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**Market-Based Approaches to Environmental
Management: A Review of Lessons from
Payment for Environmental Services in Asia**

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Bhim Adhikari is a research fellow at the School of Natural Resources and Environment, University of Michigan. This paper is based on research conducted while the author was a visiting researcher at ADBI.

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Abstract

Market-based approaches to environmental management, such as payment for environmental services (PES), have attracted unprecedented attention during the past decade. PES policies, in particular, have emerged to realign private and social benefits such as internalizing ecological externalities and diversifying sources of conservation funding as well as making conservation an attractive land-use paradigm. In this paper, we review several case studies from Asia on payment for environmental services to understand how landowners decide to participate in PES schemes. The analysis demonstrates the significance of four major elements facilitating the adoption and implementation of PES schemes: property rights and tenure security, transaction costs, household and community characteristics, communications, and the availability of PES-related information. PES schemes should target win-win options through intervention in these areas, aimed at maintaining the provision of ecological services and improving the conditions for local inhabitants.

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Contents

1.	Introduction.....	1
2.	Review of Case Studies from Asia	3
2.1	Payment for Environmental Services in Viet Nam: Assessing an Economic Approach to Sustainable Forest Management (The and Ngoc 2006).....	3
2.2	Institutional Constraints and Opportunities in Developing Environmental Service Market: Lessons from Institutional Studies in Indonesia (Arifin 2005)	4
2.3	Environmental Services “Payments”: Experiences, Constraints, and Potential in the Philippines (Arocena-Francisco 2003)	6
2.4	Compensating Upland Communities for Watershed Services in the Kulekhani Watershed, Nepal (Upadhaya 2005).....	8
2.5	Payment for Environmental Services: The Sloping Land Conservation Program in the Ningxia Autonomous Region of the People’s Republic of China (PRC) (Zhang, Tu, and Mol 2008)	10
2.6	Payment for Environmental Services: Experiences and Lessons from Viet Nam (Hoang, van Noordwijk, and Thuy 2008).....	12
2.7	Market for Ecosystem Services in Australia: Practical Design and Case Studies (Whitten, Coggan, and Shelton [eds.] in press).....	14
2.8	Developing Markets for Watershed Services and Improved Livelihoods: Fair Deals for Watershed Services in India (Agrawal et al. 2007)	15
3.	Discussion: Some Insights for Designing PES.....	18
3.1	Institutional Arrangements.....	18
3.2	Transaction Costs	20
3.3	Household Characteristics and the Role of Collective Action.....	20
3.4	Information and Communications.....	22
4.	Conclusions.....	23
	References.....	25

1. INTRODUCTION

During the mid-1980s, the concept of integrated conservation and development gained momentum in many countries in Asia and southern Africa with the goal of conserving biodiversity and supporting rural livelihood. This approach combined social development goals and biodiversity conservation, with an assumption that local livelihood practices are important threats to the biodiversity and that diversifying local livelihood options will reduce human pressures on biodiversity, leading to improved conservation (Hughes and Flintan 2001). However, many integrated conservation and development projects (ICDPs) failed in achieving the ecosystem conservation goals as these projects were unable to understand the complexity of socio-ecological systems, especially the interdependency that exists between the resources and people living around them. Although ICDPs were envisaged to be the best option for conserving biodiversity, they suffer from conceptual flaws that limit their appropriateness, especially in reconciling an increasing human demand and inherently unstable wildlife populations (Barrett and Arcese 1995). Many ICDPs could not take into account external factors such as a growing market demand for forest and biodiversity products, demographic pressures, and local social and economic realities. Illegal activities such as logging, mineral extraction, and ranching further aggravated the failure of ICDPs, which were often overlooked while designing these initiatives. One serious criticism of ICDPs is that the poorest and most marginal households have hardly benefited from these approaches. Further, most ICDPs were collapsed immediately after the technical and business support services disappeared once the initiative ended. Many researchers later questioned the viability of ICDPs, especially linking it with local communities and resource management initiatives across diverse geographic conditions and economic situations (Barrett and Arcese 1998; Gunatilake 1998).

More innovative forms of conservation strategies have gradually emerged in the past decade in response to the failure of ICDPs. These new strategies intend to provide direct economic incentives for land stewards for environmental services such as forest management, watershed protection, and biodiversity conservation. The concept has attracted unprecedented attention because natural and human-managed ecosystems produce environmental externalities (a situation where certain actions of producers or consumers have unintended external [indirect] effects on other producers and/or consumers) and that internalizing these externalities through incentive-based mechanisms will encourage individuals to take into account the effects of their actions on others, which could lead to an efficient outcome. Among these instruments, market-based approaches to environmental management such as payments for environmental services (PES) gained popularity both in developed and developing countries for maintaining and ensuring the provision of ecological services and improving the conditions of local inhabitants. The concept of PES represents a new and more direct conservation paradigm in which producers of environmental services receive direct compensation from beneficiaries of the ecosystem services for the benefits they receive from the producers (Landell-Mills and Porras 2002). Wunder (2005: 24) defines PES as “a voluntary transaction where a well-defined environmental service (ES) (or a land-use likely to serve that service is being “bought” by a (minimum one) environmental service buyer from a ES provider and the ES buyer does so if and only if the ES provider over time secures the conditional provision of that service.” PES is rooted in the theory that direct economic incentives for landowners are more effective than indirect means of financing and command-and-control regulation for better land stewardship (Ferraro and Kiss 2002) and that the incentives help internalize the ecological externalities associated with the use of ecosystem services. PES usually covers four types of environmental services: watershed protection, biodiversity conservation, landscape beauty, and carbon sequestration.

Landowners manage forests and vegetative cover to generate a variety of environmental services, but they usually do not receive any compensation for such crucial services. As a consequence, forest conservation and watershed management makes little sense to

landowners as they receive fewer benefits from such land uses compared to other practices (i.e., conversion of forestland to cropland or pastures). As a result, upstream landowners impose costs on downstream resource users in terms of decreased supply of water, sedimentation, and reduced fish catch or diminishing supply of other biodiversity-related goods and services. This can lead to socially sub-optimal land-use decisions. In such situations, payments by ecosystem service users to producers help to make conservation efforts more attractive (Engel and Palmer 2008). Payments also make land-use options with conservation more attractive to local land users or ecosystem managers. They may be better off because of the greater local benefits of the forest conservation option than that of land conversion. Downstream populations are also better off as payments to land users are less than costs that would actually be required to pay if upstream landowners opted for conversion of forest land to cropland or pastures. The payment must be more than the additional benefit to land users of the alternative land use and less than the value of the benefit to downstream populations (Pagiola and Platais 2002). It should be noted that potential payments under a PES scheme for the continued or increased supply of environmental services includes not only direct cash payments. Payments can be comprised of more innovative options such as the recognition of indigenous rights to local resources and tenure security, wages for services rendered, health and education infrastructure for local inhabitants, improved delivery of services such as education, skill training, and mechanisms for reducing vulnerability of poorer households through enhancing social safety nets, among others.

While advances in market-based instruments for environmental services help access diverse sources of funding and make conservation a more competitive land use (Asquith, Vargas, and Wunder 2008), very few empirical studies examine the factors influencing landowner decisions to participate (with the exception of Pagiola, Landell-Mills, and Bishop 2002; Zbinden and Lee 2005; Huberman and Leippraud 2006). Moreover, not much research has been done towards defining the necessary conditions of the successful design and adoption of environmental service markets so that the environmental conservation and development objectives can be achieved simultaneously (Grieg-Gran, Porrás, and Wunder 2005). While several recent studies provide some useful insights on PES mechanisms (FAO/REDLACH 2004; Huang and Upadhaya 2007; Leimona and Lee 2008), there is a need to scrutinize these claims more rigorously by collating and analyzing the available body of knowledge in this area.

Researchers have put forward a number of factors influencing landowner decisions to participate in PES schemes such as household and community characteristics (Zbinden and Lee 2005), enabling national and international conditions (Leimona and Lee 2008), political willingness on the part of national and local governments to develop policies in support of environmental service markets (Huang and Upadhaya 2007), and land use and service supply (FAO/REDLACH 2004). Yet, it remains unclear how and to what extent factors such as property rights and tenure security, transaction costs, and household and community characteristics influence the adoption of PES schemes by landowners, which are described as being crucial elements in the PES literature (Grieg-Grann and Bann 2003; Swallow, Meinzen-Dick, and van Noordwijk 2005; Pagiola, Artceñas, and Platais 2005). To date, little research has successfully addressed the knowledge gaps with regard to the adoption potential of environmental services markets in Asia.

This study relies on a review of eight existing case studies of ongoing PES initiatives in Asia. PES is a relatively new concept and has only recently begun to gain ground in most of the countries considered in this study. We therefore tried to select cases which fulfill the criteria required for a full-fledged PES as closely as possible or those that contain basic fundamentals of PES and have applied basic market-based instruments in developing reward mechanisms for environmental services provision. The PES case studies we will review here are largely exploratory and descriptive and allow us to examine the issues discussed earlier. In the following section, we will present a synthesis of the findings of the

case studies. The third section will analyze and discuss the findings from these case studies. The fourth section will provide the major conclusions.

2. REVIEW OF CASE STUDIES FROM ASIA

In this section, we will review eight case studies from Asia of watershed services, biodiversity conservation, carbon sequestration, and initiatives on establishing markets for landscape beauty. Since most of these schemes are at an early stage of operation, we will summarize important findings in these studies that may have more general implications for the success of environmental service markets in the region.

