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Article *in* Ecological Economics · August 2006

DOI: 10.1016/j.ecolecon.2005.10.010 · Source: RePEc

ECOLOGICAL ECONOMICS 59 (2006) 131 141

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ANALYSIS

On the efficiency of environmental service payments: A forest conservation assessment in the Osa Peninsula, Costa Rica

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A R T I C L E I N F O

Article history:
Received 27 April 2005
Received in revised form
20 September 2005
Accepted 17 October 2005
Available online 7 December 2005

Keywords:
Environmental payments
Forest conservation
Biodiversity
Ecological services
Costa Rica

A B S T R A C T

This study examined the efficiency of programs supporting the conservation of forest resources and services through direct payments to land owners; or payments for environmental services (PES). The analysis is based on a sample of farms receiving and not receiving PES in the Osa Peninsula, Costa Rica. Results indicate that payments have limited immediate effects on forest conservation in the region. Conservation impacts are indirect and realized with considerable lag because they are mostly achieved through land use decisions affecting non forest land cover. PES seem to accelerate the abandonment of agricultural land and, through this process, forest regrowth and gains in services. This would be a double gain (current plus future forest services) except that our results also suggest that, in the absence of payments, forest cover would probably be similar in PES and non PES farms and that forest regrowth would also take place, albeit at a slower rate. These findings have important policy implications. Specifically, they suggest that, locally, payments could be more effective if they are used for restoration purposes. In their current form, PES landholders have no long term obligation to let abandoned lands revert to forest. Payments for restoration would remove this uncertainty. Because of the lag in conservation outcomes, they may also be insufficient at larger geographic scales if there are other forest areas where the immediate risk of habitat and service loss is higher. In the short run, resources would be better used if invested in these higher risk areas. At a more general level, this study lends support to the growing expectation that project administrators improve their capacity to target payments where they are most needed and not simply where they are most wanted.

1. Introduction

This study aims to contribute to the understanding of how payments for environmental services (PES) work to protect and restore ecological services generated by and the biodi versity found in privately owned natural habitats. Widespread concern over biodiversity extinction dominated the conserva tion agenda for several decades. More recently, the role of biodiversity in general, and of natural ecosystems in parti cular, to maintain vital ecological processes has also been recognized (Hoekstra et al., 2005; Ives et al., 2005). It is also becoming increasingly clear that conservation policy should respond to site specific ecological and socio economic condi tions to protect and restore natural habitats where the need is

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doi:10.1016/j.ecolecon.2005.10.010

greatest. This concern is motivated, in large part, by the decline in international funding for conservation during the past decade but also by a greater awareness that certain habitats face greater risk than others (Sierra et al., 2002; Sierra, 2005). It is no longer acceptable to expend resources in an opportunistic manner, as has typically been the case. The expectation is that available resources are used to protect critical ecosystems first.

A growing body of research also suggests that maintaining ecological services demands strict, large scale protection of entire ecosystems beyond the boundaries of protected areas (Meffe and Carroll, 1997; Simberloff et al., 1999; Soulé and Terborgh, 1999). Today, most remaining natural habitats are on private hands, either individually or communally, and it is unlikely that sufficient amounts of these lands will ever be included under protected management domains due to political, economic, and cultural factors. Unfortunately, command and control conservation mechanisms (i.e., laws and regulations) have proven ineffective in these areas, especially in the developing world (Sierra, 2001; Faith and Walker, 2002). The most common alternative has been the implementation of programs designed to redirect labor and capital away from activities that degrade ecosystems and cause biodiversity loss. This approach, often called integrated conservation and development programs, has been labeled "indirect" by scholars of market based conservation. Billions of dollars were invested in such endeavors in the 1980s and 1990s (Ferraro and Simpson, 2002; Landell Mills, 2002). However, by the mid 1990s the initial optimism had cooled to cautious interest. Though some projects were having noticeable effects (Schelhas, 1995), observers concluded that most interventions had failed or were failing. Rice (2004) labeled this approach "conservation by distraction". Studies showed that the barriers to change were much too complex (Ferraro and Kiss, 2002). Even when conservation projects were able to change local resource use strategies in the short term, interventions rarely altered the incentives that prompted local resource users to degrade habitats in the first place. Because markets offer no compensation for protecting natural habitats, land owners have no incentives to conserve them, favoring their transformation to agriculture or intensive resource extraction (e.g., logging). This results in the loss of the services and goods of great social but relatively small private value that they provide. In this tragedy of the private lands, including those controlled as community territories, land owners bear the whole cost of conservation while many more share its benefits without compensating them.

Recognizing these shortcomings, some analysts and conservation practitioners are recommending to compensate land owners directly for the economic losses associated with habitat conservation with payments that correspond to the gain in services kept (Alix et al., 2003; Pagiola, 2002). In the ideal system, the provision of services would be negotiated by users and producers (i.e., owners of the habitats where the processes take place) through market transactions. However, this transition requires that markets be created where none existed before; not an easy task given the nature of the services involved. Many experiments with this conservation model are now being conducted on the supply side of the equation in the form of PES. By the 1990s, there were close to 300 related initiatives planned or in the early stages of implementation (Landell Mills and Porras, 2002); many in developing countries. For example, Mexico is implementing a nationwide PES scheme to address their perceived deforestation problem (Alix et al., 2003). Organizations such as Conservation International, which just a few years ago had no experience in direct market transactions, now have millions of dollars tied up in contracts protecting important ecosystems.

