



How Can Market Mechanisms for Forest Environmental Services Help the Poor? Preliminary Lessons from Latin America

MARYANNE GRIEG-GRAN

International Institute for Environment and Development, London, UK

INA PORRAS

International Institute for Environment and Development, Edinburgh, UK

and

SVEN WUNDER *

Center for International Forestry Research, Belém, Pará, Brazil

Summary. — Market mechanisms for forest environmental services are a new approach for conservation, but there is also an increasing interest in the derived developmental benefits of these mechanisms. We first propose a conceptual framework for future research on the livelihood impacts of environmental service markets. We then review eight Latin American case studies on carbon sequestration and watershed protection market initiatives, finding positive local income effects in most cases, more land tenure security and socioinstitutional strengthening in some cases, but some negative effects also. We recommend pro-poor policy measures such as reducing smallholders' transaction costs and removing inappropriate access restrictions.

© 2005 Elsevier Ltd. All rights reserved.

Key words — forests, environmental services, market mechanisms, livelihoods, conservation, poverty

1. INTRODUCTION

There is rapidly growing interest in the concept of markets and payments for ecosystem services, many of which come from forests. A recent review identified no fewer than 287 ongoing and proposed initiatives worldwide aimed at forest environmental services (Landell-Mills & Porras, 2002). They are concentrated in four fields: carbon sequestration, watershed protection, biodiversity benefits, and landscape beauty. While these new approaches are motivated by environmental concerns, there is an increasing interest in their potential to also deliver development benefits.

Four types of forest environmental services have until now been brought into the market

* The authors are grateful to William Sunderlin and two anonymous reviewers for their helpful comments in drafting this paper. We would also like to acknowledge the contribution of Montserrat Albán, María Argüello, Emily Boyd, Manyu Chang, Marta Echavarría, Peter May, Fernanda Meneses, Miriam Miranda, Mary Luz Moreno, Fernando Veiga, and Joseph Vogel, the authors of the case studies on which this article draws, and that of Josh Bishop, Natasha Landell-Mills, and James Mayers, on whose initiative these studies were conducted. Funding was provided by the UK Department for International Development (DFID), the Royal Danish Ministry of Foreign Affairs (Danida), the Shell Foundation's Sustainable Energy Program and the Swiss Agency for Development and Cooperation (SDC).

place: carbon, watershed protection, biodiversity, and landscape beauty. With respect to the first, the Clean Development Mechanism is one of several recent initiatives that aims to promote trading of carbon credits from forest carbon sequestration projects, while at the same time contributing, it is hoped, to sustainable development in poor countries. Second, in some watersheds, downstream water users pay for forest protection services to landowners upstream. Third, various market-based mechanisms are emerging to reward forest landholders for biodiversity conservation services. Finally, ecotourism activities are becoming an important vehicle for the maintenance of landscape beauty.

Yet it remains unclear to what extent the two objectives of environmental conservation and development can be achieved simultaneously through market-based mechanisms. Concern has also been raised about potentially adverse impacts on rural livelihoods (Landell-Mills & Porras, 2002; Rosa, Kandel, & Dimas, 2003; Smith & Scherr, 2002). Arguments for being concerned about the impacts on the poor are both moral (e.g., poverty alleviation as an end in itself in the Millennium Development Goals) and pragmatic. Some argue that these initiatives can only work on a long-term basis if they benefit local communities (Landell-Mills & Porras, 2002; Rosa *et al.*, 2003).

This paper presents a synthesis of findings on social and development impacts from several case studies on initiatives in South and Central America. These cases involve payments for carbon sequestration in forests in Brazil, Bolivia, Ecuador, and Costa Rica, as well as payments for watershed protection services provided by forests in the latter two countries. Although each experience depends on the context, and although most are very recent, some preliminary lessons can be drawn.

2. MARKET MECHANISMS AND ENVIRONMENTAL SERVICES

It is generally accepted that many forests provide a range of environmental services. Yet, the economic value of such services is seldom recognized in land-use decisions due to market failures associated with externalities and the provision of public goods. When farmers decide whether or not to clear natural forests for agricultural use, they will factor in the internal benefits from increased crop production

and the costs involved in clearing the land. But they are unlikely to consider forest environmental services to external users, unless they are being directly rewarded to do so. As a result, they will clear more forest than would be considered desirable for society when the benefits of increased agricultural production are compared with those associated with the full range of forest environmental services (Pagiola, Bishop, & Landell-Mills, 2002). The idea behind the introduction of market-based mechanisms is to influence land-use decisions by enabling landholders to capture more of the value of these environmental services than they would have done in the absence of the mechanism. If the payment renders forests a competitive land use, farmers, loggers, or charcoal makers may decide to alter their land- and resource-use practices to either retain forests or to (re)plant trees.

Market approaches are often perceived as an effective alternative to public regulation and to cooperative approaches. In reality, these tools may often work best in combination. A market mechanism can introduce flexibility into individual responses to land-use restrictions while ensuring that a regulatory objective is met.

3. THE IMPACT OF MARKET-BASED MECHANISMS FOR ENVIRONMENTAL SERVICES ON LIVELIHOODS

It is necessary to clarify what is meant by a "market-based mechanism." Narrowly defined, this involves a competitive market with individual buyers and sellers transacting on a voluntary basis. In this article, we use the term much more broadly. Following Pagiola *et al.* (2002), we define market-based mechanisms as initiatives that involve the sale of environmental services to change the incentives of forest managers and/or to generate resources to finance conservation efforts. This can involve cash or in-kind payments, tax incentives or trust-fund disbursements, compensations between bilateral parties, multiple private agents, governments, or NGOs. There is thus a continuum of initiatives from "purist" markets to environmental service projects for development and conservation, and to environmentally motivated regulatory approaches that make use of economic incentives. In practice, few of the existing initiatives to market environmental services are at the purist market end of the spectrum. The initiatives examined in this

paper reflect this diversity, occupying different parts of the market–project–regulation spectrum.

Second, it is also necessary to define whose livelihoods we refer to. What type of poor people are we targeting? In this article, we will mainly be concerned with poor people as potential service providers, and thus as recipients of payments. The introduction of market mechanisms for environmental services has the potential to benefit rural service providers, in economic terms, if the payment received more than compensates the opportunity cost of giving up a more rewarding (but less environmentally friendly) land use. In addition, there might be aspects of the transaction that go beyond the amount of income. These can be benefits such as diversification of income sources, reliable and stable payments, provision of training, and better internal organization among service producers. However, these transactions can also impose costs, for example, increased competition for land or social tension because of jealousies from community members that do not receive payments.

