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# Paying for Biodiversity Conservation Services

## Experience in Colombia, Costa Rica, and Nicaragua



*One of the most important reasons for the degradation of biodiversity, in mountain areas and elsewhere, is that the people who make land use decisions often receive few or no benefits from biodiversity conservation. Understandably, therefore, they generally ignore potential biodiversity benefits when choosing land use practices. The end result is that biodiversity is often lost, as are many other off-site benefits such as the regulation of hydrological flows. Efforts to enhance biodiversity conservation need to take account of the constraints faced by individual land users, who decide what practices to adopt on their land. Over the years, a variety of efforts have been made to boost the profitability of biodiversity-friendly practices for land users, with mixed results. A further approach, which has received increasing attention in recent years, is to provide direct payments for the provision of environmental services such as biodiversity conservation. The simple logic of Payments for Environmental Services (PES) is that compensating land users for the environmental services a given land use provides, makes them more likely to choose that land use rather than another. The Regional Integrated Silvopastoral Ecosystem Management Project, which is being implemented by the World Bank with financing from the Global Environment Facility (GEF), is piloting the use of PES as a means of generating biodiversity conservation and carbon sequestration services in watersheds at three sites in Colombia, Costa Rica, and Nicaragua.*



## Silvopastoral practices

Cattle production has long been an important cause of the loss of natural habitat and biodiversity in Latin America. Despite the correction of many of the policy distortions that encouraged deforestation over many decades, pressure from expanding livestock production continues to result in large-scale deforestation in many areas.

In addition to the environmental problems caused by the initial loss of forest, extensive grazing is often unsustainable (Figure 1). After an initial period of high yields, soil fertility is depleted and grass cover diminishes, resulting in soil erosion, contamination of water supplies, air pollution, further loss of biodiversity, and degradation of landscapes. Lower income for producers results in continuing poverty and in pressure to clear additional areas.

Silvopastoral practices, which combine the planting or conserving of trees with pasturing, offer an alternative to prevailing cattle production systems. They provide deeply rooting, perennial vegetation which grows persistently and has a dense but uneven canopy. These practices include:

- Planting high densities of trees and shrubs in pastures, thus providing shade and diet supplements while protecting the soil from packing and erosion.

**FIGURE 1** Degraded extensive pastures are a common sight in areas such as Quindío, Colombia. (Photo by Stefano Pagiola)

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**FIGURE 2** Coal miners have their canary, and the Silvopastoral Project has the *sabanero grillo* (*Ammodramus savannarum*). This critically endangered species was observed in a live fence planted under the Project in Quindío, Colombia. (Photo by Stefano Pagiola)



- Cut and carry systems, in which livestock is fed with the foliage of different trees and shrubs specifically planted in areas previously used for other agricultural practices.
- Using fast-growing trees and shrubs for fencing and wind screens.

The on-site benefits of silvopastoral practices to land users may include additional production from the tree component, such as fruit, fuelwood, fodder, or timber; maintaining or improving pasture productivity by increasing nutrient recycling; and diversification of production. While these benefits can be important, they are often insufficient by themselves to justify adopting silvopastoral practices—particularly practices with substantial tree components, which have high upfront planting costs and only bring benefits several years later.

**On-site and off-site benefits**

Because of their increased complexity compared to traditional pastures, silvopastoral practices also have important biodiversity benefits. They have been shown to play a major role in the survival of wildlife species by providing scarce resources and refuge; to have a higher propagation rate of native forest plants; and to provide shelter for wild birds (Figure 2). They can also help connect protected areas. The bulk of biodiversity benefits are off-site, however, so land users will tend not to include them when they are deciding which practices to adopt.

Silvopastoral practices may also generate other off-site benefits, generally referred to as environmental services. For example, they can fix significant amounts of carbon in the soil and in the standing tree biomass, and they can affect water services, though the specific impact is like-

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**FIGURE 3** A farmer in Colombia's Quindío region with the seedlings he is about to plant on his farm. (Photo by Stefano Pagiola)

ly to be site-specific. As with biodiversity benefits, these benefits will generally not be included in land users' decision-making.

## Implementing payments for environmental services (PES)

PES programs compensate land users who adopt practices that generate environmental services. Although the PES approach is intuitively appealing, putting it into practice is far from simple. The Silvopastoral Project is piloting the use of PES to encourage the adoption of silvopastoral practices in degraded pasture areas. Participating land users receive annual payments, over a two- or four-year period, for the environmental services that they generate.

The project was initiated by local NGOs working with land users in each of the countries: the Centro Agronómico Tropical de Investigación y Enseñanza (CIPAV) in Colombia, the Centro para la Investigación en Sistemas Sostenibles de Producción Agropecuaria (CATIE) in Costa Rica, and the Instituto de Investigación y Desarrollo Nitlapán in Nicaragua. In light of the biodiversity and carbon sequestration benefits that silvopastoral practices could provide, they applied for support from the GEF. The World Bank, as a GEF implementing agency, helped develop the proposal with support from the multi-donor Livestock, Environment and Development Initiative (LEAD), hosted by the Food and Agriculture Organization (FAO). The project is financed by a US$4.5 million GEF grant. It has a very strong learning focus, reflected in considerable monitoring efforts.