There are, however, important gaps in our understanding of the way PES work and their relative and absolute contribution to conservation. A key unknown is how much additional conservation is obtained through PES, a concept often referred to as additionality. Additionality simply means that the outcomes of a policy or project are in addition to what might have occurred due to other direct and indirect factors (Shrestha and Timilsnia, 2002); or in this case, in the absence of payments. A second question relates to the multi scale nature of conservation priorities and the potential for in farm and off farm leakages. Land use decisions are complex and simultaneous. It is not well known how payments are used by recipients and how these decisions indirectly contribute to or subtract from the overall impacts of PES. Farmers may use payments, for example, to transfer farming activities to other forest areas not covered by PES in the same region or even in the same farm. They may even be used to increase the pressure on more critical ecosystems or for intensifying existing productive activities with relatively greater environmental impacts.

Unfortunately, until now there has been limited empirical research linking land use decisions, and ecosystem protection and restoration to PES programs. Project reports show the size and location of lands set aside for PES contracts, but it is often unclear if the new conservation area is additional to what might have been conserved in the absence of conservation payments. A recent study of the Countryside Stewardship Scheme in England determined, for example, that between 36% and 38% of agreements showed some level of additionality and concluded that the program is likely to provide a benefit to society (Carey et al., 2003). However, this analysis was based on the farmer's perception of the impact of a signed agreement and not on land cover outcomes. Similarly, an attitudinal study in Costa Rica showed that PES farmers overwhelmingly believed that this country's program was contributing to the protection and restoration of tropical forests (Ortiz, 2004). Forty three percent of landholders said they had abandoned agriculture and pasture fields when offered the PES option. On the other hand, recent nationwide land cover studies demonstrate that secondary forest increased at a rate of 13,000 ha per year from 1987 to 1997, due in part to a series of environmental and economic factors that affected the value of cattle and agricultural production (World Bank, 2000). Hence, it remains unclear if land managers without payments were also abandoning agriculture in the same way as a result of other relevant forces.

Within this context, this study examines the PES program in the Osa Peninsula, Costa Rica. Costa Rica is often cited in the literature as a pioneer in market based conservation initiatives (Chomitz et al., 1999; Pagiola, 2002). Nearly all sectors of society have embraced the PES concept and are actively lobbying for increased funding to make it available to more landholders (Barrantes et al., 1999; Brockett and Gottfired, 2002; Sanchez et al., 2002a). Costa Rica, therefore, provides fertile ground to research how PES programs work to protect and restore ecological services in private lands. Specifically, our analysis responds to three questions: 1) Are land use decisions of landholders of PES and non PES farms different? 2) If different, what role PES, relative to other factors, play in explaining this variation? And 3) What are the in farm and off farm conservation implications of PES in the Osa Peninsula? Our analysis assumes that land use decisions are reflected in land cover characteristics and that these, in turn, manifest how payments work for conservation. This approach has the advantage that land cover is relatively easy to be quantified and, subsequently, associated with key factors that are expected to play a determining role in land use decisions.

2. Conserving biodiversity and ecosystem services in privately owned lands

There is a long history of programs designed to pay land owners directly to encourage particular land management practices to promote the conservation of specific physical resources or, in some important cases, to maintain commod ity prices. For example, charging water users to compensate upstream land owners has been used successfully in Japan for over 100 years (Richards, 2000). In developed countries, government agencies have provided for decades financial incentives to farmers to keep agricultural land out of produc tion or shift it to alternative uses. In Europe, 14 countries spent an estimated $11 billion between 1993 and 1997 to divert over 20 million ha into long term forestry contracts (OECD, 1997). In the 1990s, the United States Conservation Reserve Program spent about $1.5 billion annually on contracts for 12 15 million ha (Clark and Downes, 1999), an area twice the size of Costa Rica.

Land owners participating in PES programs also agree to apply specific conservation schemes in their lands for a given period of time in exchange for a payment. However, the main objective of PES programs is to promote the conservation of ecological processes. Although subtle, this difference is significant. Resources, such as water and soils, can be stored and their use by third parties restricted. These are usually conceived as local assets; not connected to other areas or regions. In contrast, ecological processes are a fund service property of biodiversity. They cannot be stored and are non exclusionary (Daley and Farley, 2004). Owners of the habitats where these take place who do not capture their value now incur in a permanent loss. Furthermore, they cannot impede that other users, locally or globally, benefit from them without compensation. Indeed, their value is often based on the role they play in determining natural, economic and social conditions in places that are often far removed from where they take place. PES programs are an attempt to link this spatially disjunct value system through the creation of quasi markets for environmental services based on subsidies provided by conservation agencies, multilateral organizations and governments. PES programs are expected to be an intermediary stage in the formation of true markets for environmental services, in which beneficiaries of the services and goods provided by specific habitats would pay land owners for their conservation.

To facilitate the development of markets and the interac tion of providers and buyers, researchers have been trying to qualify and quantify the value of ecosystem services. This is proving difficult because we still know so little about the specific services ecosystems provide. In fact, different eco nomic valuation techniques often generate quite distinct results (Nasi et al., 2002). Consequently, researchers are finding that valuation efforts can contribute most by deter mining how much one would have to pay different groups to get them to maintain land under natural cover (i.e., their willingness to accept), rather than the value of the service. However, this proxy approach has important drawbacks because of the complexity and simultaneity of land use decisions. Specifically, it is difficult to disentangle decisions about natural habitat (e.g., forest) use from decisions about agricultural investment. It should be expected that, given a set of initial conditions land, labor, capital, and technology, landholders simultaneously allocate multiple resources to maximize production and minimize risk. For a landholder, the opportunity cost of a habitat fragment in his or her land may be positive, but if a payment is sufficiently high, farmers may be willing to accept it to dump other activities with lower or equal value, even before they consider natural habitats. In fact, the opportunity cost of a habitat may be so low that landholders may leave a habitat untouched even without a payment incentive. As long as a payment is equal or greater to any land use alternative, landholders are likely to accept it, freeing the resources that are tied into that activity (e.g., labor), and allocating them to the next best alternative. In this case, PES may be subsidizing the productive activities of land holders and not his/her conservation activities. This issue is especially problematic because currently most PES programs, including in Costa Rica, select landholders on a first come first served basis, as well as on the lobbying power of interested NGOs and landowners (Barton et al., 2004). This approach may lead to an over subscription to the program or the unintended inclusion of owners seeking to dump other activities with a value lower than the payment and the exclusion of critical habitats.