The choice to focus our livelihood analysis on service-providing smallholders also has consequences for the poverty dimension. Landless people, often among the poorest of the poor, are excluded. Even landholders with plots sized just a couple of hectares would often find it impossible to set aside land areas predominantly for environmental service production. Finally, landholders with an insecure tenure and lacking access control are unreliable service providers (see below). Since Payments for Environmental Services (PES) schemes appeal to land-owning and land-controlling participants, by their very nature, they are less suitable to assist the poorest of the poor—a feature they share with many other forest-based activities.¹ We will in the following analysis use “the poor” to refer to those landowners that have the smallest pieces of land.

It is important to recognize that even those poor who are not service providers can be affected by a payment scheme, and the impacts on them can be highly variable:

(a) *Poor service users*: If, for instance, forest-based carbon sequestration helps alleviate global warming, this could be a significant benefit to poor farmers. They are those most vulnerable to climate changes, since they cannot afford to adjust their farming systems to anticipated changes. Poor urban water users might ben-

efit from a cleaner and more reliable water supply. However, to the extent that they used to “free ride” on water access (pay a very low price, or nothing), and the costs of upstream watershed payments now forces them to pay (more than before), they may end up being worse off in spite of the improvements.

(b) *Poor landless laborers*: If a payment scheme induces *reduced* rural activity levels, for example, by setting aside areas that would otherwise have been logged and/or converted to agriculture, this reduces employment benefits. In many cases, landless laborers (e.g., charcoal makers, woodfuel gatherers) are poorer than the landholding group because they do not have land assets. Conversely, if an environmental service scheme *increases* employment options, for example, through an agroforestry scheme or a labor-demanding tree-plantation scheme, these groups would likely derive benefits from the scheme.

(c) *Poor consumers and other groups*: Changing commodity markets also affect the poor. If a large area is set aside for conservation, this can reduce the production of a key staple crop (e.g., rice) and thus drive up the price, to the disadvantage of poor urban consumers of this crop. Similarly, there could be other downstream effects of changes in production structure that affect the poor (markets for timber, firewood, land, etc.).

For lack of data in our case studies, we will only refer superficially to these derived effects. We flag this important general point for future case studies: livelihood impacts of environmental service payments are not *only* about poor land-holding service providers, but also about effects on other groups.

Returning to the environmental service providers, could they actually be made worse off by a payment scheme? An intuitive answer is that, as long as the two parties enter voluntarily into an agreement, the rational service providers would not do something that makes them worse off. As correctly pointed out by Pagiola, Arcenas, and Platais (forthcoming), this answer is facile. In principle, there could be derived, unanticipated consequences of the type described under point (c) that eventually make poor service providers worse off. If we integrate nonincome, multidimensional livelihood parameters, this could reinforce unexpected outcomes. For instance, payments

could stimulate an interest of the powerful in appropriating marginal lands that were previously left to the poor for lack of economic value generation. Indeed, during a recent qualitative survey of a dozen market-related initiatives in Bolivia, one of us (Wunder, 2003) observed that attempts to put environmentally motivated contractual caps on land use were, whether justified or not, often seen by the poor landholder as a first step toward land appropriation.

The next question is, even if poor service providers are not made worse off, to what extent are they made better off in any significant way? There are some reasons why the poor might only benefit *marginally*, mostly due to a limited ability to compete with better-off service providers.

(a) *Informal and insecure land/resource tenure*

Eligibility requirements for clear title may *de jure* exclude people with an informal tenure. In cases where the landholders lack not only a formal tenure, but also the capacity to exclude outsiders' access to land and resources, they will also *de facto* be unreliable service providers, since they cannot guarantee specific land management services.

(b) *High transaction costs*

Negotiating with 100 small service providers entails much higher transaction costs than negotiating with one or two large landowners managing an equal area of land. Start-up, monitoring, and enforcement costs can be significant, so there are economies of scale in buying services from large landowners instead.

(c) *Little voice in the formulation of rules*

The eligibility rules underlying a payment initiative are critical for determining who gets access to the scheme, and the poor are not well positioned to lobby for their case. This is particularly relevant for government-led payment schemes emerging from subsidy systems. Rosa *et al.* (2003) highlight the importance of this aspect in the Costa Rican official PES scheme, where small-scale farmers and indigenous communities were widely excluded because agroforestry was not made eligible.

However, there are also scenarios where the poor are likely to gain because they happen to be more competitive service suppliers.

(d) *Flat payment rate with differential opportunity costs*

In the “*quasi subsidy cases*” where schemes offer just a single rate (as in the Costa Rican system), this provides a producer's surplus to those who have the lowest land opportunity cost. In many cases, it will be the poor, who use more rudimentary production techniques and have lower profits per land unit. The differences in agricultural opportunity costs can be significant, as was the case for a study area in Guatemala (Mañez Costa & Zeller, 2003).²

(e) *Spatial specificity forces service buyers to target poor suppliers*

Let us say that a certain watershed delivers two-thirds of the drinking water to a city, and a forest in the upper valley is home to an endemic primate. The watershed happens to be inhabited by smallholders with insecure land rights, engaging in forest clearing with adverse consequences in terms of soil erosion and habitat loss. Even if the transaction costs of negotiating with these smallholders are high, it may be worthwhile for buyers interested in watershed protection and biodiversity conservation to work with them, especially if there are no, or only very costly, alternatives. The opposite is true for carbon sequestration; it can happen anywhere on the globe. Smallholders have no locational advantage to differentiate their carbon services from those of larger scale, and hence more efficient, suppliers. Carbon markets will eventually become very competitive, and better-off, efficient suppliers will likely gain higher market shares.

4. A FRAMEWORK FOR ANALYZING THE IMPACT ON THE POOR

From the discussion in the previous section, three key questions regarding potential low-income service suppliers can be identified:

- (i) *Access and market shares.* To what extent are smallholders able to sell environmental services, compared to better-off competing suppliers?
- (ii) *Livelihood effect on poor service providers.* Where smallholders do have the opportunity to sell environmental services, what impact does this have on their well-being?

(iii) *Livelihood effect on the other poor.* What impacts do market-based initiatives have on the well-being of poor people not directly involved in the environmental service transaction?

The first question is addressed by analyzing the share of smallholders in a scheme, the characteristics of participants versus nonparticipants (whether at the national, regional, or local level), and the obstacles to smallholders' participation. Answering the second question requires a measure of well-being against which to assess change, and some baseline assumptions about what would have happened without the payment.