2.1 Payment for Environmental Services in Viet Nam: Assessing an Economic Approach to Sustainable Forest Management (The and Ngoc 2006)

This study provided a review of sustainable forest management in Viet Nam, which aimed at assessing constraints and opportunities for adopting PES schemes in the forestry sector. A field-based experiment was undertaken in a cluster of three selected upland communities (Khe Tre, Huong Phu, and Xuan Loc) in the Thua Thien Hue province of central Viet Nam for a period of 26 months. Data collection methods included stakeholder workshops, interviews with relevant governmental and non-governmental organizations, and collection of socio-economic data using semi-structured interview techniques. An econometric analysis approach assessed the determinants of adoption of PES schemes.

Since the late-1990s, the Vietnamese government has pursued decentralized policies towards environment and natural resource management, including the forestry sector. The legislation offers a favorable environment for supporting community-based approaches to forest management as well as PES schemes in the country. Although formal ownership of land rests with the government, households, individuals, and organizations are allocated land for long-term productive uses such as agriculture, forestry, and aquaculture. Three types of forests are considered for benefit-sharing arrangements with individuals and organizations: special, protection, and production forests. In Viet Nam, communities have very limited rights to enter into such contracts. Special forests are allocated to households and individuals who plant, regenerate, and protect the forest. It is possible for them to undertake ecotourism-related initiatives in these forests. In return, they are entitled to receive payments from the state. In protection forests, individuals and organizations can harvest dry and diseased trees and non-timber forest products. For the non-forested land allocated for conservation and protection purposes, they receive payments from the government for all conservation-related interventions. Timber harvesting through selection techniques is acceptable in the protected forests along with the use of non-forest areas for agricultural purposes (not more than 20% of allocated land). In cases where private investments have been made, households are entitled to receive 100% of the benefits when such forests reach the harvesting stage.

Compared with special and protection forests, production forests provide the most benefits to communities. In them, individuals and organizations can collect forest products such as dead trees, trees damaged by natural calamities, timber for house construction, and residual products of silvicultural operations for subsistence purposes. Further, forest products from production forests can be harvested according to the condition and state of the forest. For instance, communities are entitled to obtain 100% of the subsistence forest products from those forests that were poorly regenerated during the time of the handover, 70–80% from regenerated forests, and 2% of the annual products from the forests where the annual growth rate is over 100 meters³ (m)/hectare (ha). It is possible to harvest 95% of the products from bamboo forests. Cattle grazing is also permitted in production forests.

Households are entitled to obtain about 75% of the forest products from plantation forests established by the state and later handed over to individual (or community) management. Agroforestry and inter-planting activities are also permitted; households can enjoy 2% of the annual harvest against adoption of such land-use practices.

This case study analyzed the relationship between household characteristics and the decisions of upland farmers to participate in different PES schemes, particularly the adoption of different forest management practices. It appears that the availability of family labor was positively associated with the adoption of PES schemes. Education of the head of household was found to be another important factor that significantly influenced a household's decision to participate in PES schemes. The size of the resource was another consideration as the area of forest plantation was positively associated with the adoption of PES schemes. Another interesting finding of this study was the role of debt in participating households. Probability of adoption was negatively correlated with the amount of outstanding loans. Moreover, it was demonstrated that debt stress may force households to harvest plantation forests early. This is because income from environmental service payments would not be sufficient to mitigate the loan burden. This indicates that the long-term sustainability of these forests depends on the loan repayment ability of farmers. Characteristics of the resources themselves were positively associated with PES adoption. For instance, plantations that are easily accessible with high growth potentials are likely to be considered for PES schemes by the villagers. Farmer's adoption of PES schemes in Viet Nam was, therefore, found to be a function of the area of forests, human capital, and household economic situation, particularly education and the availability of family labor.

The study also examined potential constraints for adopting PES schemes. Lack of private ownership was identified as a major barrier for participation in PES schemes in Viet Nam. One important finding in this connection appears to be the type of rights people could practice in these three different forest management regimes. Farmers could decide the type of tree species to be planted in the case of production forests. However, this was not the case with special and protection forests where government policy dictated the choice of species, timing of harvests, and harvesting methods. PES schemes seem to be easily adoptable in production forests where forest owners have some leverage on land use. However, environmental services provided by protection and rehabilitation activities in natural forests are often valued highly compare to that of production forests. Further, services generated by production forests seem to be of limited concern to policy makers. Perhaps this is one of the constraints for PES in Viet Nam where environmental services outside protected areas have been mostly ignored.

Transaction costs for forest-based PES schemes were another concern. The total annual transaction cost per contract in the study sites was about US\$35 which is a significant amount for poor smallholders. Further, transaction costs per hectare of forest enrolled in the PES scheme were US\$20 (about D570,000). This amount is actually two times higher than the payments they receive for a hectare of forest under the PES scheme. The fragmentation of plantation forests owned by households (usually two ha/household scattered in many different places) means high transaction costs for negotiations, monitoring, and enforcement of PES-related contracts.

2.2 Institutional Constraints and Opportunities in Developing Environmental Service Market: Lessons from Institutional Studies in Indonesia (Arifin 2005)

This study examined institutional constraints and opportunities for markets for environmental services with a review of three cases of watershed, biodiversity, and carbon sequestration services in three different provinces (Sumber Jaya, West Lampung; Bungo, Jambi; and Singkarak, West Sumatra) of Indonesia.

The Sumber Jaya sub-district is a hilly area suitable for growing coffee which had been the major land use in the upper watershed. Although people had been practicing coffee-based agroforestry for decades, thousands of people were evicted during the Suharto administration as a policy of protecting the sub-watershed. The government's plan for building a hydropower plant in the early-1990s further marginalized the local people, culminating in a forced removal of large numbers of people from the watershed. After the fall of the Suharto regime in 1998, a number of conflicts emerged between the government and local coffee growers around the land-tenure issue. The degradation of the watershed continued due to coffee monocultures, environmentally unfriendly horticulture practices, and cultivation of secondary food crops without proper conservation measures. The shortage of water was a particular problem to a government-owned hydroelectricity plant which is supposed to generate 144 megawatts (mW) of electricity along with providing drinking water for the surrounding areas. In the late-1990s, the government later adopted a regional autonomy approach with some authorities devolving to local government that included taxing and levying power on coffee and non-timber forest products. The central government's decree of community-based forest management also recognized the rights of local people to coffee-based agroforestry and access to other forest products. As some scientific studies have suggested the coffee multi-strata system was as effective as other environmentally friendly land-use options, the local coffee growers were granted temporary five-year tenures in 2001. After five years, the tenure was reviewed and was able to be extended for another 25 years, allowing local people to use state-managed protected forests.

The Bungo occupies an area of 455,208 ha of the Batang Hari watershed of high biodiversity value. Main land uses in the watershed include forest (37%), monoculture rubber plantation (31%), rubber agroforestry (13%), oil palm (13%), young palm (5%), and other categories. Smallholders maintain rubber plantations and take part in rubber agroforestry under different institutional arrangements between the landlords and share-trappers. In order to increase production, the Smallholder Rubber Development Project assisted local people with clonal high yielding variety of rubber which yield an average of 990 kilograms (kg) dry rubber per hectares compared to 640 kg of relatively low yield variety. Rubber agroforestry (referred to locally as "jungle rubber") is a viable option for maintaining biodiversity services in humid tropics. The product of the jungle agroforestry system in the area (latex) provides 70% of local household income. However, jungle rubber agroforestry is under stress due to pressure for either high-value food crops or rubber monoculture with high yielding varieties. The area is also under pressure for other development interventions such as mining and oil palm investors are keen to expand plantations in upland areas.

The catchment of Lake Singkarak covers 129,000 ha. Land uses include rice paddies (21%), upland crops (17%), and other uses (30%). Lake Singkarak provides water to a hydropower plant with a 175 mW capacity. However, production in the catchment has declined significantly in recent years due to deforestation and land degradation. Poverty in the Singkarak catchment has become a serious problem. Approximately 77% of the catchment population depends on agriculture and fishery activities and 10% of them are practicing shifting cultivation. In 2004, the catchment was selected for forest-carbon projects by the Ministry of Environment. The project is expected to contribute to poverty reduction and environmental conservation through afforestation and reforestation activities. It also provides direct economic incentives to local people through the carbon sequestration service they offer through watershed conservation.

These three cases provided a number of lessons, particularly regarding the role of institutions for the adoption of PES schemes and development of reward mechanisms. The strength of collective action was key in securing temporary tenure rights and reducing the transaction costs of forest management in Sumber Jaya. In this area, five farmer organizations were recognized by the government under its community-based forest management program. They were crucial in adopting conservation values in local land-use decisions. Further, the temporary written rules on "tenure" provided an adequate basis for

protecting water resources for downstream users. The recognition of rights to organize by the government also helped build trust and a sense of guardianship among villagers. The role of bonding and bridging social capital provided a foundation for the adoption and implementation of the PES scheme in Sumber Jaya.

Institutions supporting biodiversity services in Bungo were achieved by acquiring land-use rights through forest frontier activities such as initial planting of cash crops. Major cash crops planted for claiming rights were rubber, cinnamon, and other tree crops. The local community has rights to enforce certain rules such as declaring the land common property in which agricultural activities have been absent for more than 10 years. In Bungo, there is also congruence between locally crafted rules and the state's rules with regard to forest conservation. They enforce *tanah batin* (a locally devised land-use norm) that governs lands assigned for upland paddies where a number of ritual activities could be performed. Local institutions were instrumental in Singkarak for providing carbon sequestration services. The revival of the *nagari* system (a very complex social system of governing land use in the area) contributed significantly to environmental conservation. The notion of common property is widely held in West Sumatra, which governs land use, fishing, and forests uses. The *negari* system acknowledges self-ownership of resources.