The Silvopastoral Project is being implemented in 3 microwatersheds: Quindío, in Colombia (Figure 3); Esparza, in Costa Rica; and Matiguás–Río Blanco, in Nicaragua. All 3 are hilly areas, with steeply sloping terrain. The Colombia site is located in the Central Cordillera, at an altitude of about 900–1300 m, while the Costa Rica and Nicaragua sites are considerably lower, at 300–500 m. Current land use in all 3 areas is dominated by extensive pasture. At the Colombia site, farms range from 10–20 ha to 50–80 ha. In this former coffee-growing area, many of the larger farms are owned by urban professionals. At the Costa Rica site, most farms are 30–40 ha, and are owned by smallholders. At the Nicaragua site, there is a range of farm sizes from 10–30 ha, to a few of over 60 ha. A much drier climate makes farms at the Nicaragua site much less productive than those at the other sites. This site has the highest proportion of poor households, with 71% falling below the poverty line, and 51% considered extremely poor.

### What is being paid for?

Most PES programs focus on very few land uses. Costa Rica's PES program, for example, pays for conserving existing forest. This approach has the virtue of simplicity, but it fails to recognize that different land uses can provide very different levels of services. There is a spectrum of effects, ranging from relatively inhospitable systems, such as monocultures with heavy agrochemical use, to relatively hospitable systems, such as organic coffee grown under a shade canopy of diverse native species.

To provide payments that are proportional to the level of services provided, the Silvopastoral Project developed indices of the biodiversity conservation and carbon sequestration services that different land uses provide. The **biodiversity conservation index** is scaled with the most biodiversity-poor land use (annual crops) set at 0.0, and the most biodiversity-rich land use (primary forest) set at 1.0. A similar procedure was used to establish the **carbon sequestration index**.

### How are payments made?

Payments for environmental services will have the desired effect only if they influence land use decisions appropriately. Silvopastoral practices tend to be unattractive to land users, despite their long-term benefits, primarily because of their substantial initial investment and because of the time lag between investment and returns. This leads to the hypothesis that a relatively small payment provided early on could 'tip the balance' between current and silvopastoral practices. This effect works by increasing the net present value

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**FIGURE 4** Enrique Murgueitio, Executive Director of Fundación CIPAV, explains the point system for different land uses to a participating farmer. (Photo by Stefano Pagiola)



of investments in silvopastoral practices and by reducing the initial period in which these practices impose net costs on land users. By the time payments end, the silvopastoral practices themselves will begin generating income for land users (Figure 4). The payments also alleviate the liquidity problems faced by many land users and help them finance the required investments. Based on this analysis, the project provides a payment of US$75 per incremental environmental service index point, per year, over a four-year period. It is important to note, however, that this situation is an exception. In general, payments in a PES program should be ongoing rather than finite.

### Avoiding perverse incentives

Initially, land users were to be paid only for incremental improvements: for the increase in environmental service index points over the points generated by current land uses. It soon became clear that this approach would create perverse incentives. "Bueno, corto todo," was a common reaction from land users when they were told that they would not be compensated for existing trees: "fine, I'll cut them all." As a result, the initial plan was modified to include a one-time payment of US$10/point for the baseline points. This payment also helps to alleviate financing constraints to implementing silvopastoral practices.

### Who is paying?

The principles of PES require that service users pay for the provision of environmental services. Without this feature, many of the efficiency and sustainability aspects of the approach are unlikely to be realized. If payments to service providers are made by charging service users, there is a natural constituency with a vested interest in ensuring that funds are used appropriately or effectively. If they do not receive the expected benefits, they can discontinue payments; conversely, if they receive the benefits, they have strong incentives to continue supporting the arrangement. This poses problems in cases where the main benefit is biodiversity conservation, as it is difficult to identify and charge the actual beneficiaries of this service. The GEF was created precisely to function as a representative of global interests in cases such as this. Thus, the GEF can be thought of as 'buying' biodiversity conservation services on behalf of the global community. As discussed below, however, this poses a challenge in terms of the long-term sustainability of the approach.

## Initial results

The project made baseline payments in 2003, and then payments for incremental points earned in 2004 and 2005. Average payments in the second year averaged US$357 per farm in Colombia, US$557 in Costa Rica, and US$446 in Nicaragua.

Initial results show that PES is succeeding in inducing land use change (Figure 5). In Colombia, participants added 0.19 points/ha, compared to 0.001 points/ha in a control group of farms. Similarly, participants in Costa Rica added 0.26 points/ha, compared to 0.09 points/ha in the control group, and participants in Nicaragua added 0.17 points/ha, compared to 0.12 points/ha in the control group.