There is also the difficulty of adapting payments to the spatial variability of both the value of the service and the risk of service loss. Some habitats are more valuable than others because the benefit that users obtain from the services they generate is greater and some are more valuable because the risk of losing them locally, regionally, or globally is higher, or both. This variability of the value of the conservation of habitats at regional and global scales points to the need to frame the analysis of PES efficiency as a multi scale issue. To determine additionality, researchers must first establish baseline scenarios and understand how other factors affect habitat cover change in an area and its relation to the overall (e.g., regional) conservation priorities. These scenarios, broadly described, are the collective set of economic, financial, regulatory, and political circumstances within which land use decisions operate (Moura Costa et al., 2000) and the relative global and regional risk of biodiversity and ecological service loss. A PES program may be successful at a local scale but inefficient at a regional or even global scale (but it cannot be regionally efficient if it is not locally successful). This would occur if local conservation takes place at the expense of the conservation of more critical habitats, and their services, in other areas. This, of course, does not take into account the existence and evolutionary value of biodiversity. Current experiments do not address these issues yet. Ultimately, the efficiency of PES rests on the additional contribution to conservation they provide (Shrestha and Timilsnia, 2002).

3. PES in Costa Rica

The addition of conservation payments to the conservation arsenal has been warmly received in Costa Rica, as evidenced by the fact that the country's PES program has attracted five times more applicants than it can pay for (Pagiola, 2002). Government and civil society also see them as a way to meet the country's objective of protecting biodiversity. Costa Rica's first effort to use economic instruments dates back to 1979, when the first Forestry Law established tax based incentives. These had limited effect since few landholders had land titles and thus paid property taxes. Subsequent laws were intended to increase accessibility of small rural landholders. In 1986, the *Certificados de Abonos Forestales* (CAF) provided tax exemptions during the first five years of reforestation up to the amount of the total costs. However, CAF did little to prevent logging of primary forest or as effective stimulants for reforestation (Ortiz, 2004). This program also created distortions that favored plantation forests over natural forest, which usually provide greater service value, and was finally cancelled in 1995 (World Bank, 2000; Rojas and Aylward, 2003).

In 1996, Forestry Law 7575 introduced the current PES system. By this time, Costa Rica already had in place an elaborate system of payments for reforestation and forest management and the institutions to manage it (Rojas and Aylward, 2003). The law provides the legal and regulatory basis to contract with land owners for the environmental services provided by their lands, empowers the National Forestry Financing Fund (FONAFIFO) to issue such contracts, and establishes a financing mechanism for this purpose. The four environmental services recognized by the new forest law include: 1) mitigation of green house gas emissions; 2) hydrological services, including provision of water for human consumption, irrigation, and energy production; 3) biodiversity conservation; and 4) provision of scenic beauty for recreation and ecotourism. PES are expected to provide these services by protecting primary forest, allowing secondary forest to flourish, and expanding forest cover though planta tions. These goals are met through site specific contracts with individual small and medium sized farmers. In all cases, participants must present a sustainable forest management plan certified by a licensed forester, as well as carry out conservation or sustainable forest management activities. Different compensation amounts and contract durations are provided for 1) forest protection (5 year duration and $210 per hectare dispersed over 5 years), 2) sustainable forest manage ment (15 year duration and $327 per hectare dispersed over five years), and 3) reforestation activities (15 to 20 year duration and $537 per hectare dispersed over five years). Differences reflect the relative cost associated with each activity. Forest protection receives the lowest payment because there is relatively little overhead. Sustainable forest management receives more to cover the cost of designing and implementing a sustainable harvest. Reforestation receives the highest compensation in order to cover the high cost of planting and maintaining tree plantations. The $42/ha per year paid for forest protection reflects the loss of revenue that landholders would earn if their forest were converted to pastures or other land uses (Ortiz et al., 2003). Between 1997 and 2003 more than 375,000 ha had been included in almost 5500 PES contracts with a total cost of $96.2 million. Almost 87% of this area was under forest protection contracts (Ortiz, 2004).

One of the main initial concerns was how to fund Costa Rica's PES program. In 1997, the Kyoto Protocol's concept of Joint Implementation (JI) offered an opportunity to overcome this barrier. JI is a mechanism whereby a donor country contributes to the implementation of pollution abatement measures in a host country in return for credits to meet its own pollution abatement obligations. While it was initially severely criticized by nearly all developing countries (Grubb, 1999), Costa Rica supported it and immediately set up the Costa Rican Office on Joint Implementation (Oficina Costarri cense de Implementación Conjunta or OCIC) to attract funding (Rojas and Aylward, 2003). Expectations that Costa Rica's experiment with PES would attract large amounts of outside financial support were high from the start. The Costa Rican legislature authorized the Ministry of the Environment to find international partners for the PES program so that the cost of producing environmental services like CO_2 reduction could be shared with the international community. By 2003, the program was primarily financed by fuel taxes (Ortiz et al., 2003). However, a World Bank loan and a GEF grant were needed to meet expected PES shortfalls until the year 2005 (Rojas and Aylward, 2003). Fortunately for advocates of PES programs, opportunities for international cooperation appear to be increasing.

4. Data

Farm level payment and land cover data for this study was pooled from four sources: 1) a list of PES beneficiaries from the Fondo Nacional de Financiamiento Forestal (FONAFIFO), 2) archival research in the offices of the Ministry of the Environment and Energy in Puerto Jimenez, 3) a recent land tenure, land use study by Centro de Derecho Ambiental y de Recursos Naturales (CEDARENA), and 4) personal interviews conducted by the second author on the Osa Peninsula during July and August, 2003. Additional information for model implementation was obtained from official cartographic data for farms, infrastructure, rivers, and terrain.