In all the cases, the existing institutions were instrumental in reducing transaction costs, particularly encouraging collective action towards forest and watershed conservation. In Sumber Jaya, the *gotong-royong* (labor sharing for common property) and *arisan* (capital sharing on regular basis) systems provided much required social capital for facilitating markets for environmental services in the area. It was also true for Bungo where *pelerin* (labor sharing for private land) and *berselang* (labor sharing for paddy planting and harvesting) systems were instrumental in uniting local communities for marketing carbon sequestration services. Cooperative actions mediated by these institutions helped develop criteria and indicators required for equitable and fair payment systems that would have been expensive without the recognition of traditional management institutions.

This review also shed light on the role of intermediary organizations which facilitated the adoption of sustainable land-use practices in the area. Further, building the capacity of local government in forestry and watershed management appeared as another factor which promotes the implementation of PES schemes.

Conversely, this review found that transaction costs (currently US\$55/household with annual farm income of US\$1,035 [i.e., 6%] in Sumber Jaya) of the PES schemes are still high and that could be an obstacle for the sustainability of the PES schemes in the long run.

2.3 Environmental Services “Payments”: Experiences, Constraints, and Potential in the Philippines (Arocena-Francisco 2003)

This study reviewed four ongoing PES schemes in the Philippines with varying management interventions, development assistance, and institutional arrangements. Watersheds included in this study were: Makling Forest Reserve (MFR) managed by the University of the Philippines, the Maasin watershed managed by the local government unit with multiple funding sources, Northern Sierra Madre Natural Park (NSMNP) managed by a non-governmental organization (NGO) with funding from the European Union and the United States Agency for International Development (USAID), and Mount Kanlaon National Park controlled by the Department of Environment and Natural Resources with funding from Global Environment Facility. In terms of land area, the sites range in size from the 4,244 ha MFR to the 359,486 ha NSMNP. While the Maasin watershed covers an area of 6,738 ha, Mount Kanlaon National Park occupies 24,557 ha and is one of the ten priority sites covered by the Conservation Priority Protected Areas Project in the Philippines.

These areas experienced severe deforestation and watershed degradation in the early-1990s. Inadequate water supply during the dry season was a major problem in the MFR. Encroachment of adjoining land posed a serious challenge for watershed conservation. About 64% of the Maasin watershed is under cultivation resulting in severe degradation of forests. At present only 35% of household water requirements are fulfilled by the watershed and dry season irrigation is a major hurdle for local people not only due to inadequate supply of water, but also quality and intermittent faucet flow. Widespread logging and shifting cultivation practices pose a threat to the NSMNP watershed in which the forest area shrunk by 25% from its 1950s level by the 1990s. Livelihoods of 5,000 households in this watershed are under stress due to reduced supply of forest products, agriculture inputs, and fishing. Mount Kanlaon National Park is a very diverse park in terms of the biodiversity it supports, but there is already huge pressure on its resources. Both indigenous and migrant people occupied a big portion of the land resulting in accelerated degradation of the watershed.

Since the early-1990s, PES schemes were supported in these areas to reverse the situation. Reforestation and tree-planting activities were supported in the MFR along with the adoption of agroforestry systems. Local people were provided with tenure security through some local arrangements, paid labor, scholarships for high school students, cash incentives, and training activities on sustainable land-use practices. People participated in watershed rehabilitation projects in the Maasin watershed through a variety of conservation initiatives such as reforestation, assisted natural regeneration, timber stand improvement, and rattan and bamboo enhancement, among others. A number of national and international organizations provided funding for PES schemes in this area including the Asian Development Bank, the Overseas Economic Cooperation Fund, the National Economic and Development Authority, and the national and district governments. In the NSMNP, a number of conservation efforts have been initiated through Plan International with funding support from the Dutch government. Some of these initiatives include community-based forest management, forestland regeneration, nursery establishment, resource inventory, training activities, and other interventions targeted at supporting local livelihood. Security of land tenure was among a few incentives provided to local farmers in the area. Park management activities vested on the Protected Area Management Board in the Mount Kanlaon National Park. Local people are now receiving funding for non-destructive livelihood projects. Communities in the watershed are expecting secure tenure rights through the community-based forest management agreement which is awaiting approval from the Department of Environment and Natural Resources.

This review captured quite a few operational issues associated with participation in and adoption of PES schemes. A few notable issues were: the role of government support, communication, and information; the presence of local NGOs; and local contextual factors. As discussed in the theoretical framework, political willingness and support from the local government was a success factor. This was confirmed by the case of the Maasin watershed where the local provincial governor and municipal mayor were champions of PES, motivating local stakeholders and mobilizing finance for conservation activities. The case of NSMNP was similar as local government contributed to the PES activities, another successful rewarding mechanism in the area. Further, continuous support from the local government was instrumental when charging a watershed protection fee as in the case of MFR.

Information exchange and communication between different stakeholders appeared to be critical for creating a support base for PES as substantiated by the case of the MKNP and Maasin watersheds. In the Maasin watershed, about 70 information centers serve different actors by providing information on watershed management and also support for environmental movements in the area. The Watershed Management Council in MKNP is serving the same purpose through facilitating the adoption of a watershed management strategy. Efforts towards educating people, better communication, and exchange of information were key in the successful implementation of PES schemes in the Kanlaon area.

The role of intermediary organizations was apparent in many cases, especially in raising awareness among stakeholders. Their actions in organizing and mobilizing communities, collecting data, garnering volunteering support, conflict resolution, and executing local activities of environmental interest were a notable mention in Maasin. Support from outside agencies (mainly funding agencies) was another stimulus for PES. However, the Maasin case also offers some cautions for uncoordinated efforts in financing PES schemes. It is recommended that less emphasis be given to external funding for local PES schemes and more to increasing local awareness through education, communication, and information exchange based on purely locally driven initiatives, which are likely to have more positive impact on the sustainability of PES schemes.

Spatial coverage of PES schemes was another condition that emerged from this case study. It appears that targeting the entire watershed yields more positive results than considering only the upland communities. Wunder (2008) also discussed the possibility that strategic spatial targeting could have larger biodiversity, landscape beauty, and watershed protection benefits. These services are often very space specific. Further, reaching the offsite beneficiary is important as they stand to benefit the most from environmental services provisioning. However, a larger watershed implies more resources for protection. Watershed protection activities (including the use of resource pricing) were at a very advanced stage in the two relatively small watersheds (Maasin and MFR) compared to the larger watershed of NSMNP. Institution building is another obstacle in larger watersheds where communities are heterogeneous in terms of socio-economic characteristics.

The case study also highlighted the importance of a number of contextual factors. First, the location of the watershed (proximity between where services are generated and the area where these services are consumed) appears to be a “push factor” for creating demand for environmental services. This is exemplified by the case of the Maasin watershed where the forest watershed is in close proximity to the city. Due to this proximity, any negative changes in the provision of watershed services (especially quality and quantity of drinking water supply) could be immediately felt by the local population. Second, the case demonstrated the impact of different levels of community preparedness for undertaking PES schemes. For example, communities that already have social infrastructure in place, such as mature community organizations, are more likely to succeed in implementing PES schemes than communities without them.

2.4 Compensating Upland Communities for Watershed Services in the Kulekhani Watershed, Nepal (Upadhaya 2005)

The Kulekhani watershed, distributed over 12,492 ha and encompassing portions of eight village development committees (VDCs), is located in the Makwanpur district of Nepal. About 45,000 people live in the upper catchment area of the watershed. They collect a variety of forest products including fuel wood, fodder, and other non-timber forest products from the forested watershed for subsistence purposes. It provides water to two hydroelectric plants, constructed in 1982 and 1985, respectively, which generate a total of 92 mW of electricity. The power station is operated and managed by the Nepal Electricity Authority (NEA), a public sector utility company that owns most of the power plants in the country. However, soon after it began operation, it was noticed that the watershed was a source of sediment influx into the Kulekhani reservoir along with water for hydroelectricity generation. According to a study (Amatya 2004), the soil erosion rate for agricultural land in the Kulekhani watershed was substantially higher (73 metric tons/ hectare/ year) than that of forest land (1 metric ton/ hectare/ year). The total storage capacity of the reservoir had been reduced by 23 million m³ by 2002.

In the early-1980s, the government initiated watershed conservation efforts with financial assistance from USAID, the Food and Agriculture Organization of the United Nations (FAO), and the United Nations Development Programme (UNDP). The main objective of the project

was to reduce the rate of sedimentation to increase the lifespan of the reservoir and improve land-use practices aimed at supporting rural livelihoods. Major project activities included community forestry, conservation education, terrace improvement, and fruit plantation in marginal lands. These conservation efforts resulted in reduced siltation and increased dry season water flow. The study was able to establish a link between land use and the sedimentation rate. Studies show that a total of 243,311 m³ of additional water was made available because of forest conservation in the upstream watershed.

The NEA requires a portion of revenue generated from hydropower plants to be paid to the central government. As envisaged in the Local Self-Governance Act of 1999, the central government allocates 12% of the royalty to the local government through the Makwanpur District Development Committee (DDC). According to 2006 DDC guidelines, 50% of this revenue must be spent in the upstream-downstream of the Kulekhani watershed where electricity is generated. Subsequently, the government made it mandatory that another 38% of the royalty be distributed among all districts that house hydropower plants.