Initial results also indicate that the practices promoted by the project are in fact improving biodiversity and carbon sequestration. Intensive monitoring of bird, ant, and other species under different land uses shows that silvopastoral practices tend to have significantly higher bio-

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**FIGURE 5** Silvopastoral practices introduce a variety of tree species in pasture. Here, cattle graze in an intensive leucaena or leadtree (*Leucaena leucocephala*) system in Quindío, Colombia. Such systems can be more productive and can harbor much higher levels of biodiversity than the extensive pastures they replace. However, high initial costs often make them financially unattractive to land users. (Photo by Stefano Pagiola)



diversity than current monocultural, treeless pastures. Figure 6 shows initial data from biodiversity monitoring at the Costa Rica and Nicaragua sites. These results show that land used under a silvopastoral system harbors higher levels of biodiversity than treeless pastures. The observed diversity of bird species, as well as the number of individuals (not shown in Figure 6), is greater on land with trees, and higher yet when the tree density is higher. Similar results are being obtained for other indicators (vegetation, ants, and butterflies).

Results of the study on the impact of the project on the welfare of participants are not yet available. However, as participation is voluntary and participants receive payments, there is a presumption that they will be better off. Whether this impact will be large or small remains to be seen.

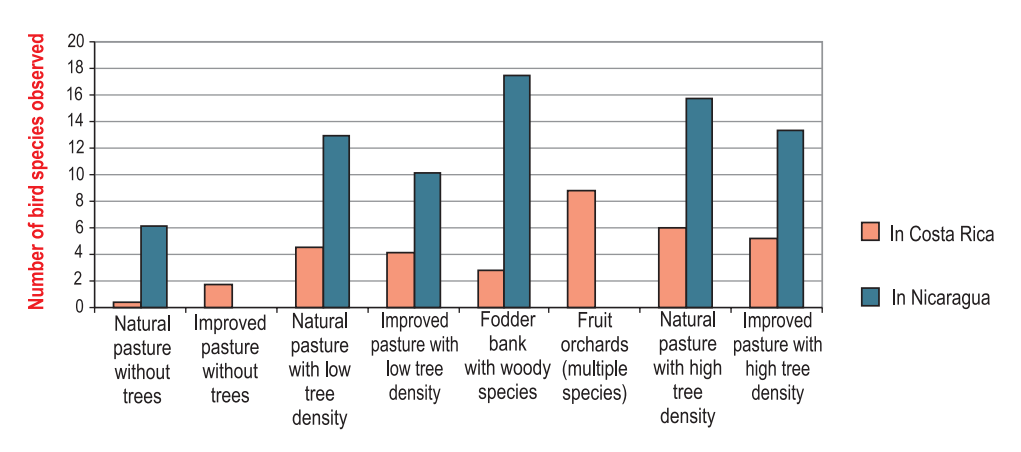
## Conclusions

The project is still on-going, so it is too early to draw definitive conclusions. Already, however, it seems that the two main hypotheses of the project—that appropriate payments can induce land use change, and that appropriate land uses can improve biodiversity conservation—will be confirmed. The impact of the project on the welfare of participants is also being monitored closely.

The main challenge for the future is to develop sustainable funding sources, both in order to expand the approach to other areas and, if needed, to provide longer-term payments to participants. Unlike PES programs based on water payments, programs based on GEF funding have finite funding. In Costa Rica, silvopastoral practices are now being added

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**FIGURE 6** Monitoring of results shows that biodiversity is much higher in silvopastoral systems.




to the country's on-going PES program, but there are no equivalent mechanisms in Colombia or Nicaragua.

Initial results of monitoring of the water impacts of silvopastoral practices show a positive effect on water quality, indicating a potential for tying this approach to water-based PES mechanisms. There is a strong local demand for new approaches to protecting local supplies. Sites in mountain areas are particularly likely to be able to use water payments, as land use may affect many downstream water users. Not all watersheds have substantial numbers of downstream water users willing and able to pay for water services, however. Nor is it necessarily true that inappropriate land use in the upper watershed is always the most significant problem affecting downstream water use. Contamination or excessive withdrawals further downstream could easily negate the benefits of upstream conservation. The potential for generating funding through water payments will thus vary substantially from case to case.

As with many approaches to conservation, PES should not be seen as a 'silver bullet' that will solve all problems everywhere, but rather as one of several tools which, under the right conditions, can help address natural resource management problems.

*The opinions expressed in this paper are the authors' own and do not necessarily represent those of the World Bank Group, FAO–LEAD, GEF, CIPAV, CATIE, or Nitlapán.*

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Interested readers may download a copy of a more detailed report on this project from http://www.worldbank.org/environmentaleconomics; additional information may also be found at the CATIE and FAO–LEAD websites at http://www.virtualcentre.org/es/res/gef_proy and http://lead.virtualcentre.org/silvopastoral/default.htm

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