One concept of well-being, encompassing both economic and noneconomic aspects, is the sustainable livelihoods approach (SLA), originally developed by Chambers and Conway (1992) and promoted by the UK Department for International Development (DFID) (Carney, undated).³ SLA has been used both for project design and for monitoring and evaluating impacts (Ashley & Hussein, 2000). The assumed advantages of SLA are that it is people centered, analyzes people's livelihood strategies built on different assets (financial, social, natural, physical, and human), and is informative about the causal processes reducing or increasing poverty. Critics have pointed out that the different asset effects are overlapping, that welfare relates to asset *returns* rather than to the assets themselves, and that the approach cannot rank situations where some assets improve while others deteriorate (Angelsen & Wunder, 2003). For instance, a change in "monetary income" is normally treated in the SLA analysis as an impact on "financial assets." Yet this change in assets only materializes if part of the income is saved—*income per se* is always a flow variable, not a stock or an "asset." Moreover, changes in income most likely reflects interaction not exclusively with financial capital but also with other types of assets.

Notwithstanding these valid critiques, we believe that the SLA can provide at least a useful checklist of possible livelihood effects of the introduction of environmental service markets. For this purpose, in Table 1 as in the remainder of this article, we analyze impacts on five types of livelihood assets as in the DFID version of SLA.

The third question requires a detailed analysis of the derived effects of schemes on rural development paths; most initiatives are too re-

cent to assess that. However, a first round of effects on employment and nonfinancial dimensions of livelihoods can be identified and assessed.

5. CASE-STUDY BACKGROUND

The case studies to be reviewed in the following sections examined initiatives in four Latin American countries: Bolivia, Brazil, Costa Rica, and Ecuador. Six relate to carbon projects in the four countries; two describe market mechanisms for watershed services in Costa Rica and Ecuador.

(a) *Research methods*

Research methods in the case studies varied significantly. While all started with a prescreening of secondary information, the Virilla and Pimampiro watershed studies applied a household survey to scheme participants and, in the case of Virilla, to a small sample of nonparticipants. The case studies of Huetar Norte, PROFAFOR, and Noel Kempff used a combination of focus groups and key informant interviews. The remaining studies (Plantar, Peugeot, and Bananal) relied on key informant interviews only. None of the studies involved a comprehensive comparison of field research results against baseline data. The approach followed was to directly ask interviewees how they perceived the new initiative had affected them, or local people more generally. While such qualitative statements can be vital components in an overall livelihood evaluation, their usefulness is reduced if it remains unclear how representative they are of the larger target population.

All case studies analyzed multidimensional impacts of market initiatives on local communities, drawing to some extent on the SLA approach that goes beyond the merely financial aspects. Yet, some of the case studies directly used an asset-based approach (Albán & Argüello, 2004; Miranda, Porrás, & Moreno, 2003, forthcoming). Others examined impacts on economic, social, and environmental variables (May, Boyd, Veiga, & Chang, 2004) or developed their own checklist inspired by the asset-based approach (Vogel, Albán, & Meneses, 2004). The case studies also concentrated on the direct and indirect impacts, while giving less attention to the initial question of smallholders' access to the schemes.

Table 1. *Potential impacts of forest environmental service markets on assets held by the poor*

Possible benefits	Possible risks
<i>Natural assets</i>	
—Higher forest values due to improved management and market opportunities	—Lost use values (e.g., timber and NTFPs) if harvesting restrictions are imposed, and lost options for forest conversion to agriculture
—Positive spin-offs for other natural assets: soil fertility, pollination, water flows, and quality	—Negative spin-offs for other natural assets, for example, forest-based predators, birds attacking crops
<i>Physical assets</i>	
—Infrastructure development: transport, marketing, research, health care	—Dismantling of infrastructure compromising the environmental service, for example, roads
<i>Human assets</i>	
—Education and training: forest and project management, enterprise development, negotiations	—The poor capture few educational and skill development opportunities since offered only menial jobs
—Improved health: from better water supply, investment in health care, higher household incomes	—Reduced health if poor are excluded from collecting NTFPs for domestic consumption and for disposable income
<i>Social assets</i>	
—Increased tenure security where markets spur rights formalization	—Higher competition for land causing displacement of poor who lack formal property rights
—Strengthening of community-based institutions	—Erosion of cooperative arrangements due to increased inequality
—Protection of forest-based cultural heritage	—Markets and commercialization undermine local value system
—Increased visibility and representation of community <i>vis-à-vis</i> government, donors, etc.	
<i>Financial assets</i>	
—New income from sales of environmental services	—New restrictions on forest exploitation and conversion result in income loss
—Higher income from forest-related sources: NTFPs, fuelwood, timber, ecotourism	—Reduced flexibility arising from long-term land-use contracts hampers livelihood responses to short-term shocks
—Improved security and stability of income due to diversification	

Source: Landell-Mills and Porras (2002) and own modifications.

All these differences in approach among the case studies limit the scope for comparisons among them. They also imply that the empirical case study results will only partially answer the questions posed in the conceptual framework we developed above. For these reasons, we consider our assessment to be preliminary.

(b) *The market initiatives*

In the first four initiatives described below, monetary payments were made to local communities, contingent on their continued provision of environmental services. For the other four initiatives, all carbon projects, local smallholders did not receive contingent, monetary payments. This is because the intention was

for the carbon services to be sold by a company or an NGO. Instead, local people were affected indirectly through the creation of employment and/or the provision of nonmonetary benefits.

(i) *Payments for Environmental Services (PES) (Huetar Norte, Costa Rica)*

In the national PES program, established in 1996, payments are made for a bundle of four environmental services (carbon, watershed protection, biodiversity, and landscape beauty) provided by private forestlands, to be achieved through protection, forest management, and reforestation. Expected future benefits from carbon credits are assumed to dominate; in the short run, the main source of financing has been a gasoline tax. Payments are the high-

est for reforestation at US\$520 per hectare paid out over five years. This case study focuses on a reforestation program in Huetar Norte, the most forestry-oriented region of Costa Rica (Miranda *et al.*, forthcoming).

(ii) *Payments for Environmental Services (PES) (Virilla, Costa Rica)*

The Virilla watershed, a second case study area for the Costa Rican PES, has been closely involved in the PES program since its beginning. The upper part of the watershed provides 54% of the Greater Metropolitan Area's potable water, threatened *inter alia* by erosion from land-use change. Compared to Huetar Norte, this area is more relevant for hydrological services provided by natural forest protection. Moreover, in this watershed, financial contributions from water users—a brewery and two utility companies—complement the funding from the gasoline tax (Miranda *et al.*, 2003).