The conservation efforts of the communities in the upper watershed proved to be crucial in lowering sedimentation and increasing the amount of water available for electricity generation, especially during the dry season. Winrock Nepal, under the Rewarding Upland Poor for Environmental Services (RUPES) program, facilitated the set up and operation of a reward mechanism for sharing hydropower revenues with upland communities, as well as motivating them to practice environmentally friendly land-use options. The program facilitated the formation of the Kulekhani Watershed Conservation and Development Forum (WCDF), a local organization comprising environmental service providers within the Kulekhani watershed. The program recently proposed that the DDC should earmark 20% of the hydropower revenue received by the district government for conservation of the upstream watershed. This fund would be managed by a committee comprised of local environmental service providers and downstream environmental service beneficiaries.

This case study provides a few insights that are crucial for the adoption and establishment of markets for environmental services. First, the enabling of environmental policy, particularly community-based policy aimed at natural resource management, was a key factor in the adoption of the PES scheme. Nepal is considered a leader in community forestry for its progressive laws and policies. Local communities were granted significant use and management rights over local forests through the Forest Act of 1993. The government's emphasis on providing a sense of tenure security over forest resources has helped facilitate not only the community forestry initiative, but also a number of other conservation undertakings such as leasehold forestry, water, and wildlife management. Rights to forest resources provided a good context for negotiating and initiating the reward system in the watershed. Further, a number of other local governance regulations favor the idea of marketing watershed services. Notably, the Local Self-Governance Act and the Electricity Act support paying for the environmental services generated by watersheds.

Second, the role of intermediary organizations was critical to convincing service providers and beneficiaries of the value of watershed services. These organizations have played a crucial role in capacity building in the local communities, raising awareness about environmental services, and providing policy support that is seldom offered, especially in environmental service market sectors. The presence of the RUPES program (an initiative of the World Agroforestry Center, which conducts targeted action research to examine and explore the environmental service markets in the region) was vital in facilitating the whole process through its research and advocacy work aimed at developing positive incentives for service providers. The review of this case study explicitly emphasized that the presence of credible local organizations, such as community forestry user groups, was instrumental in mobilizing local communities for the PES program. These organizations also triggered the establishment and functioning of the Watershed Conservation and Development Forum (WCDF), which has played a crucial role in mobilizing local communities towards

conservation initiatives and managing allocated revenues for watershed management and local empowerment activities.

The Kulekhani is a smaller watershed, for which establishing links between upstream conservation efforts (e.g., afforestation, terrace improvement, and changes in land-use practices) and downstream water quantity and quality was relatively easy. The watershed service market was reinforced by a number of good case studies that established the direct connection between land degradation in the upper watershed and its downstream effects on the provisioning of watershed services. The ease of demonstrating the cause-and-effect relationship helped motivate both service providers and buyers to realize the importance of watershed management. The presence of a buyer for environmental services (i.e., the hydropower company) proved to be another important condition for marketing watershed services.

The Kulekhani case study also highlighted a number of policy challenges to materializing the operation of an effective PES scheme. The first challenge was to enhance the capacity of stakeholders to institutionalize the reward transfer mechanism. Second, an appropriate use of received payments in conservation and development was crucial for the sustainability of the PES scheme. Finally, continuous support to local communities through social mobilization and institution building was another ingredient to encourage landowner participation in the scheme. The study indicated that political instability could divert the government's priorities towards short-term projects and policies rather than PES schemes. Another challenge for PES is to make sure that payments for environmental services work for poor people and subsequently help reduce poverty in the area.

2.5 Payment for Environmental Services: The Sloping Land Conservation Program in the Ningxia Autonomous Region of the People's Republic of China (PRC) (Zhang, Tu, and Mol 2008)

In 2002, the PRC government initiated the Sloping Land Conversion Program (SLCP) aimed at reducing soil erosion and increasing forest cover in the PRC. The program was initially piloted in 1999 to discourage agricultural activities in steep slopes and marginal lands in response to a severe drought in the Yellow River basin and the devastating floods in Yangtze River basin in 1998. With a budget of US\$40 billion (CNY337 billion), the program is now being implemented in more than 2,000 counties across 25 provinces and municipalities. Approximately 15 million farmers are covered in this first "payment for environmental services" program in the PRC. The State Forestry Administration plans to convert around 14.67 million ha of fragile cropland (with a slope greater than 25 degrees) to forests and grassland by the completion of the program in 2010, making it one of the PRC's most ambitious environmental initiatives in recent decades.

Although the initial focus of the program was on ecological restoration, the focus has shifted slightly towards off-farm income generation. In recent years, the program has come under scrutiny with regard to the rationality, adequacy of institutional design, and implementation modalities adopted by the program. Particularly, concerns have been raised about the relevance of such large-scale, campaign style, and top-down approaches to environmental conservation.

Compensation for farmers in this program includes both kind and cash payment. Participating farmers must modify the existing parcels of lands either into forests or grasslands. Three major types of PES mechanisms were considered: ecological forests, economic forests, and grasslands. In the Yangtze River basin, each household receives an annual grain subsidy of 2,250 kg for a conversion of a hectare of existing agricultural land into one of these land uses, whereas this is set at 1,500 kg/ha in the Yellow River basin. These grain subsidies are decided on the basis of the average productivity of the land.

Currently, farmers can get a cash subsidy of CNY300/ha/year for eligible land uses. Both grain and cash subsidies are provided for up to eight years for ecological forests, five years for economics forests, and two years for maintaining grasslands in the watersheds. For those farmers who are willing to undertake afforestation activities, they receive subsidized seedling with a value of CNY750/ha. The underlying assumption of the program is that if farmers are provided with economic incentives, it could be possible for them to divert from traditional and destructive land-use practices towards environmentally friendly activities. This also helps reduce poverty by encouraging surplus agricultural forces to engage in other off-farm activities.

This paper reviewed the implementation of SLCP in the Ningxia autonomous region with particular focus on social capital for the sustainability of the SLCP program. The high rates of poverty, fragile and degraded ecosystems, and political and economic isolation are a few characteristics of this region. A survey was undertaken in three southern counties: Tongxing, Pengyang, and Xiji. A total of 316 households were interviewed to collect information on the socio-economic characteristics of households, livelihood activities, and perceptions and experiences in the SLCP program. In addition, information was collected with regard to perception about land security, decision-making power, and access to credit, capital, and market.

This review indicated that SLCP-related PES activities are highly ecologically oriented. The program is putting less emphasis on socio-economic and institutional issues. Institutional factors such as land rental, tenure security, and inadequate focus on social capital development emerged as few constraints for the success of the program. Further, access to market and credit was important to mention. About 63% of respondents stated that they have to use personal networks based on family kinships to get information about markets, technologies, skills, and jobs. The adoption of PES schemes was slower due to the absence of a market as well as an absence of off-farm income opportunities for individuals and households. Although the role of off-farm activities was greatly emphasized in order to divert people from traditional agriculture practices, the study found that this strategy hardly addresses the problem as the average education level of households in the region is very low.

Farmer organizations are considered a luxury in the Ningxia region compared to more developed regions of the PRC. Further, organization building and strengthening were not part of the program which is considered a rather new phenomenon in Ningxia. Even where they were present, these organizations were not strong enough to spread risk by pooling community resources in time of economic shock and hardships. It appears that only 8% of the respondents were members of a farmer organization. Although 70 % of laborers involved in the SLCP are women, there is no single self-initiated women's association. Further, top-down approaches to SLCP excluded farmers from participating in decision-making processes on many occasions.

This study pointed out that the sustainability of SLCP in the region depends on enabling economic policy measures such as off-farm income opportunities, strengthening farmer organizations, and participatory decision-making processes. Further, the current level of compensation schemes is not adequate for the sustainability of the SCLP and these incentives should be strong enough to change farmer behavior towards more environmentally friendly land uses. Another fundamental problem for the sustainability of SCLP in the region is the lack of policies in social capital development. The SCLP was similar to other poverty alleviation programs in the government as a result of insufficient institutionalized participation of local farmers. The study concluded that the program will not succeed in the long run unless favorable policies for social capital development are put in place.

2.6 Payment for Environmental Services: Experiences and Lessons from Viet Nam (Hoang, van Noordwijk, and Thuy 2008)

This study drew lessons from payment for environmental services by reviewing four PES case studies from Viet Nam. During the late-1990s, the Vietnamese government enacted a number of laws such as the Law on Water Resource (1998), Law on Land (2003), Law on Forest Protection and Development (2004), and Law on Environmental Protection (2005). These laws, to a certain extent, recognize environmental services provided by ecosystems such as biodiversity conservation, watershed protection, carbon sequestration, and landscape beauty. Later, a number of resolutions endorsed economic instruments for environmental management. Of particular interest are the Natural Resource and Water Resource Acts that specify taxes to be paid by users of ecosystem services.

The first case was the PES scheme in the Tri An watershed, comprised of the Dong Nai and La Nga rivers in Dong Nai province. These rivers are sources of water for the Tri An hydropower plant. Further, the lower Dong Nai is a source of water for the three provinces of Hi Chi Minh City, Dong Nai, and Binh Duong. Increased pollution was a severe problem in the Doi Nai River due to the industrial and domestic wastewater, agricultural run-off, contamination from fish farms, and sedimentation in river beds from deforestation in the surrounding watersheds. This substantially increased the treatment costs for water utility companies. Water supply companies were interested in watershed protection activities in the upper watershed for maintaining the provisioning of clean and continued supply of water. A project funded by Danish International Development Assistance, the World Wide Fund for Nature (WWF), and other partners was aimed at addressing water pollution in the Tri An reservoir and the lower Dong Nai River. The group proposed the establishment of a payment scheme between water supply companies and the upstream groups who were polluting the river. Since finding the source of pollution and costs incurred to water companies is the first step towards establishing payment systems, a study of pollution and hydrology in the watershed is currently underway. Based on the findings of this study, a fund will be established in order to encourage local communities towards environmentally friendly land uses. A management board (consisting of representatives from relevant stakeholders) will oversee the potential payment systems with a provision of third-party monitoring.