The initial database included 61 farms receiving PES for forest protection and 585 non PES farms. Other type of PES contracts were not included in this analysis. Both PES and Non PES farms were georeferenced and digitized by CEDAR ENA and FONAFIFO. All the farms below 30 and above 350 ha were eliminated from both samples. The lower threshold is the minimum size that was considered consistent with the level of cartographic detail used in this study to generate spatial data for model implementation. The upper threshold corresponds roughly to the largest area that could be placed under PES contract in any given farm.[1] Thirty PES farms met this criteria. This is equivalent to approximately 1 of every 6 PES farms in the Osa Peninsula.[2] Thirty non PES farms were selected randomly from the non PES set that met the same criteria for comparison (Fig. 1).

Farm level land cover characteristics, measured as percent of a farm's area, were extracted from field surveys for the following classes: 1) agriculture, 2) charral, 3) intervened forest, and 4) primary forest (Fig. 2). Each class represents distinctive land use conditions recognized by local forest engineers and landholders. The agriculture class includes pasture, agricultural fields, fruit orchards, and African palm plantations. Charral corresponds to abandoned or fallow agricultural areas for 2 7 years that are in the process of early secondary succession. Charral areas have dense undergrowth and occasional emergent trees, but are still lacking substantial qualities to be considered secondary forest. Intervened forests have observable signs of human intervention. These were usually managed for timber extraction in the past one to two decades or are the result of late secondary succession where pastures and agricultural fields have been abandoned for over a decade. Primary forests are closed canopy forest with relatively little human intervention.

5. Group comparison and model specification

Land use decisions of landholders of PES and non PES farms were assessed based on the land cover characteristics of each farm for each of the four land cover types described above. Their land cover characteristics were compared using analysis of variance (ANOVA) for the total sample and subsets of PES farms based on the length of time that the contracts had been in place.

The role of PES, relative to other factors, was examined through an set of OLS regression models that explain variations in land cover as a function of PES incentives and proxy measures for regional and local costs of agricultural production. The general model is specified as:

$$\text{LndCov} \quad \alpha + \alpha_1 \text{TransportCost} + \alpha_2 \text{ConvertCost} + \alpha_3 \text{PES} \qquad (1)$$

where LndCov is the land cover characteristic for each farm. LndCov is measured as the percent of each farm under each land cover class, plus total forest (intervened plus primary forest) and total agriculture (charral plus agriculture). TransportCost is an estimate of the relative transportation costs from each farm to the main regional transportation hub. It is used here as a proxy measure of the attractiveness of transforming a forest area into other land uses. ConverCost is a relative measure of each farm's terrain characteristics. It used here as a proxy measure of the attractiveness of transforming a forest area into other land uses based on the cost of converting forest cover to agricultural land covers. PES is a dummy variable for the presence of payments in a farm.

Relative regional transportation costs were calculated for each farm from its centroid to the point where the peninsula's main road joins the mainland highway. A travel time map was created using a weighted or cost distance procedure taking into consideration the type of roads and slope in the Osa Peninsula. Each road type and the area outside roads was assigned a relative time cost index based on an expected average travel speed. In addition, travel outside of roads was penalized based on the slope of terrain. The log of the raw travel time value from each farm was used in the model. Lower weighted distances, such as those of farms close to the hub or to roads, result in lower transportation costs and greater incentives for agricultural land uses. This approach is consistent with multiple studies showing that transportation constraints are among the most significant and reliable factors related to forest conversion to agricultural land (e.g., Sader and Joyce, 1998; Angelsen and Kaimowitz, 1999; Pfaff, 1999). Conversion costs are a relative measure of on site production costs in each farm, i.e., the accessibility to forest resources for logging or the costs and expected benefits of transforming forest areas to agriculture, independent of a farm's distance to roads and markets. These were estimated as the average slope of each farm (in percentages). Slope was derived from a 50 m digital contour data from the GEF INBio Ecomap project (Kappelle et al., 2003).

6. The land cover outcomes of PES in the Osa Peninsula, Costa Rica

Table 1 shows the land cover characteristics of each study group, the length and proportional coverage of PES in farms receiving payments, and the results of the ANOVA analysis. The typical (i.e., Non PES) landholder in the Osa Peninsula leaves a large fraction of the land under forest cover (75%). Approximately two thirds of this area is primary forest. The remaining third are intervened forests. The typical farmer also allocates almost 10 times more land to active agriculture than to temporary or permanent fallow, or charral.

The overall expectation of the way PES work for conservation in a typical farm is illustrated in Fig. 3. The initial pressure on forest resources in the region is expected to result in changes in forest cover in a typical farm equal to vector *ab*; at a rate equal to its slope, which is equal to the sum of the rate of deforestation plus the rate of logging in the region. According to Sanchez et al. (2002b) forest area in the Osa Peninsula declined from 977 to 896 km^2 between 1977 and 1997, when the PES program began. This is equivalent to an annual deforestation rate of 0.4%. With PES, forest area in some farms should stabilize, as in vector *bc*, but is expected to continue to decline in farms without payments, shown by vector *bd*, with the difference in forest cover conditions increasing with time.

[1] Contracts for areas greater than 300 ha are possible when made with groups of farmers or with indigenous communities. Only 3.4% of the total area under PES were under these contract types in 2001 (Ortiz et al., 2003).

[2] There were approximately 180 farms in the Osa Peninsula in 2003. The last precise count is from 2001, when 170 farms had received PES (Ortiz et al., 2003). Based on the trends of the previous years, we expect that no more than 10 new farms were added to the group between 2002 and 2003.