(iii) *PROFAFOR project (Ecuador)*

This carbon sequestration through reforestation initiative is implemented by FACE (Forests Absorbing Carbon Dioxide Emissions), a Dutch consortium of electricity companies. Since 1994, PROFAFOR has signed 154 contracts with communities and private landowners, covering an area of 24,075 hectares. It finances 70% of the start-up plantation costs and 30% in the third year, provided that an 80% tree survival rate has been achieved. In return, the beneficiaries cede their carbon rights to FACE, and commit themselves to manage the plantations according to standards set by PROFAFOR. They retain their rights to timber revenues. The case study focuses on five communities (Albán & Argüello, 2004).

(iv) *Pimampiro (Imbabura Province, Ecuador)*

This Andean municipality covers an altitude range of 1,600–4,000 m above the sea level, with three different forest types and high altitude grasslands (*páramo*). The town of Pimampiro draws water from the Palaurco watershed, but has faced problems of irregular and insufficient water supply, partially due to rapid deforestation and other land-use change by farmers in the upper watershed. A pilot payment scheme was therefore introduced to a group of landowners in the upper part of the watershed to induce them to maintain natural vegetation (forests, *páramo*) instead of clearing it. Complementary activities focused on technical assistance in social conservation, organic

agriculture, and forest management (Echavarría *et al.*, 2004).

(v) *Noel Kempff Mercado Climate Action Project (Bolivia)*

The project was established in 1997 as part of the US Initiative on Joint Implementation, which aimed to test carbon mitigation activities (May *et al.*, 2004). It is an emission avoidance (avoided deforestation) project⁴ with complementary activities aimed at reducing leakage, that is, curbing deforestation in neighboring areas. The Nature Conservancy (TNC) and a consortium of US companies, including American Electric Power, together with the Bolivian government, have bought out the holders of preexisting logging concessions to increase the area of a national park. It is thus a “bundled” initiative combining carbon and biodiversity benefits. Complementary activities included monitoring of logging companies and assisting development of communities in order to compensate them for lost employment in the timber industry and to reduce the threat of carbon leakage through displacement of economic activities to other areas. Communities were assisted to gain land title, a microcredit scheme was established, and agricultural and forestry extension were provided.

(vi) *Plantar carbon project (Minas Gerais State, Brazil)*

This initiative aims to generate carbon credits to be traded according to the rules of the Kyoto Protocol. Plantar is a reforestation company, established in the late 1960s. There are two main components: first, to use carbon credits as a subsidy to maintain the use of charcoal in the pig-iron industry, instead of switching to the cheaper coke alternative; second, to promote reforestation with eucalyptus. A purchase commitment for carbon credits by the Prototype Carbon Fund, managed by the World Bank, has enabled the company to obtain a bank loan for new plantations. The main involvement of the local population in the project has been as employees in the forestry and industrial operations (May *et al.*, 2004).

(vii) *Peugeot Carbon Sink Project (Mato Grosso State, Brazil)*

The initial aim was to plant 10 million native trees in an area of 5,000 hectares (later scaled down to 2,000 hectares owing to low survival rates and a decision to control weeds manually) of degraded pastureland in the “Arc of

Deforestation” of the southern Amazon basin. There is no stated intention to seek Kyoto carbon credits for this project, but the company (PSA Peugeot-Citröen) hoped to improve the environmental image of the automotive manufacturing industry and to learn more about the emerging forest carbon market. The project has generated some employment for local communities and has paid local residents for collecting seeds of native species. A social integration program includes environmental education for schoolchildren and distribution of seedlings of native species to local farmers (May *et al.*, 2004).

(viii) *Bananal project (Tocantins State, Brazil)*

The initiative was financed by a philanthropic group, linked to a UK gas utility company, and implemented by Instituto Ecológica, a regional socioenvironmental NGO. It is experimental and is aimed at demonstrating the local development potential of carbon storage. There is no intention to seek carbon credits. The project aimed to improve the living standards of the population in the project’s areas of influence through environmental education and support for sustainable income-generating activities. In the original strategy, carbon storage was to be achieved primarily through avoided deforestation. Carbon sequestration through reforestation, agroforestry, and regeneration was contemplated as a minor component. Envisaged partnerships with the local and federal governments did not materialize, so the carbon impact was greatly reduced (May *et al.*, 2004).

6. CASE-STUDY FINDINGS

In this section, we examine the extent to which the case studies provide answers to the three research questions posed in Section 4.

(a) *Access of smallholders to the market initiatives*

Three of the initiatives, the two PES schemes in Costa Rica and the PROFAFOR project in Ecuador, have eligibility criteria relating to the size of landholdings. The PES scheme in Costa Rica requires landowners to have a minimum of one hectare to receive payments for reforestation and two hectares in the case of forest protection. It also sets a maximum area that can receive PES of 300 hectares (600 hect-

ares for indigenous people’s reserves) (Rojas & Aylward, 2003). This appears favorable to smallholders, but it is important to examine what happens in practice.

The case study of the Virilla watershed provides some detailed information on the characteristics of landowners enrolled in the PES scheme. However, the information on nonparticipants needed for comparative purposes is less reliable and less comprehensive. Information on the 110 landowners receiving payments in the Virilla watershed shows that 6% of total payments in 2001 were going to properties in which 30 hectares⁵ or less were incorporated in the PES scheme and over 80% was going to properties of 70 hectares or more enrolled. A survey of 32 landowners receiving payments in the watershed revealed that they were relatively wealthy, with an average income of US\$22,000 per year and with more than half having their main occupation outside the farm.

When asked about the main constraints for entering the PES scheme, the small sample of nonparticipant landowners (14) indicated the difficulty of separating forest from other activities on the farm, in particular the PES scheme restrictions on using forests as a temporary shelter for cattle. Another concern expressed was distrust of the legal system and the possibility that future changes in the law would result in further restrictions or bind them to undesirable commitments.

The second Costa Rica study, payment for reforestation in Huetar Norte, did not examine distribution of payments by size of landholding. However, it revealed some factors in the underlying regulatory framework that tend to restrict access for the rural poor. First, once households become participants in the PES scheme, they are barred from accessing some other public benefits such as housing subsidies. Second, land reform beneficiaries are not eligible for PES, even if their land contains forest or is suitable for forestry activities. Third, until recently, forestry activities were not eligible for credit from the National Bank System for Financing, the main source of finance in Costa Rica. As the PES do not cover the full costs of reforestation, some additional finance is necessary. This restriction on bank credit was particularly hard for small landowners as they have fewer alternatives for funding.

PROFAFOR’S eligibility criteria explicitly encourage the access of communities and small landowners by placing a limit on the area (300 hectares) for which private landowners

can be funded. At the end of 2002, nearly 30% of PROFAFOR's contracts in the highland region of Ecuador were with communities, accounting for 40% of the 23,722 hectares of land covered by these contracts. The figures suggest success on the part of PROFAFOR in ensuring participation of communities in the schemes. There are no official figures available on the breakdown of communal and private land for the highland region to form a basis for comparison. However, studies such as that by Mera-Orcés (2001) on specific areas in the highland region suggest that communities account for a relatively small proportion of total land tenure and therefore are "over-represented" in the PROFAFOR scheme in relation to current land-tenure patterns at the regional scale.