The second case study looked at a sustainable financing model for landscape beauty in Bash Ma National Park in central Viet Nam. The park covers 37,499 ha, of which 32,157 ha is upland forested area in the Perfume River watershed. In 2007, WWF Viet Nam and the Forest Protection Department of Hue undertook a study on the willingness of tourists who visited the national park to pay an entrance fee. The study recommended fees of D39,000 for international and D34,000 for domestic visitors. The watershed has also been providing water to a regionally renowned water company operating in the region since 2005. Potential contributions from the water company for the park management were also considered. The study further identified other potential companies and downstream water users who benefited by watershed protection and who would be willing to pay for improved watershed services. Currently, an effort is directed towards establishing a conservation trust fund. This fund will be invested in biodiversity conservation and sustainable agriculture practices in the buffer zone of the park.

In the Cao Phong district of the Hoa Binh province, a pilot carbon sequestration project is being jointly undertaken by the Department of Forestry, Japan International Cooperation Agency Vietnam Forestry University, and the Research Center for Forest Ecology and Environment. It has strong environmental protection and poverty reduction components through income generation from forest products and a carbon sequestration scheme. It is estimated that about 60,000 to 80,000 carbon credits could be obtained through the certified emission reductions (CERs) under the United Nations Framework Convention on Climate Change within the next 20 years. The identified buyers were domestic paper companies and international carbon markets through the CERs. Honda Viet Nam provided financial support

for this project. The beneficiaries include 300 local households who will benefit from timber and sale of carbon credits from the protected forests. The protection activities include a plantation of 350 ha of acacia forests, an establishment of 30 ha of fodder crops for improving cattle grazing, biogas as an alternate fuel to firewood, and effective use of crop residues. The local government will have an important role in implementing the project activities.

The final case study was of the Nha Trang Bay marine protected area (MPA) which contains important coral reefs, sea grass, and mangrove habitats. This 13,000 ha MPA hosts more than 350 species of corals and provides a number of benefits to local communities. The park is also crucial from the tourism point of view as 400,000 tourists visited the park in 2004 for sightseeing, snorkeling, and diving. From 2002–2005, a number of discussions were held with the private and public sectors about how agencies could generate adequate funding for the protection of the MPA. As a result, entrance fees were introduced for securing sustainable financing for the protected area. The project aimed to share 10–15% of the income generated from entrance fees with local communities for a number of development and environmental conservation activities. To date, a total of six villages have already received US\$2,000 (for each village) to undertake specific development and environmental activities including development of waste management system, construction of a road, a trail path for school children, and establishment of a village learning center. These funds are managed by the Khanh Hoa People's Committee (a committee established for developing formal mechanisms to allocate funds). Further, a total of US\$115,000 was provided to the Nha Trang Bay MPA Authority for the management of the park.

A number of lessons can be drawn from these PES initiatives in Viet Nam. First, the case of the Tri An watershed emphasized that any efforts to secure payments for watershed services should clearly demonstrate the costs and benefits of watershed protection to relevant stakeholders. PES schemes are likely to be successful if the benefits of watershed protection are clear, particularly to the buyers. In this regard, technical studies that identify links between upstream land uses and downstream water quality are of prime importance. Buyers of watershed services can only be persuaded after this connection has been established. Second, enabling government policies were instrumental in addition to voluntary involvements of buyers and sellers. The role of micro-credit is another factor for the adoption of PES schemes. The study highlighted that micro-credit initiatives are instrumental if farmers have to modify the current land uses for adopting the PES scheme. Finally, experience shows that formal contracts between buyers and sellers are important features for the successful implementation of PES schemes as demonstrated by the case of Tri An.

The quality of environmental services appears to be fundamental as demonstrated in the case of Bach Ma National Park. For instance, improving tourist services was the first step towards attracting a large number of visitors that subsequently helped raise revenues to finance conservation and reward local people for the environmental services they provide. The carbon sequestration project of the Cao Phong district demonstrated that integration of the forest-based carbon sequestration objective into forestry development with voluntary payment mechanisms serves as an important recipe for a PES scheme for carbon sequestration. Clear and transparent benefit-sharing systems with a strong equity component appear to be another key ingredient for successful implementation. The importance of a clear mechanism for allocating funds appears to be important, as shown in the case study of the Nha Trang Bay marine protected area. Support from the government agencies in the area of capacity building and technical assistance were crucial for PES schemes to operate sustainably. The role of government support has been emphasized in all case studies, particularly for clear mechanisms that provide community-wide benefits, policy, and capacity-building assistance and enforcement of contracts in addition to voluntary contracts between buyers and sellers.

2.7 Market for Ecosystem Services in Australia: Practical Design and Case Studies (Whitten, Coggan, and Shelton [eds.] in press)

This paper analyzed three different market-based instruments in Australia. While the first case study dealt with a rewarding mechanism for reducing salinization in the Wimmera region of southwest Australia; the second dealt with water quality, biodiversity, and amenities values in Murrumbidgee Shire in Victoria; and the third addressed the maintenance of native vegetation. Each case study focused on an important ecosystem service that addressed a number of environmental problems in the region. The Wimmera region is predominantly an agriculture-based economy. The main environmental problem in this region is the recharge of saline ground water aquifers causing soil salinization and increased in-stream salinity. The ecosystem service studied in the Whitten et al. paper was the management of salinity outcomes, particularly reducing recharge to saline aquifers through the establishment of deep-rooted and perennial vegetation. Potential sellers for salinity-reducing services were local landowners who owned land on steep hill slopes within the target region of the catchment. The Wimmera Catchment Management Authority (WCMA) was the buyer.

Land fragmentation (especially for hobby farming and rural residencies) is a serious issue in Murrumbidgee. This has an adverse impact on many ecosystem services in the region. Market-based approaches for establishing native vegetation were a major issue for the third case study. This is of particular importance as there is no clear cut understanding between the use of provenance-specific seed and important ecosystem services. Institutional, industrial, and biophysical constraints are considered to be the root cause of failure of native seed markets in Australia.

A number of factors emerged from these cases studies, particularly the importance of market failure, information asymmetry, and scientific uncertainty while establishing markets for environmental services. For instance, this review showed that rights to salt and water movement in landscapes are not clearly defined. Compared to steep hills with perennial vegetation, hills with sparse vegetation and limited deep-rooted perennial vegetation have greater potential to contribute to deep drainage and, therefore, to the movement of salt in landscapes. As a result, downstream landowners expect salinity neutral land-use practices in the upper watershed. Upstream farmers, however, do not have any incentive to meet those expectations as a result of property rights failure (e.g., rights to salt movement). At present, there is no mechanism for rewarding a particular action directed to reduce ground water discharge because of the no-rivalry or non-competitive properties of this service in the sense that all downstream users benefit from the reduction, but no one is forced to pay for maintaining the provision of service in question. This is the most important feature of market failure in ground water management and also, the largest potential driver of policy intervention in the region. Information asymmetry was another constraint. Landowners were not aware of the specific contributions that different changes to the land management could generate different recharge outcomes and reduce the movement of salt. Scientific uncertainties such as knowledge about recharge quantity, ground water dynamics, and salt sources and concentrations were among a few other difficulties in identifying the potential outcomes. Transactions costs of monitoring and difficulty in measuring the success appears to be an obstacle for adopting market-based approaches to ecosystem services. For instance, one challenge for the project was to identify the best possible recharge outcomes through the modification of current use practices. Improvement in current land uses, however, requires considerable upfront investment which is beyond the capacity of many local landowners. Further, benefits from these investments could only be realized over the long term, which further complicates landholder decisions to invest. The cost of monitoring was the major concern for the success of the reward mechanism as compliance to different land-use decisions was not easy to measure.

The study recommended a number of measures to address property rights failure, the problem of information asymmetry, and scientific uncertainties associated with the market-based approach to ecosystem services. First, negotiations around “who is to pay whom” could be possible only after establishing well-defined property rights over the service in question. Second, the contributions of specific land use to reduce salinization need to be assessed at the best downstream location. Defining the boundaries of those eligible would be an alternative means of identifying location impacts in the provisioning of services (establishing the connection between service providers and users). Additionality was another factor, especially measuring how changes in ecosystem services compare to the “business as usual” scenario. Finally, the presence of a service purchaser (in this case WCMA) was an important condition to address the issue of non-excludability (or the problem of public good) in ecosystem service markets. Some additional elements such as decision-making processes, transparency, and negotiation of contracts were identified as additional ingredients for the successful implementation of PES schemes.

The remaining two case studies further stressed the establishment of property rights because of the strong non-excludable property of the services under consideration. Further, mechanisms to address the problem of asymmetric information were discussed. The study suggested that competitive tender mechanisms especially designed to create incentives for landholders by revealing the costs incurred by them due to changes in land use could help eliminate the problem of cost-related asymmetric information. Similarly, revealing the costs of reclaiming salt-intruded land to downstream landowners could help to solicit the support required for implementing a reward mechanism. The case study provides three major conclusions. First, there should be an established link between land management practices in upper watersheds and changes in downstream ecological outcomes. By doing so, it could be possible to create a market for ecosystem services in which ecosystem users could be willing to pay for an increased supply of these services. Second, tender and contract processes must be robust with the adequate participation of concerned stakeholders. Finally, appropriate mechanisms should be in place to make sure that management changes are successfully implemented to achieve desired outcomes. On the whole, the paper argued that market failure associated with ecosystem services needs to be overcome by designing an effective and efficient rewarding mechanism for land-use practices. Market-based approaches to ecosystems are not only about creating markets for all services, but careful selection and design of an appropriate instrument with the objective of fulfilling the needs of participants.

