magnitude of these programmes is still small, however, and they remain mostly, but not exclusively, confined to developed countries. The public sector has been the major source of payment programmes so far, in both developed and developing countries, but privately funded programmes are also emerging.

Future demand for environmental services is likely to increase, driven by population and income growth, and globalization. The demand may come from disparate sources, such as local water users, international offset programmes for carbon sequestration and biodiversity, and private-sector purchasers interested in meeting consumer demand for improved environmental management (certified, for example, via ecolabels) or in improving their corporate image. There is also potential for additional growth in national public-sector programmes, even in low-income developing countries where environmental services can meet critical policy objectives, such as the availability of clean water and prevention of natural disasters.

Although this report has focused on the three environmental services that have seen the most significant expansion in PES programmes to date, demand for other services – for example, disaster prevention, pollination and disease control – is likely to rise in the future. In addition, bioenergy has recently become one of the most dynamic and rapidly changing sectors in the global energy economy. While significant impacts on agriculture and environmental services are possible, their nature and magnitude remain uncertain. Bioenergy will be examined in greater detail in next year's *State of Food and Agriculture* report.

Agriculture can provide a better mix of ecosystem services to meet society's changing needs.

Farmers both depend on and generate a wide range of ecosystem services, and their actions can enhance or degrade ecosystems. As population and income growth puts increased pressure on farmers and the ecosystems they manage to provide ever greater volumes of conventional agricultural outputs, threats to other services – such as the three referred to above – are intensifying. There are very significant costs involved in the inadequate provision of these services, and these costs are receiving

increased attention from the media and policy-makers as well as the private sector. Through changes in land use and production systems, agricultural producers can provide a better mix of ecosystem services, expanding the share of those characterized as externalities, to meet society's changing needs.

The way in which environmental services can be generated varies by service, type of production system and agro-ecological context. The changes needed range from shifts in land or water use (e.g. away from crops or livestock production to grasslands or forest) to modifications within a given production system (e.g. adopting farming practices that provide higher levels of environmental services alongside conventional agricultural outputs).

Often there are synergies in the provision of different ecosystem services. Production practices adopted to enhance one type of service may enhance others at the same time. For example, enhancing soil carbon sequestration through the adoption of conservation agriculture can have beneficial implications not only for climate change mitigation and water quality but also for the provisioning services of food production. However, in many cases there are trade-offs among the provision of different ecosystem services. Although agriculture has the technical potential to supply enhanced levels of environmental services, the costs and, hence, the economic feasibility of the changes required, are central to understanding whether they can be achieved and what level of payments would be required to realize them.

If farmers are to provide a better mix of ecosystem services, better incentives will be required. Payments for environmental services can help.

For a variety of reasons, the full value of all ecosystem services is not normally reflected in the incentives faced by the service providers. As a consequence, many environmental services are underprovided, because adopting the necessary changes in land use or management practices would result in lower benefits to the producers. In addition, many farmers, particularly in developing countries, face barriers to the adoption of new practices, such as constraints on access to information, appropriate technologies and financing, as well as non-existent or insecure property rights and legal or regulatory constraints. The effect of these barriers is often compounded by poorly functioning markets and infrastructure, risk and difficulties in collective management of commonly held resources.

There are several options for policy-makers to change farmers' incentives. In the past, non-market instruments, such as regulations or taxes, were most common, but today flexible, decentralized market-based approaches are receiving increasing attention. Payments for environmental services are among these options.

Farmers may be compensated either to enhance the provision of certain environmental services that may be degraded or undersupplied as a result of current agricultural practices or to offset pollution generated in other sectors. In the first case, a critical decision is whether farmers should be paid to reduce the negative externalities they generate rather than requiring them to bear the cost themselves. Who holds the initial rights to the environmental services: the producers or society? The answer to this question is complex and may differ according to service and context. In the second case, the appropriateness of payments to farmers hinges on the more technical consideration of the efficiency of the offset in meeting the intended objective.

Cost-effective PES programmes require careful design based on the characteristics of the service and the biophysical and socio-economic context.

Different types of PES programmes are appropriate to different socio-economic and agro-ecological contexts. The process of designing an effective payment programme involves four important and challenging steps: identifying what should be paid for; who should be paid; how much should be paid; and what payment mechanism(s) should be used. Ideally, payments should be linked directly to the level of service provided. More frequently, however, they are linked to some proxy associated with

changes in the provision of environmental services, as this may reduce transaction and measurement costs. The most common payments are those made for changes in land use, but farmers are also frequently paid to change their management practices on agricultural land.