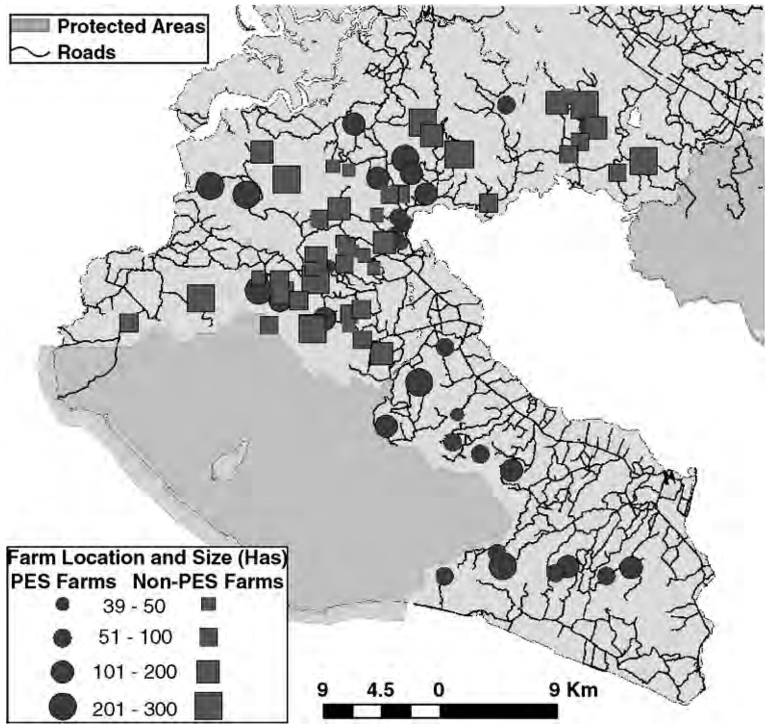

Fig. 1 – Study area map. Location and relative size of PES and Non-PES farms is shown.

Indeed, the underlying rational of and the justification for PES is that a payment is needed to avoid *bd*. This is achieved by compensating landowners for the loss of income resulting from forest conservation. In the long run, the expected result of PES would be a gain of forest cover equivalent to *n*. This is the additional impact of PES. In theory, landowners should accept payments that are equivalent to the marginal return of the forest being put under contract. The fact that not all forests are placed under contract suggest that some forest areas may have a greater marginal return that the payment option.

The comparison between forest cover conditions in PES and Non PES farms, however, highlights important incon sistencies with this model. Forest cover conditions in the two groups are statistically similar whether the comparison is made for primary, intervened, or total forests (Table 1). Indeed, while under the initial set of assumptions it cannot be expected that, or tested if, forest cover increased in PES farms in the maximum of six years the contracts had been in effect, it should be expected that a noticeable area of forest should have been cleared or logged in Non PES farms in that period. Using the deforestation rates reported by Sanchez et al. (2002a) in six years, forest cover in non PES farms should have declined by an average of 2.5%. This assumption was tested by comparing forest cover conditions in farms where conserva tion contracts have been active for the longest time (5 years or more, *N* 12) with farms without contracts (Table 1). The statistical similarity in forest cover conditions between these two groups leads to the preliminary conclusion that there was no difference in the way land owners decided to allocate land to forest and non forest cover types at the time the contracts began. This assumption is supported by two land cover studies in the Osa Peninsula. Rosero et al. (2002) show that between 1980 and 1995, before the implementation of the PES program, pasture and agricultural lands were already being abandoned and were returning to forest cover. Sanchez et al. (2003) found that no deforestation occurred between 1986 and 1997 in buffer areas of two protected areas in the same area.

There is, however, an alternative scenario that would explain these similarities. If the initial marginal value of converting one additional hectare of forests to agricultural land cover in current PES farms was higher than in Non PES farms, the pressure to convert them to agriculture or log them would also be higher and their forest cover proportionally lower than in Non PES farms at the beginning of contracts. This is illustrated by the steeper vector *ae* for PES farms relative to the vector *ab* for Non PES farms before contract. After contract, forest cover in PES farms stabilizes (i.e., vector *ed*) while forest cover in farms without conservation incen tives continue to drop (i.e., vector *bd*) approximating forest cover conditions in PES farms, in this case at the time of our observations. This assumption was tested by comparing forest cover conditions in farms where conservation contracts have been active for a short time (2 years, *N* 12) with farms without contracts. In these farms, the difference in forest cover would be expected to be the greatest (difference *m* in Fig. 3). Table 1 shows the results of the ANOVA analysis for these two groups of farms. The statistical similarity also supports the preliminary conclusion that there was no difference in the pressure to convert forest in these two groups before contracts.

In contrast, Non PES farmers allocate significantly more land to active agriculture than PES farmers, a proportion of almost 3 to 1, and even less land to charral, a proportion of more than 1 to 4. This suggest that in Non PES farms