2.8 Developing Markets for Watershed Services and Improved Livelihoods: Fair Deals for Watershed Services in India (Agrawal et al. 2007)

This case study drew together lessons from three watershed management projects (Kuhan and Suan of Himanchal Pradesh and Bhoj in Madhya Pradesh) that aimed to adopt incentive-based mechanisms to watershed protection and rural livelihoods improvement in India.

The Changar region of Himanchal Pradesh is a water-scarce area where springs used for drinking water often run dry in the summer. Local people rely on a lift-based drinking water supply (a Gesellschaft für Technische Zusammenarbeit [GTZ]-funded project has been under operation since the early-1990s) during the dry season. The project covers 37 micro-watersheds with a focus on watershed management and livelihood enhancement. Two catchments of interest are Kuhan and Suan in Himanchal Pradesh. The Kuhan catchment covers about 210 ha where agriculture is the mainstay of the local economy. The major problem in this catchment was the high silt load which resulted in silting up in the reservoir which provides water to the nearby lift irrigation system. Another catchment, Suan, covering an area of 406 ha, experiences a similar water scarcity problem. Forest fires, declining water

quality and quantity, and drying up natural springs encouraged the local political unit (the Village Development Committee) to think about installing a lift irrigation system. Though this did not materialize due to some local level conflicts, the focus later shifted towards upstream land management through fire control, erosion control measures, and grassland conservation.

The Bhoj wetlands of Madhya Pradesh cover an area of 361 kilometers² (km) and a water spread of 31 km². A smaller lake was created in 1794 and receives water from the upper lake. The Bhoj watersheds are an important source of drinking water and recreation for the residents of Bhopal City. Currently, the upper lake provides about 40% of the city's drinking water requirements. A large number of local people depend on the wetlands for fishing, non-timber forest products, and recreation. However, the wetlands are facing twin problems of poor water quality and reduction in storage capacity due to siltation. Major sources of pollution are an inflow of sewage and solid waste from the urban areas and runoff from nearby agriculture fields.

Incentive-based mechanisms to watershed protection were tested through an action-learning approach in these three watersheds. In Kuhan, the objective was to strengthen local institutions and increase downstream coverage of irrigation in order to have a large constituency of beneficiaries and generate funds for the catchment protection. The second objective was to motivate villagers for ecologically sensitive land-use practices in the upper catchment. A geo-hydrological assessment of the watershed helped to identify erosion-prone zones and areas where immediate conservation measures were required. Villagers helped the project by closing a small patch of land close to the stream and also agreed to plant trees for restoring the degraded area. In return, they were provided with tree saplings and technical assistance to implement the watershed conservation program. A number of other conservation measures were put in place such as construction of check dams to combat soil erosion.

Maintaining and enhancing summer flows of the stream was the chief objective in the Suan micro-catchment for the planned irrigation scheme. Despite the initial interest of villagers, this irrigation project was not realized due to a conflict in the lower village, limited impact of land-use changes in the provisioning of watershed services as indicated in the geo-hydrological assessment, and lack of initial success in securing government funds for the project. Further, there was an issue of initial investment for fencing the cropped area to reduce crop damage by wild animals. In the Bhoj catchment, a change in agricultural practices in upstream farms was the major concern. Some proposed activities included switching from chemical to ecologically-friendly agriculture, erosion control, and improvement of lake water quality. Further, raising awareness for both upstream and downstream stakeholders was a key component. Payments from watershed protection beneficiaries to service providers have been attempted at all three sites, but payments have been taking place only in Kuhan. Of the remaining two watersheds, payments may take place soon in Bhoj, but this has not yet materialized in Suan.

A number of methodological lessons emerged for an incentive-based approach to watershed protection in these sites in India. It was found that projects that build on the existing partnerships are likely to come into operation sooner and also be successful over the project cycle. Community mobilization at the initial stage of the projects is crucial for motivating stakeholders towards collective action. PES-related initiatives usually do not have provisions for heavy investment in physical infrastructures. It required, therefore, a greater effort to motivate communities to participate in the scheme. An element of capacity building and training turns out to be crucial where new concepts and techniques are being tested. Capacity building in downstream institutions is very important for changing perceptions about paying for watershed services. Effective communication and exchange of information play an important role in building and maintaining support for PES-related schemes as the concept of watershed services is still new to the local communities.

As in the case of other community development projects, broader participation of different sections of the society was a stimulus for implementing market-based approaches to watershed services. For instance, there were intense consultations with woman-headed households in Kuhan that led to an agreement. However, this process was not visible and inadequate in Suan where upstream stakeholders were not willing to shift grazing from the catchment and this resulted in the collapse of negotiations in the Bhodi catchment of the Suan watershed. Transparency in the transaction process is very important for the voluntary market for environmental services. In Kuhan, the selection of a new VDC executive body promoted transparency and also boosted confidence in the VDC functioning. A shorter planning horizon is not conducive to watershed service markets because any payment agreements should allow time required for effective land-use change.

Another lesson was congruence between the spatial scale of the biophysical processes and administrative areas. For instance, the catchment was under the Panchayat administrative boundary in Kuhan. The overlap of catchments with the administrative boundary made it possible for buyers and sellers to reach an agreement. This was not the case in Bhoj, where users and suppliers of watershed services are represented by different administrative bodies. This review also stressed the match between the temporal scale of the biophysical process and the decision-making process. In Kuhan, a time frame for the agreement was adequate for changing certain activities, such as stopping grazing in the catchment. In Bhoj, however, the negotiated time frame for switching from high external input agriculture to organic methods was not realistic. Instead, a long-term agreement for reducing pollution and increasing the quantity of water in the lake would have been a more effective solution.

Local available technology could be more acceptable to landowners when it comes to changing land-use practices. This kind of local solution also creates a win-win situation and helps provide direct benefits for the upstream community and watershed service benefits for downstream users. For example, a bamboo plantation in Kuhan resulted in grass yields while maintaining grass cover during the monsoon. Further, locally mobilized resources (both cash and kind) and legitimate reasons for farmers to participate were more effective than motivation from external funding. People highly valued cash payments generated locally over payments by NGO or government institutions.

Credible scientific information that links watershed services to land-use practices is important for watershed services agreements. Convincing hydrological information helps assess problems, areas of intervention, and builds consensus among stakeholders to make payments and change land use. However, this seems to be a significant challenge for all PES-related schemes. Another lesson from this case study was the role of local institutions for reducing transaction costs. In Kuhan, functional local institutions that represent both buyers and sellers helped to reach agreements and reduce transaction costs. However, this was not the case in Bhopal where the lack of credible local institutions at the upper watershed together with multiple downstream beneficiaries increased the costs of transaction.

Another interesting condition for the PES negotiation that emerged from this study was addressing the multiplicity of ecosystem services in cases where there is no single dominant financial benefit from watershed service markets. The Bhoj case suggests that demonstrating multiple use and non-use values of the lake (e.g., water quality, recreation, bird habitat, and fish catch) to both upstream landowners and downstream users expedited the payment agreement. As in other case studies, the role of local champions (e.g., local politicians or local NGOs) was critical for driving the process forward. Exchange visits and field trips to successful sites help to increase understanding and motivation among stakeholders. Finally, the study concluded that market-based approaches to watershed services would likely be sustainable where the PES processes addressed the needs of various stakeholders upstream.

3. DISCUSSION: SOME INSIGHTS FOR DESIGNING PES

Evidence from the case studies reviewed here suggests a number of factors that have implications for the adoption of PES, and the impact this may have on livelihoods, as well as the ultimate effectiveness of the mechanism in protecting ecosystem services. The findings of this review could be organized into four broad categories: property rights and tenure security, community characteristics and the role of collective action, transaction costs, and the role that information and communication in PES schemes play in the likelihood of them being adopted by local landowners. In the following section we will elaborate these findings under these four headings. Although it is still too early to fully evaluate these PES schemes as they are at an early stage of implementation and lessons are still more suggestive than conclusive, we hope lessons from this review will offer some fundamentals for the next generation of PES schemes to becoming a success.

3.1 Institutional Arrangements

Secure property rights arrangements have been considered prerequisite in the PES literature (Grieg-Grann and Bann 2003). Most ecosystem services are public goods because of the difficulty of excluding anyone from enjoying these services and also the inability of management institutions to limit the benefits to only those who bear the cost of maintaining these services. This non-excludability and non-rivalry in consumption means there can be failure in the markets and free riding. As PES schemes usually require a significant upfront investment for land-use modifications or improvements, insecure land tenure could discourage farmers from making long-term investment decisions. This is particularly true for poor squatter communities in rural areas where usufruct rights held by the communities are vulnerable to development interventions. Past experience shows that countries that manage to clarify and strengthen land tenure are most likely to succeed in implementing PES schemes (Leimona and Lee 2008). The case studies support these prepositions and suggest that launching large-scale PES schemes cannot be sustainable without addressing land tenure issues, an urgent necessity for generalizing conservation contracts (Karsenty 2008).