The Pimampiro watershed-service payment scheme is run by the municipal government, so access rules are set at the local rather than the national level. A small community of landowners has been targeted, primarily because of its strategic location near the headwaters of the river supplying water to the town of Pimampiro. These landowners jointly have 638 hectares, corresponding to 2–3 hectares of agricultural land per family; most of them can be characterized as smallholders.

To enter the payment scheme, members of this community must sign an agreement with the municipality. There were no additional constraints on access within the scheme, and a high percentage of the members of the community participated, at least initially.

The study of carbon projects in Brazil and Bolivia looked at community access only at the project level. The extent to which the local communities are involved as sellers of carbon is influenced by the original design and motivation of the project. For the two commercial carbon projects in Brazil, the company supplies carbon sequestration services. Local communities benefit indirectly, for example, from employment in reforestation. The case study authors recommend that the companies enable local communities to become suppliers of carbon services. In the two NGO-led carbon projects, local communities also do not receive direct financial payment for carbon sequestration services to date. In the case of Noel Kempff, communities benefit indirectly through community development activities, but as an *ex post* compensation for employment lost due to the termination of logging activities, rather than as a *quid pro quo* remuneration for service

provision. The ineligibility of avoided deforestation under the Clean Development Mechanism has since removed any scope to adapt the project in this regard. The Ilha do Bananal project in Brazil, while specifically designed to target local and indigenous communities, adopted a similar approach to that of Noel Kempff (May *et al.*, 2004).

In summary, the case studies provide us with little hard data on the extent to which smallholders and communities have the opportunity to become remunerated providers of environmental services. The studies describe certain eligibility rules, some discriminating against smallholders while others operating in their favor, but they generally do not document the outcomes in a systematic way. The limited evidence provided by these studies is mixed, with smallholders having favored access in some schemes and being hampered in others.

(b) *Impacts on rural communities selling environmental services*

This section concentrates on the four initiatives in Costa Rica and Ecuador where local communities received a financial payment for providing environmental services. The size of payments received has to be seen in relation to the costs incurred to access the scheme and to meet its requirements, as well as other benefits, financial and nonfinancial.

(i) *Impact on financial assets*

Table 2 presents a comparison of the financial impacts of the four initiatives. The highest absolute levels of payment are found in the Costa Rican schemes. However, if the payments are measured as a proportion of household income, they are higher in Ecuador. The payments in the Pimampiro case appear to be making an important contribution to the household budget, accounting on average for 30% of the household expenditure on food, medicines, and schooling. The drawback is that we do not know how payments compare to the opportunity cost of foregone land uses, though most of the preferred land-use conversions are actually illegal. This raises the question of what is the appropriate alternative land use to consider.⁶ Nine of the 11 landowners interviewed responded that a fair level of compensation would be higher than that currently paid, but opportunistic answers to a question like this are highly likely. Note that nine of the 11 landowners also thought that the payments

Table 2. *Impacts on the financial assets of environmental services sellers in four case-study areas*

Initiative	Payments	Diversification of income sources	Opportunity costs	Transaction costs
Huetar Norte	US\$516 per hectare paid over 5 years, covering 60% of plantation establishment costs. Main financial benefit will be from timber sales	Enables diversification at farm level through incorporation of forestry	Participants lose eligibility for subsidized housing and bank credit	Land must remain idle while the application is processed (up to 12 months)
Virilla Watershed (PES)	US\$225 per hectare/year for forest protection (92% of landowners). Corresponds on average to 16% of household income, but only 4% for small landowners (<30 hectares)	Minimal impact	Average per hectare returns from alternative land uses (dairy farming, export agriculture) are higher than the service payments	Of the participants surveyed, 80% used intermediaries charging 12–18% of the payments
PROFAFOR	Up-front payments per hectare in US\$68–119 range, covering full costs of plantation establishment. Average internal rate of return is expected to be in the 12–27% range over 30 years	Adds forestry to the livelihood basket, but long-run land-use contracts also reduce land-use flexibility	Returns to livestock, the main alternative land use, are currently lower than for forestry	Several trips to Quito required for legal procedures
Pimampiro	US\$6–12 per hectare/year, depending on vegetation type. Average payments equal 30% of household spending on food, medicines, and schooling	Compensatory activities, for example, ecotourism, through conservation and development projects	Alternative land yields may exceed service payments, but are illegal	Carried mainly by the municipality

Source: Authors' assessment based on Miranda *et al.* (2003, forthcoming), Albán and Argüello (2004), and Echavarría *et al.* (2004).

motivated conservation. More telling perhaps, as a measure of the adequacy of compensation, is the fact that several families were removed from participation in the scheme because of contract violations. They were caught extracting timber or converting enrolled land to agricultural uses. The scheme started off with 27 families in January 2001; by the end of 2002, only 15 were left. This could indicate that the financial incentives for service provision were insufficient and/or that landowners had underestimated the capacity to detect violations.

The absolute payments in the Virilla watershed case are significantly higher than those in the Pimampiro case, but appear to have less impact on household income. This reflects the fact that landowners in the scheme in this watershed are relatively well off, with 75% of the sample earning more than US\$820 per month, and a high proportion not being dependent on land cultivation for their livelihood. In a situation where the opportunity costs of retaining land as forest are high, given that the main alternative land uses are export-oriented dairy farming, and coffee and ornamental plant cultivation, the payment is likely to be accepted by landowners who intended to keep their land as forest in any case, that is, independent of the introduction of the scheme. The survey of PES participants revealed that the main reason for entering the program was environmental. Landowners wanted to protect their existing forest or engage in reforestation activities because of the environmental benefits provided. This was particularly the case for landowners receiving payments for forest protection.

In the Costa Rica and Ecuador carbon projects, community members interviewed in focus groups indicated that the payments are important as a means of income diversification and stabilization. The payments help to cover the upfront costs of establishing a plantation, making it a more viable option. Since plantations have only been established in the last few years, sales of mature timber from the plantations will not take place for at least another 10–20 years. The financial net benefits are therefore hard to predict. In the Ecuador case, estimated internal rates of return for the five communities ranged from 12% to 27% over 30 years—a favorable outlook. In terms of the net present value per family, there was a greater variation among villages (US\$46.6–2,481), reflecting differences in population density and plantation size.