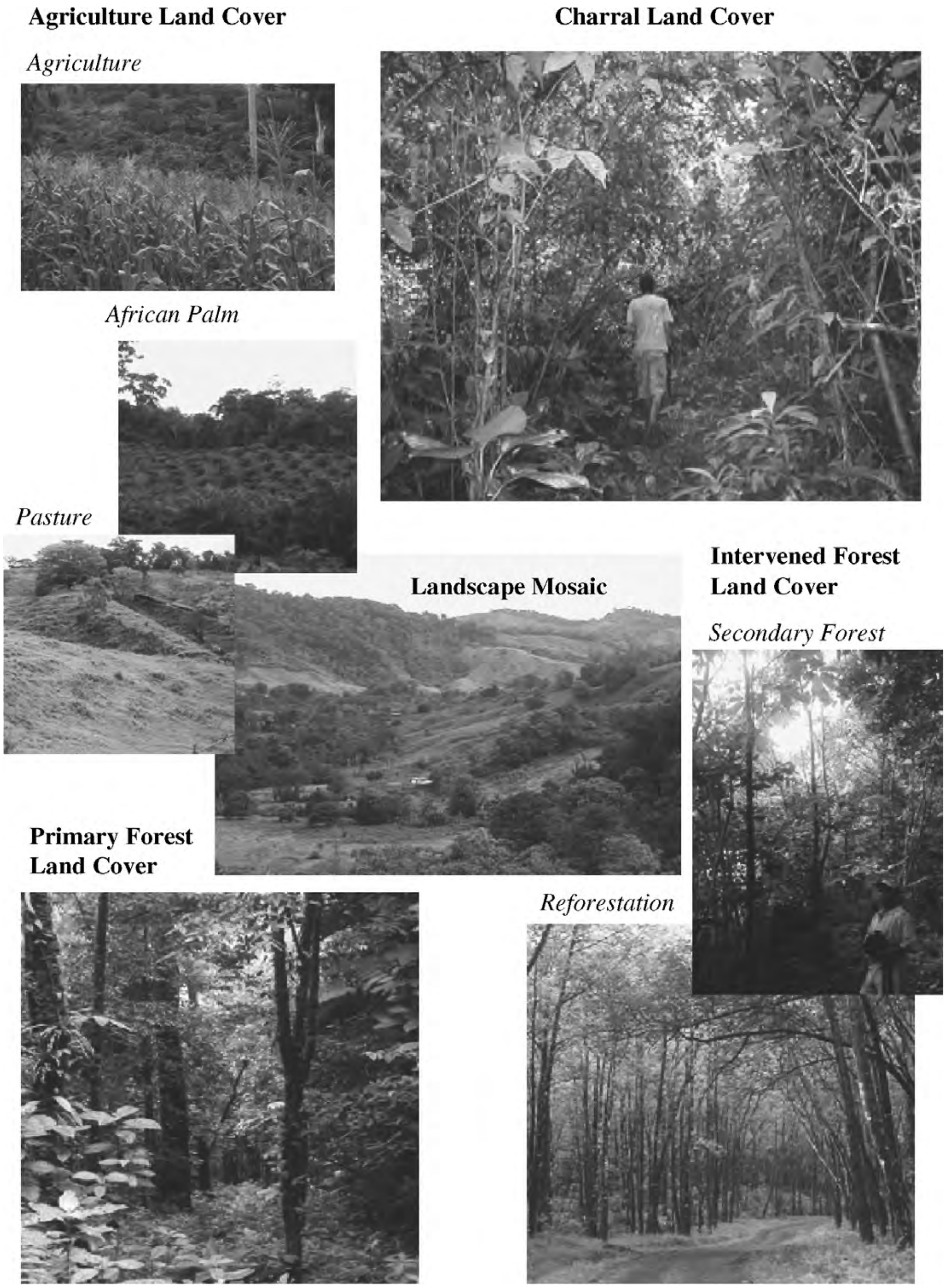

Fig. 2 – Illustration of land cover types used in this study.

agriculture is significantly more attractive than in PES farms. This distinction is statistically significant whether the com parison is made with the proportional area dedicated to each agricultural land use or with the proportion of active to inactive agricultural land, or charral. In fact, the great majority (25 out of 30) of Non PES farms have very small or no charral cover, a condition that probably reflects pre contract trends in current PES farms. This assumption is supported by the dissimilarity of charral cover in PES farms with recent contracts (2 years) and Non PES farms. However, the relative value of agricultural land changes with the availability of capital from conservation payments. Payments allow land holders to accelerate their exit of agriculture as suggested by the significantly lower proportion of agricultural land in older PES farms relative to Non PES farms. Indeed, as illustrated in Fig. 4, the time a farm has been under a conservation contract seems to play an important role in defining how much land is dedicated to agriculture. The longer the payments have been

Table 1 – Land cover characteristics of PES and Non-PES farms and results of group comparison (ANOVA)

Land cover	Typical (Non PES) farms					PES farms					ANOVA significance		
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD	Total sample	PES years 2	PES years >5
Size (ha)	30	44.0	282.0	117.0	77.3	30	39.0	339.0	127.3	71.4			
Years under PSA	30	0.0	0.0	0.0	0.0	30	2.0	6.0	3.9	1.6	na	na	na
% of farm under PSA	30	0.0	0.0	0.0	0.0	30	46.0	100.0	84.1	0.2	na	na	na
% under primary forest	30	0.0	100.0	56.0	31.9	30	0.0	100.0	51.2	35.3			
% under intervened forest	30	0.0	100.0	19.1	30.4	30	0.0	100.0	29.8	30.9			
% under forest (Int+Pri)	30	16.7	100.0	75.1	22.4	30	28.6	100.0	81.0	18.1			
% under agriculture	30	0.0	83.3	22.6	22.3	30	0.0	53.6	7.8	12.7	***		***
% under charral	30	0.0	22.2	2.5	5.3	30	0.0	71.4	11.2	15.9	***	**	***
% transformed (Ag+Ch)	30	0.0	83.3	25.1	22.7	30	0.0	71.4	19.0	18.0			
Ratio: primary to intervened forest	30	0.0	100.0	10.5	29.4	30	0.0	100.0	18.7	34.9			
Ratio: total forest to total agricultural	30	0.2	100.0	21.1	36.6	30	0.4	100.0	22.4	36.2			
Ratio: agricultural to charral	30	0.4	84.3	18.1	22.7	30	0.0	54.6	4.4	11.3	**		**

Key: significance: na = not applicable; = not significant; * = 0.1; ** = 0.05; *** = 0.01.

in effect, the less agriculture a farm has. By the fifth year, almost all farmers receiving PES have abandoned agriculture altogether. The fact that the variability in the degree of abandonment is greater early into the contract suggest that this "push to exit agriculture" is an ongoing process, happening whether farmers were actively working in agriculture or marginally dedicated to agriculture. Payments facilitate and maybe are critical for bolstering the abandonment process. On the other hand, we cannot say that PES is preselected by those with lower agricultural share. In fact, our analysis of variance suggest that there is no difference between these groups in terms of agricultural area when the begin PES (See Table 1). Furthermore, by pulling both the charral and agricultural conditions together it is possible to propose the possibility that PES farms were more agricultural than Non PES farms before PES began. This would mean that these farms are farther along in the abandonment process, since they have more "charral" (fallow) and the same amount of agricultural land.