Importance of tenure security, from identifying service suppliers to determining beneficiaries and encouraging farmers to invest in land conservation decisions, strongly emerged as a stimulus for the environmental service markets. For instance, even with the temporary written rules (a sense of tenure security), communities in the Sumber Jaya province of Indonesia were willing to maintain watershed service provisions for downstream users. Further, the recognition of informal institutions such as rights of a local community to declare the village land where agricultural activities have been absent for more than ten years as common property facilitates the adoption of the PES scheme. Bungo's case shows congruence between locally crafted rules and the state's rules, an important factor that helps promote institutional efficacy with regard to forest conservation. A number of locally practiced land-use norms such as tanah batin (lands assigned for upland paddies where a number of ritual activities could be performed) and nagari (a complex social system governing land use) were instrumental in Singkarak for executing a carbon sequestration project. The notion of common property approaches to land is widely held in West Sumatra which governs land use, fishing, and forests uses. These traditional institutions acknowledge self-ownership of land by both the state and societal rules which, to some extent, facilitate the PES scheme in the area. The importance of tenure security also came up strongly in the case study of the Kulekhani watershed in Nepal. It demonstrates that the implementation of the PES scheme was possible due to the policy of community-based forestry adopted by the government through the enactment of the Forest Act in 1993. In contrast, the lack of private ownership of land was identified as a factor responsible for the relatively lesser degree of success in adopting a PES scheme in Viet Nam.

A large body of literature recognizes informal institutions as a key determinant in understanding rural development outcomes (Scoones 1998; Mehta et al. 1999). This notion appears to be consistent with the outcomes of PES schemes in Indonesia. For example, in Sumber Jaya, two informal institutions, gotong-royong (labor sharing on common property) and arisan (capital sharing among community members), were instrumental in facilitating the adoption of local PES schemes. This was also the case in Bungo where pelerin (labor sharing for private land) and berselang (labor sharing for paddy planting and harvesting) systems were instrumental in uniting local communities for the carbon sequestration project. These informal institutions help increase local participation and adoption of conservation measures as well as reduce the costs of transactions. This review of the case studies confirms that social relationships and networks are critical to uniting communities, and that these institutions promote cooperation, share resources and risks, and facilitate the adoption of PES schemes.

In some cases, PES schemes help strengthen land rights (e.g., temporary rights established through frontier activities) where tenure security is very informal. For example, in the Bungo watershed in Indonesia, institutions supporting biodiversity services were achieved through acquiring land-use rights by forest frontier activities. This includes the planting of cash crops such as rubber, cinnamon, and other tree crops. Plantation of these cash crops facilitates the adoption of PES schemes, which in turn, provide a sufficient basis for farmers to claim permanent land rights in areas where PES schemes are functional.

Enabling policy environment appeared to be crucial for both tenure security and mobilizing resources for PES schemes. The case studies show that major support for PES usually come from dynamic and innovative leaders at both local and national levels who can act as champions for innovative approaches. For example, political willingness and support from the local government was a success factor in the Maasin watershed in the Philippines where the provincial governor and municipal mayor were champions of PES, motivating local stakeholders and mobilizing finance for conservation efforts. Further, in the NSMNP watershed in the Philippines local government contributed to the PES scheme directly. This support was not only crucial to consolidate local efforts towards PES, but also instrumental in designing acceptable watershed protection fees to be paid by watershed service beneficiaries in the area. Even though government entities would not assume the role of suppliers and buyers of all environmental services, participation in PES could be enhanced through enabling policy support, and financial and technical assistance. The role of national governments will be more relevant when it comes to creating the necessary legal framework for PES schemes, and if sufficient governmental institutions are present, property rights can be clearly assigned and enforced (Huberman and Leippraud 2006). Equally important is cooperation between other relevant institutions towards the shared objectives of enhancing environmental service markets and conservation. Since partnerships between private and civil society institutions are relatively uncommon (Agrawal 2008), a more coordinated and integrated approach helps efforts toward addressing poverty-related environmental degradation and comprehensive natural resource management.

Equity has to be addressed especially in the adoption of a proactive approach in areas such as distribution of entitlements, designing payment schemes, and crafting institutions for resource use by reflecting the welfare of those directly affected by the scheme. The Viet Nam case study accentuates the importance of transparency and equity in benefit sharing. The case study of the Nha Trang Bay marine protected area unequivocally pointed out the importance of clear mechanisms for allocating funds to legitimate stakeholders. Researchers have emphasized the importance of accurate information, fair institutional mechanisms, and appropriate incentives for watershed service markets (Asquith, Vargas, and Wunder 2008).

The success of the PES scheme also depends on how property rights are assigned. The issue of property rights could be determinant in ensuring equitable participation, potentially excluding landowners who do not hold proper land titles (Huberman and Leippraud 2006). For instance, implementation of PES schemes could alter the existing system of resource

use as enjoyed by poorer households under the informal and customary institutional arrangements. Any alteration of resource use due to the definition or redefinition of existing property rights could have negative consequences on local livelihoods. For example, an alteration could cause concern to the landless, who do not have formal rights to land despite their cultural and spiritual dependency on ecological services. In such a situation, resistance to PES could emerge if these informal rights are not considered. Evaluating the social impacts of PES schemes is thus important for understanding the possible social consequences of PES schemes on different stakeholders or policy changes with regard to resource management. India's experience shows that formalization of property rights through a market-based mechanism for watershed services may hurt the poor where rights to ground water are ill-defined (Kerr 2002).

3.2 Transaction Costs

Consistent with theory, this review posits that high transaction costs could be a barrier for participation because they create disincentives for market exchange. Transaction costs in PES schemes refer to those costs associated with negotiation and enforcement of the scheme. Negotiation costs include time and effort in organizing buyers and sellers, assessment of current land uses and land-use practices, establishing and designing contracts, and preparing documentations as well as the costs of making implementation decisions. The transaction costs of monitoring include costs of certification, monitoring of contractual obligations of buyers and sellers, and among groups of buyers and sellers (Swallow, Meinzen-Dick, and van Noordwijk 2005; Adhikari and Lovett 2006). Higher transaction costs involved in PES schemes have implications on cost-efficiency, effectiveness, and equity involved in developing PES schemes as well as sustainability in the long run (Mayrand and Paquin 2004). Findings from this study confirmed the earlier arguments that high transaction costs (e.g., of information, of defining property rights, and of drawing up legal contracts) could create barriers for small holder's participation in environmental service markets (Asia-Pacific Forestry Commission 2006).

The role of intermediary organizations appeared to be vital to link service producers and buyers as well as reducing the costs of transaction. Past evidence shows that awareness of environmental services and even willingness to pay for environmental services rose through the concerted efforts of environmental NGOs (Leimona and Lee 2008). These organizations can mobilize and assist communities in crafting rules and regulations at the local level. The role of NGOs was apparent in many cases, especially in raising awareness among stakeholders. In the Maasin watershed in the Philippines, NGOs helped in community mobilization, organization build up, data collection, conflict resolution, and execution of environmental activities compatible with the PES scheme in the watershed. In the Kulekhani watershed in Nepal, the presence of credible civil society organizations, such as community forestry user groups, boosted the adoption of PES schemes through community mobilization, advocacy, and raising awareness. Institutional access was relatively easy in this area because of the presence of mature community-based organizations. Local intermediary organizations could facilitate negotiation and coordinate activities to help reduce the costs of negotiation, monitoring, and implementation.

3.3 Household Characteristics and the Role of Collective Action

The case studies highlighted a number of socio-economic factors that have important policy implications for the adoption of PES schemes. Household characteristics such as education, income, labor, skills, and technical capacity are central to implementing PES schemes, as demonstrated in the Viet Nam study. Technical capacity of individual farmers was shown to be crucial, as households with minimum levels of education were experiencing difficulty adapting to a new land-use system. These findings are similar to those of previous studies which found family labor availability to be a key factor in the participation of households in

land-use modification and technology adoption decisions (Thatcher, Lee, and Schelhas 1997). While the availability of family labor was positively associated with the adoption of PES schemes, education of the household head significantly influenced the decision to participate. The larger the land holding was, the greater the chance of its members participating in PES schemes. This was due to the fact that small landholders might not be able to allocate land for PES schemes without jeopardizing their food security.

Another finding of this review was that PES schemes can be viable where participants are socio-economically better off and landholders are well structured. This is consistent with previous arguments that PES schemes are likely to be more functional where land users are well organized (Mayrand and Paquin 2004). This is due to the fact that the decision-making procedure becomes more complicated and costly with increasing group size since the required time and effort appear to be rapidly increasing functions of the size of the group.

Profitability of adoption or modification of existing land uses emerged as an important concern for the poor and smallholders. Acceptability of PES schemes could be low if payments were not sufficient to meet costs associated with socially and environmentally acceptable land-use practices (Pagiola 2002). This could happen as a result of a mismatch between the net value of the current payment and net costs for adopting the new technology (e.g., land-use practices) and forgone income from existing land uses. PES schemes must be able to meet the opportunity costs of land if sustainability conditions are to be satisfied. Adequate socio-economic incentives for local people help shift farmers' behavior towards more environmentally friendly activities, even though this sort of land use provides little benefit in the short run. The PRC case study emphasized the role of off-farm activities in diverting people from traditional agricultural practices, but that alone might not bring the desired outcome unless it is supported by capacity-building measures (e.g., education and skills) for participating households.

The India case study showed the importance of participation of broader sections of society, especially the gender dimension, for adopting market-based approaches to watershed services. Recognition of the success of women-headed households in implementing watershed conservation programs prompted intense consultations with women in Kuan, leading to a timely and much-needed agreement. This was not the case in Suan, where the objective of shifting grazing pressure from the catchment resulted in failure due to the inability of the management institution to consider needs of stakeholders (e.g., the Bhodi micro-catchment). Another imperative was maintaining transparency in the decision-making process for the voluntary market for watershed services. Once again, democratically elected local leaders were successful in securing confidence among users in Kuan.