Opportunity costs of land are crucial in assessing the impacts. In Huetar Norte, oppor-

tunity costs are low, as soils are poor, and communities are remote. In the PROFAFOR case, the criteria for the scheme stipulate use of land that is not suitable for agriculture, livestock, or pasture, though some of the areas used are degraded pasture. Returns from livestock are currently lower than in previous years because of decreases in wool and meat prices, making forestry a more attractive option, but there are concerns that this could change in the future. In both cases, it is clear that participants have little experience of reforestation and undeveloped perspectives on its net benefits.

Our examples show that environmental service suppliers bear significant transaction costs in the three cases that are part of a national-level scheme. Intermediary organizations in Costa Rica charge between 12% and 18% of the payments. As mentioned previously, there are also opportunity costs of leaving land idle during a lengthy application process.

(ii) *Impacts on nonfinancial assets*

Qualitative impacts of the initiatives on nonfinancial assets of local communities are summarized in Table 3. There is a diversity of effects, both positive and negative. For two of the initiatives, PROFAFOR and Virilla, participation in the scheme is perceived by participants as contributing to land tenure security. In the first case, this is because of the length of the contracts and in the second because of the official recognition given to forest protection, a land use which would normally be considered unproductive, and hence subject to expropriation. In the Pimampiro case, securing of land title formed part of a project preceding the payment scheme, and may have facilitated the latter's introduction.

A significant finding is that there is little indication that the market initiatives had adverse effects on social capital. In three of the four cases, positive impacts were found. This is consistent with results from schemes elsewhere in Latin America (Rosa *et al.*, 2003). Only in the Pimampiro case was there a relationship between the payment scheme and adverse effects on community organization. Nine of the 11 survey participants believed there had been some deterioration in this respect, but it is likely that this reflects social changes related to the move from communal to individual land titles that preceded the introduction of the payment scheme.

Table 3. *Impacts on nonfinancial assets of environmental service sellers in four case-study areas*

Initiative	Land-tenure security	Social assets	Human assets	Physical assets	Natural assets
Huetar Norte	No major impact: land-reform effects predate the initiative	Encouraged the creation and strengthening of community associations	Increased local knowledge on reforestation, but acquired mainly through experience rather than formal training. Losses for early participants	Deterioration in roads due to increased use for forestry and wood-processing industry	Recovery of forest landscapes in the region has improved soils and has provided a side benefit of promoting tourism
Virilla Watershed (PES)	Participation increases security against land invasion	Promotion of community organization and networking	Training in forest management and agroconservation	No major effects	Participants perceive reduced soil erosion and protection of water sources
PROFAFOR	The plantation helped to secure land tenure ^a	Communities mention few impacts, but the initiative has helped establish a community credit system	Some training in forest management, though probably too little	Community fund created, which has helped purchase a tractor and land for a school	One of five communities had its water quality reduced. General increase in game supply. Plantations serve as important windbreaks
Pimampiro	Activities preceding the initiative helped secure individual land titles	Farmer's association was weakened, but probably prior to the scheme's introduction	Assistance for soil conservation, organic farming, and forest management	Unknown	Unknown

Source: Authors' assessment based on Miranda *et al.* (2003, forthcoming), Albán and Argüello (2004), and Echavarría *et al.* (2004).

^a Information based on Milne, Arroyo, and Peacock (2001).

(c) *Indirect impacts on local communities*

Indirect impacts are most relevant to the four projects studied in Brazil and Bolivia where the planned or executed market transactions are not intended to involve local communities directly as recipients of financial payments. There is a clear division between the projects implemented by private companies (Plantar and Peugeot), which have commercial objectives, and the two spearheaded by nongovernmental organizations (Noel Kempff and Bananal), which have prioritized community development.

Employment impacts are significant for the two commercial projects. The Peugeot project employed 100 workers in the rainy season and 20 in the dry season in its first three years, a significant increase over the employment generated by the site's previous land use, cattle ranching, which had only two permanent workers. However, by 2003, employment was reduced drastically to an average of 23 for the first nine months of the year and will decline further once plantation establishment is complete. The Plantar project is preventing the loss of 1,270 jobs in forestry and in charcoal and steel production in an area where there are few other employment alternatives. Without the option to sell carbon credits, these activities would not have been viable. For the Noel Kempff project, the case study highlights the jobs lost through the termination of the logging concessions and suggests that employment creation has been minimal. However, an earlier study pointed to community members being employed as park guards, tourist guides, or assistants for carbon monitoring (Asquith, Vargas Rios, & Smith, 2002). These authors acknowledge though that one of the three communities, the one with the strongest logging industry, experienced a net loss of employment. The other NGO project, Bananal, has had limited direct impact on employment, apart from seasonal employment of four workers in a research center and five employees in a seed nursery.

The two commercial projects have given little attention to community development. However, the managers of the Peugeot project, in an effort to respond to adverse public reaction, have begun to invest in some community activities. They set up an environmental education program for school children and by 2003 had distributed 68,266 seedlings of native species to 83 farmers for use in agroforestry systems. The case study authors acknowledge that this

is not a typical private sector project, with little chance of being replicated on a profitable basis. The directors of Plantar point to the market constraints under which they operate as a reason for not investing in social development. They hold the view that employment generation is a sufficient benefit.

In contrast, social development activities have been the priority for Noel Kempff and Bananal, but with varying degrees of success. A clear positive impact of the Noel Kempff project has been the move to secure the land title of some 400,000 hectares for the local communities. Linked with this is improvement in social organization, as each community now has a functioning village council with statutes. There is also an organization, representing several communities, which has established a heart of palm business.

Efforts to establish income-generating activities have shown less success. In the Bananal case, activities have been hampered by interruption of funding due to the bankruptcy of the original investor. Some small pilot projects, involving beekeeping techniques, a sweet factory using native fruits, ecotourism, and handicraft activities have been established. It is too early to judge their effectiveness. The Noel Kempff project set up a revolving fund to promote alternative income-generating activities. During 1998–2001, 93 community microprojects in agriculture, livestock, ecotourism, and small businesses were funded, but only six of these were still functioning in 2001.

The case studies of these four initiatives show that there are a number of ways in which local communities can benefit from market initiatives, even when they are not receiving direct financial payment. The cases do not provide conclusive evidence that the commercial model of concentrating on employment is any better or worse in terms of improving community well-being than a more inclusive approach. The difficulty is that measuring employment impacts against other types of impacts is ultimately subjective.