These findings, in turn, suggest that there are other factors that should explain the variation of forest and agricultural cover in both groups. These relationships are explored by Model 1 (Table 2). As expected from the previous discussion, models 1a and 1b show that PES do not affect landholder's decisions about how much primary or intervened forest cover is left in a farm. These models also show that local conversion costs or regional transportation costs do not affect the decision to leave a forest area intact or to log it for the individual types of forest but do affect total forest area. There are other factors, not included in the model, which explain the variation in the decision to log or not to log a forest. This condition and the significance of these factors as explanatory variables for the decision about allocation of land to agricultural uses (model 1f) suggests that landholders make land use decisions based primarily on the marginal value of agriculture, which is strongly but inversely affected by both types of costs. Farmers with greater transportation costs have less incentives to clear forest for agriculture; but they may or may not extract timber form the remaining forest. Other studies support these propositions. In the study area, for example, Rosero et

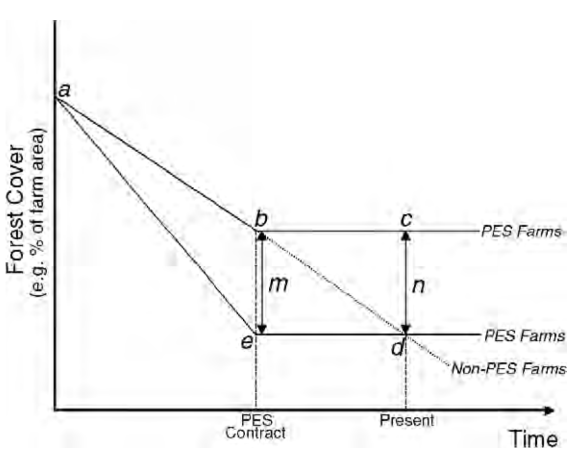

Fig. 3 – Model schematic of the impact of PES on forest land cover.

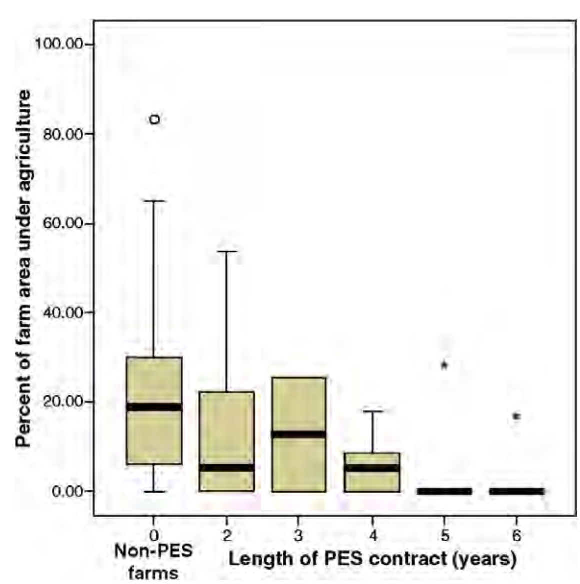

Fig. 4 – Effect of the length (in years) of PES contracts on agricultural land cover.

Table 2 – Results of Model 1

Model 1	A			B			C			D			E			F		
	Primary forest			Intervened forest			Total forest (Pri+Int)			Charral			Agriculture			Total transformed (Ag+Ch)		
Factors	*B*	*t*	Sig.	*B*	*t*	Sig.	*B*	*t*	Sig.	*B*	*t*	Sig.	*B*	*t*	Sig.	*B*	*t*	Sig.
(Constant)		1.42	0.16		0.64	0.53		1.37	0.18		0.56	0.58		3.62	0.00		2.78	0.01
Conversion costs (ConverCosts)	0.28	1.94	0.06	0.07	0.47	0.64	0.35	2.57	0.01	0.17	1.18	0.24	0.25	1.98	0.05	0.28	2.18	0.03
Transportation costs (TransportCosts)	0.23	1.68	0.10	0.06	0.43	0.67	0.28	2.18	0.03	0.10	0.68	0.50	0.36	3.02	0.00	0.34	2.50	0.02
PES	0.25	1.88	0.07	0.22	1.55	0.13	0.08	0.61	0.55	0.39	2.88	0.01	0.18	1.53	0.13	0.07	0.55	0.58

al. (2002) show the role of transportation costs in the decision to clear a forest plot. They demonstrated that the probability of forest clearing decreases from 30% for forests located less than 1 km from a road to 9% for land located between 5 9 km. Empirical work by Kinnaird et al. (2003) in Sumatra illustrate the local interactions. They showed that forests on flat slopes disappeared 16 times faster than forest on steep slopes. Timber harvest in areas with steep slopes can be especially problematic due to the legal hurdles, added time, and heavier equipment needed to cut and extract trees making it an expensive proposition and relatively less profitable endeavor.