Scholars have pointed out the significant association between social capital and both transaction costs and organizational outcomes (Fussell et al. 2006). Social capital also helps overcome factors such as group heterogeneity and controls deviant behaviors. The lack of effort towards building institutions at the community level appears to be critical to the success of SLCP in the PRC. Compared to other parts of the country, building strong farmers' organizations was considered a luxury in the Ningxia province. The absence of a strong community-based organization resulted in weak social networks and lack of community capacity to spread risks by pooling community resources in times of natural disaster and economic hardship. The Ningxia case study strongly considered social capital to be an important ingredient for PES schemes and for making the conservation program sustainable. This case highlighted that mobilizing collective community strength, enhancing institutional access to information and credit, and addressing inefficiencies of government institutions were crucial if a strong case was to be made for farmer adoption of the program. Building local institutional capacity for implementing program activities, enhancing their competence to influence decision-making policy, and rationalizing local tenure systems were central to inducing a change in conservation practices aimed at improving the quality of environmental services.

Technology adoption may be hindered when returns are risky and insurance or other financial markets are imperfect (Giné and Yang in press). Scholars have highlighted income and debt as factors influencing household decisions related to adoption of or participation in PES schemes (Sureshwaran, Londhe, and Frazier 1996). Because access to credit is very limited in the rural areas of developing countries, micro-credit programs could facilitate poorer household participation in PES schemes. Support for PES should therefore include credit service and technical advice for enhancing efforts for the provisioning of environmental services. The Viet Nam case study illustrates a strong correlation between household debt and adoption of PES as the probability of adoption was negatively correlated with the amount of outstanding household loans. Most land-use modifications in PES require upfront investments which could be a barrier for participation. Moreover, it became clear that debt burden may force households to harvest plantation forests and this could undermine the optimal level of watershed services. Micro-credit facilitates for potential farmers may encourage the adoption of PES in such situations. The Australia case also addressed the issue of upfront investments for farmer decisions towards land-use modification.

Collective action towards PES is envisaged as an efficient solution for the provisioning of environmental services such as biodiversity conservation and watershed protection. Swallow, Meinzen-Dick, and van Noordwijk (2005) supported this proposition because community-based approaches help to minimize the costs of transaction. Community-based approaches help reduce the costs of transactions, particularly those related to the monitoring and certification of PES schemes. This is because of the community's built-in incentive and idiosyncratic knowledge that can be used to make resource-specific decisions. The cases from Indonesia, the Philippines, and the PRC reinforce the notion that collective action towards PES is central to reducing the costs of transaction. It helps farmers to coordinate spatial coverage of PES schemes with larger geographical scope such as biodiversity conservation and watershed protection. Collective choice rules crafted by local communities retain the potential of reducing the costs of monitoring and certification as these institutions amplify individual's compliance towards management decisions.

Few local contextual factors appear to be relevant for the uptake, adoption, and operation of PES and also their outcomes. In the Maasin watershed, the proximity of the watershed to beneficiaries was a real stimulator for the market for watershed services. The watershed is very close to the urban area so any changes in the quality of watershed services could be immediately realized by the nearby population, particularly quality and quantity of drinking water supply. Another contextual factor was the level of community preparedness for implementing market mechanisms to environmental services. For example, communities that already have good social infrastructure in place (e.g., mature community organizations) seemed to be more efficient in implementing PES schemes than communities without them.

3.4 Information and Communications

There is significant consensus in the case studies that participation in environmental service markets can be realized and enhanced through maximum dissemination of information. Through various dialog and consultative processes, households and communities could be motivated to participate. The key purpose for consultation with strategic stakeholders would be raising awareness on PES as well as facilitating stakeholders' buy-in to the importance of the PES concept. Advocacy, through media mobilization, could also facilitate the awareness-raising process and highlight the demand for increased information on the subject. It is therefore important to galvanize proposed PES schemes with awareness-raising efforts that illustrate how PES options contribute to mobilizing local resources, poverty reduction, and environmental improvement. In the Maasin watershed, approximately 70 information centers provided information on watershed management and also supported environmental movements. In the Kanlaon area, efforts directed towards educating people, exchange of information, and better communication were crucial for the project. The watershed management council of MKNP was a strong player which facilitated the adoption of a

watershed management strategy with a strong component of conservation education. In Australia, landowners were not aware of the implications of different land management practices in reducing recharge to saline aquifers. Although scientific uncertainties associated with ground water dynamics, salt sources, and concentrations were overriding concerns, even general knowledge about ecosystem services production processes such as changes in vegetation cover and salinity outcomes could address impediments to creating market-based instruments for ecosystem services.

This review finds that PES design should be influenced by well-informed technical studies. Quite often, there is a great degree of uncertainty, as well as a disconnect between conservation activities undertaken, and associated ecological outcomes. Willingness to pay for environmental services often increases if there is an established link between the upstream land-use practices and their corresponding effects on downstream environmental outcomes. The Nepal case study shows the importance of a good technical study in order to make the downstream beneficiaries confident about the relationship between increased conservation activities in the upper watershed and enhanced supply of downstream environmental services (i.e., water quality and quantity). The Viet Nam case study also put emphasis on carefully designed cost-benefit analysis of watershed degradation to pursue both buyers and sellers. The Australia case study further stressed an established link between land management practices in upper watersheds and downstream environmental outcomes. The India case study underscores the importance of credible scientific information to assess problems, find areas of intervention, and build consensus among stakeholders to modify land-use changes and design the payment system.

Well-informed hydrological and economic valuation studies are instrumental for PES schemes. An effort to put monetary value on environmental services is not straightforward because of the difficulty of measuring public goods and assigning a proper value to them (e.g., value of wetlands such as flood control and pollution reduction), but careful choice of valuation methods with insights from local use of resources could help design of viable markets for environmental services.

This review suggests a need to engage and build support and partnerships at different levels for enabling legal and environmental policy. This is essential to help build constituency for a broad-based acceptance and interest in PES, gain legitimacy from both buyers and sellers, and support for developing social infrastructures.

4. CONCLUSIONS

Although market-based instruments for ecosystem services are relatively new mechanisms, they have emerged as strong candidates for addressing a number of problems such as ecological externalities, incentive incompatibility, information asymmetries, market failure, and provisioning of local public goods. During the past decade, a large sum of money has been invested in carbon sequestration, watershed protection, and biodiversity conservation through voluntary initiatives of the private sector, pilot activities of financing agencies, and applied research programs in the developing world (UNDP/London School of Economics and Political Science (LSE) 2005). Despite the growing interest and a mounting body of literature on PES, there are still glaring gaps in the theory's predictions and actual situations, particularly how different factors affect the PES outcomes. This review paper aimed to fill this gap, drawing on available case studies, both regional and international, in order to understand the factors that are necessary for adoption and sustainability of markets for environmental services.

This review has come to the realization that designing PES schemes is a complex task and that there are no simple prescriptions or blueprints for optimal designs. The difference in the success of PES schemes could be understood by examining institutional, socio-economic, biophysical, and contextual factors associated with the individual scheme. Perhaps one

important message from this review is that PES is likely to be more successful where there are secure property rights to land and forest resources as well as enabling policies that promote community-based approaches to natural resource management. The argument of tenure security consistently emerged in all the case studies. However, this conclusion obviously needs to be approached with some caution. Although the adoption of PES schemes could be linked to reforming existing property rights, all reforms can create both winners and losers. The agents who benefit from such a change will have a larger stake as a result of the reform, but new systems of property rights may impose a corresponding disincentive effect on others. This is particularly true in cases where communities are enjoying greater access to common pool resources, but such traditional rights could be threatened due to the formalization of property rights for the sake of establishing markets for environmental services.

Another principle message that emerges from this review is that PES schemes will benefit greatly from capacity-building support and availability of information. The aim of capacity building is to raise awareness of market-based approaches to environmental services, develop legal instruments, and provide training on technical aspects of implementation. Access to information was critical and education programs have increased awareness in downstream communities about the potential impacts of land-use change in the upper watershed. Equity and transparency in decision making in payment schemes are additional areas where capacity-building support should be directed. Political economy aspects of the program such as getting support from dynamic and innovative leaders at local, regional, and national levels, and from politicians, the administration, and civil society (who can act as champions for innovative approaches) should be an integral component for designing markets for environmental services.

Credible intermediary institutions can play an important role and, in this review, their support was a key ingredient for success. Adoption of PES was higher in cases where there is the presence of NGOs and civil society institutions, particularly community-based organizations. Moreover, factors such as markets, access to credit, and appropriateness of proposed technology appear to be critical. Building trust between buyers and sellers is also important. Even where there is initial lack of support, PES initiatives should seek to create a policy dialog among different actors. A well-informed dialog may involve multiple components, all having a foundation in local engagement and consultation. Greater inclusiveness and transparency of the program design helps improve program effectiveness, strengthen links between producers and beneficiaries, reduce the enforcement costs, and improve outcomes. Further, the gender dimension of PES, such as consultation with women members for ensuring their participation in all aspects of PES design, is very crucial.

Promoting synergy between poverty reduction and environmental conservation goals could help achieve equity and sustainability. Further, credible scientific information, particularly the hydrological regime within the watershed, became apparent and demonstrated in the case studies. For example, market-based instruments could work well where there is an established link between land-use practices in the upper watershed and downstream provisioning of ecosystem services. Finally, PES schemes should be informed by good valuation studies that link payment options with increased environmental service provisions.

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