7. CONCLUSIONS AND RECOMMENDATIONS

With the exception of the Costa Rican PES system, market-based initiatives for environmental services have only recently been established. In most cases, it is too early to fully evaluate their impacts. For instance, some

community-based carbon sequestration projects will only deliver their main financial benefits when timber can be harvested. The second- and third-round effects of payments on prices and land use will also take time to develop. For many initiatives, it remains to be seen if service-user payments will be sustained or discontinued in the future. On the other hand, growing pressure on natural resources will in many tropical regions open up windows of opportunity for new market-based forest service initiatives. This topic will grow in importance, so it is essential to discuss its developmental implications from the early stages.

The Latin American initiatives analyzed in this article were quite heterogeneous, in their scale, operating time, and in the mode of involvement of local communities. In addition, the case studies on these initiatives, though all inspired by an asset-oriented approach, used different methodologies that complicated comparisons. The researchers also differed in the aspects they chose to emphasize. As a result, they did not pose all the questions necessary for a full assessment of the impacts on the poor, at least to the degree necessary to examine the linkages we have conceptualized in the theoretical section of this article (Section 3).

Moreover, the initiatives are occupying different points on the spectrum from purist markets to traditional projects and to publicly regulated schemes. In the recent literature, schemes with *conditional* payments, made *directly* from the service user to its provider, with prices determined by *negotiation*, have been promoted with strong theoretical arguments (e.g., Ferraro & Kiss, 2002; Ferraro & Simpson, 2002; Hardner & Rice, 2002). However, none of the reviewed initiatives fully corresponds to these "ideal" characteristics. The Costa Rican PES comes closest, but the Costa Rican government heavily regulates access and sets prices, in a manner that bears some resemblance to the forest subsidy scheme it succeeded (Rojas & Aylward, 2003). At the other end of the spectrum, the Noel Kempff carbon and biodiversity project in Bolivia involves communities in ways where the service buyer "is viewed not as a development partner, but as a paternalistic charity. There was no contract, either implicit or explicit, detailing the communities' and [the buyer's] rights and responsibilities" (Asquith *et al.*, 2002, p. 333). Some of these initiatives are thus much closer to traditional Integrated Conservation and

Development Projects (ICDPs) than to *quid pro quo* initiatives.

How easily can the rural poor access market-based service initiatives? For the four initiatives where local communities receive financial payments, it is the rules of the scheme that have most influence on the extent to which small landholders participate. The disadvantages smallholders face in competing with more efficient suppliers of environmental services appear to be less important as a determinant of access. This reflects the aforementioned fact that none of the initiatives are pure market systems where participants compete exclusively on the basis of price to provide services. Instead, selection criteria are set by the administrators of the scheme. Three initiatives have eligibility criteria based on farm size that favor small landowners and communities. But other rules discourage or exclude smallholders. In particular, such rules exclude informal land tenure and mixed livestock-forest or agroforestry systems, which are often favored by poor people with limited land resources.

A general pro-poor PES recommendation from our review could thus be: "Eliminate excessive access discrimination against mixed, pro-poor production systems." Obviously, this raises the question "what is *excessive*?" If a landowner has full *de facto* control over land but (still) no formal land title, exclusion on the basis of the absence of *de jure* control would be excessive. If an area is to be set aside for watershed protection, then prohibition of hunting by local people is probably excessive and would discourage smallholders from joining a payment scheme. But if a biodiversity donor wants to protect a primate species that depends on natural forest diversity, it is probably not a good idea to tell him/her to invest in agroforestry instead—although this might be beneficial both to other species and to the poor. Few markets work well when the sellers dictate what the buyers should buy. Some product- or habitat-specific discrimination measures are well justified by the specific service that the buyers demand.

In other words, excessive discrimination should be judged in relation to the scientific rationale for land-use restrictions and the extent to which they ensure provision of environmental services that buyers are willing to pay for. But this becomes complicated when there is lack of scientific consensus on certain biophysical relationships, or when there is a discrepancy between scientific knowledge and

local knowledge. What is defined as an environmental service is ultimately a function of both scientific information and a process of lobbying and negotiation, as in the case of the rules on carbon sinks. The lobbying argument has particular relevance for “subsidy-type” initiatives where a large area of forestland is rewarded without specifying spatially what services a specific forest provides.

Once poor people participate in market-based PES initiatives, what impacts are they likely to experience? In the four cases involving direct payments to communities, the contribution to cash income has been important, but there are some significant caveats. For the two reforestation projects, the full benefits are realized only when mature timber is sold. For Virilla, the financial payments have made a clear contribution to local incomes, but most recipients may not have been poor from the start. Pimampiro shows the clearest financial benefits for a poor rural community, but over a very limited time frame, and only for a small number of families.

The impacts of payment schemes on non-financial livelihood assets were mixed. A main positive impact is in the consolidation of land tenure, which occurred in half the cases. There were also mostly positive effects on social capital through strengthening of local institutions. Training in forest management was another common benefit, though with variation in quality. There is less evidence of negative impacts, apart from deterioration of roads in one case. The SLA framework does not provide means to measure positive and negative asset effects against each other. One alternative is to convert into monetary terms the losses and gains to each type of asset, where possible. For the Noel Kempff project, this cost–benefit calculus led *Asquith et al.* (2002) to conclude that the aggregate impact on two of the three communities had probably been positive.⁷ Yet some impacts are also the result of measures that precede or accompany the introduction of the market initiative, making it difficult to establish causality.

Are the indirect impacts of market-based initiatives typically positive or negative? The carbon sequestration initiatives that did not directly reward local communities as formal sellers illustrated that local people can still benefit, notably through higher employment. Could communities be made even better off if they were directly involved? There is a danger that companies would desist from investing in such projects if they perceive too many complex

requirements on them to promote local development processes, rather than concentrate on the purchase of the service. There is insufficient evidence from these initiatives to reach a firm conclusion on this. However, the experience of Peugeot suggests that reputational pressures influence the way companies evaluate the trade-offs between commercial viability and local development. This may add to the reasons for some companies to avoid altogether carbon projects in developing countries and associated reputational risks. But an alternative scenario is that some companies proactively seeking to promote a socially responsible image will still pursue this market.

Our review also highlights insufficient willingness to pay for environmental services as a key obstacle to scaling up these initiatives. Costa Rica’s payment scheme is heavily oversubscribed on the supply side. If all applications from landowners for PES enrolment were to be accepted, three to four times the amount of financing currently available, would be needed (*Rojas & Aylward, 2003*). The PES scheme is also still very dependent on fuel tax revenue for financing despite efforts to secure external buyers. PROFAFOR in Ecuador has been obliged to rethink its scope and not sign further contracts, as a result of reduced financial backing. Expansion of the Pimampiro pilot scheme to other communities in the watershed will depend on higher domestic water tariffs and charges for irrigation water. It is not clear as yet whether either of these measures would be politically feasible.