To maximize cost-effectiveness, payments must be targeted to farmers and locations where the largest gain in environmental service provision can be obtained for a given level of payment, or where a given increase in environmental service can be achieved for the lowest cost. Some PES programmes address multiple objectives (e.g. environmental service provision and poverty reduction); in many cases this will lead to some degree of trade-off between the objectives or to an increase in the cost of providing the environmental service.

The level of payments required to motivate farmers depends on the opportunity costs, or foregone benefits, they face in making a change in land use or management. These vary according to agro-ecological conditions, technology employed, level of economic development and policy environment. Land diversion programmes (away from agriculture) are most likely to be effective where the returns to land in agriculture are low. In land-scarce environments, changes that generate environmental services within agricultural production systems are more likely to be favoured. The opportunity cost of labour also plays a role in determining the feasibility of changes. Where labour is scarce, production changes that reduce labour use are more likely to be adopted.

Minimizing the transaction costs involved in programme implementation, including monitoring and enforcement, can play a pivotal role in designing programmes that will be cost-effective. These costs are influenced by the availability of information and the institutional capacity for managing exchanges, both of which vary by country as well as by environmental service. Choices may need to be made between programme designs that may be effective in service provision but entail high transaction costs and others with lower levels of both effectiveness and transaction costs.

An enabling environment is critical for PES programmes. No transactions can take place in the absence of supporting institutions, which can range from informal to highly regulated in nature. Capacity building will therefore be an essential component of efforts to support the use of the PES approach in developing countries.

- ***Payments for environmental services are not primarily a poverty reduction tool, but the poor are likely to be affected, and implications for the poor must be considered.***

Reducing poverty and increasing the supply of environmental services are two distinct policy objectives. Using one policy instrument to achieve both may reduce its effectiveness in reaching either. However, most public-sector-funded payment programmes require that socio-economic impacts be taken into account, and even some private-sector-funded schemes include poverty reduction criteria. PES programmes can affect the poor, either positively or negatively. The poor may be affected directly, as potential suppliers of environmental services, or indirectly, through effects on wages, food prices or land values, particularly in large-scale programmes or in areas with limited links to external food and labour markets. If appropriate measures are not incorporated into the programme design, PES programmes could hurt the poor, especially the landless, by driving down wages or increasing food prices. They could also result in the poor being excluded from lands to which they have only informal rights. Given these possibilities, universal assumptions that PES programmes will benefit the poor should be avoided.

Nevertheless, PES programmes have been shown to be potentially accessible and beneficial to the poor. Where poor producers considering adopting improved agricultural practices are faced with barriers such as lack of credit, property rights or technical information, PES programmes can sometimes offer opportunities for overcoming them. For location-specific services such as watershed management and biodiversity conservation, the presence of the poor in specific areas of importance for environmental service provision makes their participation indispensable.

The transaction costs involved in contracting with numerous small-scale

producers, many of whom have limited access to resources, can be a critical constraint on the participation of the poor in PES programmes. These costs may remain prohibitive in the case of poor producers – who are generally small-scale suppliers – unless strategies are adopted to reduce them.

The way forward

Payments for environmental services represent a broad and flexible array of measures aimed at improving farmers' incentives to provide services such as carbon sequestration and water purification that are increasingly valued by society. These measures range from narrowly defined voluntary private transactions to more broadly applied public programmes.

Although payments for environmental services are not a panacea for solving all environmental problems, they nevertheless have significant potential for further application in both developing and developed countries. However, much work remains to be done before they can play their role in full. Three key challenges confront public and private stakeholders at the local, national and international levels.

The rights to environmental services must be clarified

First, the establishment of PES programmes involves inherently difficult and potentially controversial decisions about who should bear the cost of providing the services. Any environmental policy is based on an, at least implicit, assumption about who holds the rights to a service and who should bear the costs of providing it. These rights are related to, but not the same as, rights to the resources that contribute to the provision of environmental services. If society decides that farmers hold the right to use the land, water and other resources at their disposal in ways that may have adverse environmental consequences (as has historically been the case), then those who wish to reduce those adverse consequences will have to compensate farmers for any necessary changes. On the other hand, if changes in production practices or impacts warrant, society may decide that farmers should bear the cost of reducing those impacts. Naturally, the question is open to debate and must be resolved on a case-by-case basis. The answer will vary according to the nature of the threat involved and the specific biophysical and social context it occurs in.