As expected, the role of PES relative to other factors on land cover characteristics is more evident in the area under charral (Model 1d). This supports the conclusion of the importance of the payments for farmers seeking to abandon agriculture to engage in more desirable productive activities. In our con versations with land owners, nearly all of them said to be developing alternative income generating activities that could sustain them even beyond the term of their contracts. In some cases these were said to be financed by the PES, but our findings suggest that it is a common process. A more commonly stated objective was to move to the region's towns and engage in "urban" work, such as driving taxis, retailing, or in tourism. A few landowners said that they used the payments to expand or improve agricultural activities (e.g., buy cattle) but since our analysis suggests that agriculture is abandoned in PES farms, it could be assumed that much of this investment takes place in other, possibly Non PES, farms. Indeed, some landholders in this study reported moving their cattle to better drained, more fertile soils in the flatter regions of the peninsula.

7. Final comments: conservation and policy implications

Despite the small sample size, this study strongly points to a critical land use mechanism arising from the application of PES in the Osa Peninsula and offers important insights for policy design. PES are a potentially efficient mechanism to achieve the conservation of forest habitats and the services they provide as they do affect land use decisions: agricultural land is abandoned by landholders who use the payments as capital to engage in other (often urban) productive activities and forest cover is maintained or let increase. However, because the existing forest area would not have changed without the payments, any additional gain would be from the new forest growing in previous agricultural and charral areas.

These findings suggest that there are three conditions that determine the level efficiency of PES:

1) whether forest cover would be lower without the payments,
2) whether any additional gain in forest cover is temporary or permanent, and
3) whether the protection of some forest habitats in a farm creates pressure in other habitats, maybe biologically and economically more important, in the same farm or elsewhere.

Our findings suggest that PES in the Osa Peninsula may be inefficient on the account of factors 1 and 2, but possibly not on 3. The fact that there seems to be generalized tendency to abandon agriculture in the Osa Peninsula suggests that a similar land cover outcome could probably be achieved in the medium to long run without payments. Farms farther away from markets and with higher costs due to local conditions would show the greatest gains. Furthermore, because con servation contracts do not apply to forest cover gained, there is no long term guarantee that it would be permanent. Because the costs of recovering an agricultural area that has been abandoned increases with time there is pressure on the part of the farmer to keep fallows as short as possible. For example, once the trunks of emergent trees in a secondary forest area reach 10 cm in diameter, it is not only more expensive to be cut but it is also protected by law. A recent report (SINAC, 2002) revealed that landholders regularly cut back fallow areas in order to maintain them as pasture.

Even if the new forest cover was permanent, the marginal gain of every hectare of forest created by PES would have to be compared with the value in services that could be potentially obtained if invested in another critical area, both in the same region or elsewhere. This is particularly important in those cases in which the local benefits will be accrued with a significant lag. In this case, the gain may be less than the marginal loss of not protecting existing habitats somewhere else because the restoration of tropical humid forests may take several decades.

Notwithstanding this long term concern, this study points to the potential value of committing conservation resources to degraded areas, and the apparent capability of PES to affect these results. Currently, most PES programs cannot be applied to non forest lands. Standards set by a recent GEF grant and World Bank loan to Costa Rica, for example, require that these funds exclusively target areas that are already under second ary or primary forest, but not agricultural or pasture fields. This policy shift is attributable to the general understanding among foresters that forest regeneration is not important to forest management objectives and the recognition that priorities should be set. However, while this approach may ensure that available funding targets forested areas, more efficient opportunities for forest re conversion may be missed in areas where forest cover is relatively stable but insufficient. The restoration of forest ecosystems could play a critical role in planning and programs of government agencies and non governmental organizations. This would also help to counter act the declining opportunities for conservation of natural areas (Meffe and Carroll, 1997). Indeed, outside of the PES debate, restoration is slowly, but surely making its way into mainstream conservation discourse.

Finally, the implication of the third condition stated above is that in the short term effectiveness of PES is directly related to the targeting of high risk habitats. This speaks to the financial and environmental cost efficiency of PES programs and the importance of using spatial prioritization mechan isms based on land cover change risk assessments. An opportunistic approach in PES contracts does not distinguish between landholders who want payments and those that need them. In the specific case of forest habitats in the Osa Peninsula, the regional targeting system which FONAFIFO currently uses enables PES managers to select farms that are important to regional conservation objectives. However, by awarding PES to protect forest based on a “first come first serve”, the current selection does not counter the immediate threats that are driven by underlying land use change processes. Indeed, anecdotal information collected during this study suggests that the farmers who came first to request PES coverage were those who were more familiar with the forest engineers in charge of promoting the program and with forestry related subsidies and other options. Techniques currently used to prioritize conservation decisions could easily be assembled to assist PES administrators with the task of setting socially acceptable and privately optimal prices according to spatial and land feature characteristics. Studies in Costa Rica, Peru, and Ecuador show the effectiveness of these approaches to measure the relative conservation risk of various habitats and regions (e.g., Barton et al., 2004; Rodriguez and Young, 2000; Sierra et al., 2002, respectively). Programs should focus on habitats that are at greatest risk. In the case of Costa Rica, the fact that demand (farmers seeking PES compensation) far outweighs supply (FONAFIFO funding to compensate landholders) suggests that many landholders receiving payments would still conserve their forest even if lower compensation amounts were offered. Rojas and Ayl ward (2003) suggest considering auctions for PES. By auction ing to the lowest bidder, a higher area could be conserved. However, if farms were selected based on the lowest bid, then they may still not target priority areas based on risk, where higher prices might be required to lure land holders away from forest conversion and extraction activities. The main point of their argument, however, is not lost. The system could allow for a variable price or, possibly the unbundling of compensa tion payments to more accurately reflect an equilibrium between the value of protecting the pubic good and the reward necessary to compensate land users for lost revenue. Variable pricing mechanisms could be made more plausible by employing spatial modeling, economic indicators and ecolo gical priorization to optimize the prices of PES contract offerings. The optimal price for PES should just meet the optimal expectation of the buyers and sellers of environmen tal services but should also reflect the environmental or conservation risk of a given habitat.

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