Finally, one of our recommendations relates to the schemes situated more toward the purist market end. For these initiatives, it will be important to try to make poor potential service providers more competitive *vis-à-vis* the better-off providers. One way to achieve that is to reduce transaction costs. Efforts are currently being made in Costa Rica to “bundle” PES applications for groups of smallholders. Making contracts simpler could also reduce transaction costs. Donors could help by subsidizing start up costs. To the extent that transaction costs cannot be sufficiently lowered, another market-based pathway is to seek “pro-poor premia,” that is, find buyers who are willing to pay more for a product that is not only environmentally beneficial but also pro-poor. The carbon market experience to date shows that both private companies and development donors are willing to enter these certified markets.

NOTES

1. For instance, any tree-growing activity is a long-term investment that will require secure land tenure and access control in order to reap the benefits (Angelsen & Wunder, 2003).
2. The authors use farm data from the Alta Verapaz Department and shadow prices from a linear programming model as indicators for the large variation in opportunity costs across farm types. The poorest farms are those that are most flexible and able to adapt.
3. Other SLA variants, such as the Household Livelihood Security Approach, are employed by CARE (Drinkwater & Rusinow, 1999).
4. This kind of project is not Kyoto eligible and thus does not qualify as a CDM project, at least for the first commitment period 2007–12.
5. The area receiving payment may be smaller than the total size of the property.
6. Clearing of natural forest in this area is forbidden by a poorly enforced law. Echavarría *et al.* (2004) argue that it is inappropriate to treat these illegal land uses as the relevant opportunity cost. The payment should be considered instead as compensation to landowners for actively protecting their forests against incursions from third parties.
7. Asquith *et al.* (2002) found that community losses during 1997–99 amounted to US\$229,800 (plus forest usage rights, but with assumptions on continuous gains from logging employment, which seemed to be already declining) while corresponding gains amounted to US\$358,380.

REFERENCES

- Albán, M., & Argüello, M. (2004). *Un análisis de los impactos sociales y económicos de los proyectos de fijación de carbono en el Ecuador*. El caso de PROFAFOR-FACE. Markets for Environmental Services No. 7, International Institute for Environment and Development, London.
- Angelsen, A., & Wunder, S. (2003). *Exploring the forest-poverty link: Key concepts, issues and research implications*. CIFOR Occasional Paper No. 40. Bogor, Indonesia: Center for International Forestry Research.
- Ashley, C., & Hussein, K. (2000). Developing methodologies for livelihood impact assessment: Experience of the African Wildlife Foundation in East Africa. ODI Working Paper 129. London: ODI.
- Asquith, N. M., Vargas Rios, M. T., & Smith, J. (2002). Can forest-protection carbon projects improve rural livelihoods? Analysis of the Noel Kempff Mercado Climate Action Project, Bolivia. *Mitigation and Adaptation Strategies for Global Change*, 7, 323–337.
- Carney, D. (undated). *Sustainable livelihoods approaches: Progress and possibilities for change*. Department for International Development, London. Available from www.livelihoods.org.
- Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: practical concepts for the 21st century*. IDS Discussion Paper 296, Institute of Development Studies, Brighton.
- Drinkwater, M., & Rusinow, T. (1999). *Application of Care's livelihoods approach*. Presentation for NRAC '99. Available from www.livelihoods.org.
- Echavarría M., Vogel, J., Albán, M., & Meneses, F. (2004). *The impacts of payments for watershed services in Ecuador*. Emerging lessons from Pimampiro and Cuenca. Markets for Environmental Services No. 4, International Institute for Environment and Development, London.
- Ferraro, P. J., & Kiss, A. (2002). Direct payments to conserve biodiversity. *Science*, 298, 1718–1719.
- Ferraro, P., & Simpson, R. D. (2002). The cost-effectiveness of conservation payments. *Land Economics*, 78, 339–353.
- Hardner, J., & Rice, D. (2002). Rethinking green consumerism. *Scientific American*, 286, 88–95.
- Landell-Mills, N., & Porras, I. (2002). *Silver bullet or fool's gold? A global review of markets for forest environmental services and their impacts on the poor*. Instruments for sustainable private sector forestry series. International Institute for Environment and Development, London.
- Mañez Costa, M., & Zeller, M. (2003). *Peasants' production systems and the integration of incentives for watershed protection*. A case study of Guatemala. Paper presented at the CIFOR-BMZ Conference on Forests, Livelihoods, and Biodiversity, Bonn, Germany; May 2003.
- May, P. H., Boyd, E., Veiga, F., & Chang, M. (2004). *Local sustainable development effects of carbon projects in Brazil and Bolivia*. A view from the field. Markets for Environmental Series No. 5. International Institute for Environment and Development, London.
- Mera-Orcés, V. (2001). Caracterización social de los páramos. In V. Mena, G. Medina, & M. Hofstede (Eds.), *Los Páramos del Ecuador. Particularidades, problemas y perspectivas*. Abya Yala/Proyecto Páramo, Quito.
- Milne, M., Arroyo, P., & Peacock, H. (2001). Assessing the livelihood benefits to local communities from forest carbon projects: case study analysis, in Forest Carbon, Livelihoods and Biodiversity, a Report to

- the European Commission. Centre for International Forestry Research.
- Miranda, M., Porras, I. T., & Moreno, M. (2003). *The social impacts of payments for environmental services in Costa Rica. A quantitative field survey and analysis of the Virilla Watershed*. Markets for Environmental Services, No. 1. International Institute for Environment and Development, London.
- Miranda, M., Porras, I. T., & Moreno, M. (forthcoming). *The social effects of carbon markets in Costa Rica. A case study of the Huetar Norte Region*. International Institute for Environment and Development, London.
- Pagiola, S., Arcenas, A., & Platais, G. (forthcoming). Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date. *World Development*.
- Pagiola, S., Bishop, J., & Landell-Mills, N. (Eds.) (2002). *Selling forest environmental services market-based mechanisms for conservation and development*. London: Earthscan Publications Ltd.
- Rojas, M., & Aylward, B. (2003). *What are we learning from experiences with markets for environmental services in Costa Rica? A review and critique of the literature*. Markets for Environmental Services No. 2, International Institute for Environment and Development, London.
- Rosa, H., Kandel, S., & Dimas, L. (2003). *Compensation for environmental services and rural communities lessons from the americas and key issues for strengthening community strategies*. PRISMA Programa Salvadoreño de Investigación sobre Desarrollo y Medio Ambiente.
- Smith, J., & Scherr, S. J. (2002). *Forest carbon and local livelihoods: Assessment of opportunities and policy recommendations*. CIFOR Occasional Paper No. 37, Bogor Barat Indonesia, Centre for International Forestry Research.

Available online at www.sciencedirect.com