Resolving the question at the practical level requires a political process of negotiation, which may range from the international level for issues such as climate change mitigation and biodiversity conservation, to the local level involving community-based farmer associations and representatives of urban consumers in the case of watershed management. Equity as well as efficiency concerns are important in making these decisions, and in some cases it will be necessary to balance trade-offs between the two criteria. However, growing pressure on the Earth's natural resource base, together with the increasing scarcity of environmental services and their associated costs, calls for serious political commitment to clarify the issue of rights to environmental services to allow the problem of environmental management to be addressed effectively, be it through payments for environmental services or through other instruments.

More information is needed through research in both natural and social sciences

A second area of pressing need is further research in both the natural and social sciences of environmental service provision and use. Better information on the causal links between land-use and farming-system practices and their environmental outcomes is critical not only as an aid to clarifying rights to environmental services, but also for identifying the locations and activities that will generate the highest environmental service benefits and for designing effective PES programmes.

Social science research is equally important in order to identify the socio-economic contexts in which payments will be most effective. More work is also needed on the development of guidelines and frameworks for assessing potential, institutional requirements and ways of meeting them, as well as for designing programmes. Such

research outputs will constitute an important means of reducing the high transaction costs that PES programme participants, both buyers and sellers, currently face. High-quality data on both natural and social science indicators are needed to support the analysis required for effective targeting of priority services, areas and programme participants. Geographic information systems can be used to understand and illustrate the interactions among agriculture, environmental services and poverty. Rich, spatially referenced databases are already being generated and offer strong potential for improvement in this area.

In addition, it should be recognized that agricultural production is just part of a long and complex chain that begins with input supply and continues with post-harvest processing, transportation, marketing, consumption and disposal. Each of these stages has impacts on environmental services, and a more complete understanding of the provision and use of environmental services would require analysis of these processes also.

Institutions and capacity building must be strengthened

A third and final challenge relates to institutional support and capacity building. Improved coordination between the public and private sectors through partnerships can enhance the demand for environmental services as well as the sustainability of funding. The public sector also has an important role to play in establishing frameworks for private-sector PES programmes. For instance, improving the coordination among the various ecolabelling schemes and clarifying the environmental benefits that can be obtained from certified products will help to increase the effectiveness of this form of payments for environmental services.

Designing rules that facilitate the access of developing country suppliers to international PES programmes is a further important aspect of the institutional requirements. Rules for certification are indispensable, but can represent serious barriers to entry into global markets for developing country suppliers of environmental services, and there is a need to work across the public and private sectors to develop strategies to overcome these barriers. A relevant issue in this domain concerns the types of activities allowed under flexible trading mechanisms such as the CDM. Restrictions on the type of land-use activities allowable under this mechanism greatly limit the potential demand for environmental services supplied by farmers.

Institutions and capacity building are also needed at the national level to establish the enabling environment required for effective PES programmes and to facilitate the transfer of internationally sourced payments for environmental services. Aligning national environmental, agricultural and financial regulations to support PES projects is another important area where national governments can provide institutional support. In some cases, national government support in clarifying property rights to the natural resources on which PES programmes are based (particularly land) can be critical for their success. Close cooperation among various national ministries and other bodies is a necessary condition for effective coordinated national efforts.

Finally, local institutions and capacity building are required to facilitate the technical and institutional changes needed for enhanced provision of environmental services. Building upon and strengthening the capacity of existing community groups is essential. Working with local organizations to facilitate the transfer of payments, monitoring and certification also serves to reduce transaction costs, particularly where smallholders are involved. Non-governmental organizations can play a fundamental role as mediators between buyers and sellers, as neutral brokers or by helping to facilitate farmers' collective action.

Current policies and incentives favour the production of conventional agricultural outputs at the expense of non-marketed environmental services such as climate change mitigation, improved water quality and quantity, and biodiversity. The costs to society of degrading environmental services are increasingly being recognized. However, it is also essential to recognize that providing enhanced levels of these services entails costs. Potential providers must be offered appropriate incentives.

Developing mechanisms to provide these incentives is challenging. This is a new area – the science is not always clear, the policy context is complex and budgetary resources are a constraint, especially in poorer countries. Nevertheless, payments for environmental services can trigger creativity in finding innovative solutions to improve the management of agricultural and environmental resources, even in countries that are poor in budgetary resources but rich in potential supply of environmental services. When effectively designed, PES programmes can give both providers and users of environmental services more accurate indications of the consequences of their actions, so that the mix of ecosystem services provided matches more closely the true preferences of society.