

Combining Qualitative and Quantitative Methods to Evaluate Participation in Costa Rica's Program of Payments for Environmental Services

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The Costa Rican Program of Payments for Environmental Services provides financial compensation to forest owners for the environmental services generated by their forests. This program offers a unique opportunity to evaluate the impacts of direct incentive payments on conservation. In order to measure the causal effect of this program on outcomes of interest, it is fundamental to understand the factors that influence enrollment in the program. Economic theory suggests that opportunity costs are key, but many factors may determine and mediate the influence of these costs. This article reports findings from an integrated qualitative and quantitative approach to this question. Within an iterative field research framework, information was gathered through (a) semistructured interviews with government officials and forestry professionals, (b) case studies of participant and nonparticipant forest landowners based on in-depth interviews, field visits, and a review of records, and (c) a quantitative survey of participant and nonparticipant landowners. The semistructured interviews and case studies provide important insights that can be incorporated into the quantitative analysis, specifically by identifying potential determinants

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of program participation and land use change. Hypotheses about the relationship between program participation and the opportunity costs of participation are confirmed using both approaches.

KEYWORDS *Costa Rica, iterative field research, participatory econometrics, payments for environmental services, program evaluation*

INTRODUCTION

Environmental Services and Deforestation

Forests provide multiple services, including conservation of biological diversity, soil and water; supply of wood and nonwood products; provision of recreation opportunities; and storage and sequestration of carbon. Deforestation and forest degradation can irreversibly and substantively impair the ecosystem functions of forests. Examples from situations where this natural degradation has occurred raises the question of why society and governments would allow rapid or excessive deforestation (Pattanayak & Butry, 2005). In fact, deforestation, mainly conversion of forests to agricultural land, continues at an alarmingly high rate—about 13 million hectares per year (Food and Agriculture Organization [FAO], 2005) despite billions of dollars having been invested in conservation worldwide (James, Gaston, & Balmford, 2001; Hardner & Rice, 2002).

Economists contend that unreliable information regarding the value of services from these ecosystems is one reason for their loss (Pattanayak, 2004). In general, the provision of ecosystem services will be suboptimal because ecosystem services are public goods, ecosystem management involves externalities, and ecosystems are often the only capital of the poor who have no money or political voice (Pattanayak & Wendland, 2007).

Payments for Environmental Services

As wilderness and natural habitats shrink, environmental services provided (Wunder, 2005) by intact ecosystems are becoming increasingly threatened. This emerging scarcity makes them potentially subject to trade using Payment for Environmental Services (PES). In this article, we describe the first nationwide and long-term program of payments for environmental services from tropical forests and describe the factors that drive landowner participation in this program, based on our integrated qualitative and quantitative field research in Costa Rica. Specifically, we describe the main driving forces of enrollment in the Costa Rican PES program using an iterative qualitative approach. We consider case studies of landowners in the Sarapiquí Region of Costa Rica combined with semi-structured interviews of forest officials and local professionals in order to gain an understanding of the enrollment

process, program administration, and motivations for participation. This qualitative component was then combined with a quantitative survey that interviewed 50 program participants and 150 nonparticipants in the Sarapiquí Region.

Costa Rican Program of Payments for Environmental Services

Globally, the area of forest designated principally for the conservation of biological diversity has increased by an estimated 96 million hectares since 1990 and now accounts for 11% of the total world's forest area (FAO, 2005). These forests are mainly, but not exclusively, located inside protected areas.

Costa Rica shows the same positive trend in forested area devoted to biodiversity conservation. As shown in Table 1, the area designated for biodiversity conservation grew 66% between 1990 and 2005.

According to Table 1, 58% of the total forest area in 1990 was of multiple purposes compared with 74% for 2005. Much of these forests under "multiple use" in Costa Rica are privately owned. These lands have the potential to provide services such as biodiversity and watershed protection, landscape beauty, and carbon sequestration if they are managed accordingly. In recognition of the potential of private lands to provide environmental services, the Costa Rican government has implemented a system of payments for environmental services called "*Programa de Pagos por Servicios Ambientales*" which is a formal economic recognition of the owners of natural forests and plantations for the environmental services that their natural areas provide to society (Rodríguez, 2001).

In the 1970s and 1980s Costa Rica received negative environmental publicity for having one of the highest deforestation rates worldwide (Kleinn, Corrales, & Morales, 2002). In response, the forestry laws were revised

TABLE 1 Costa Rica: Designated Functions of Forest and Other Wooded Land

FRA 2005 Categories/ Designated Function	Area (1000 hectares)		
	Primary function		
	1990	2000	2005
Forest			
Production	–	3	3
Protection of soil and water	52	45	45
Conservation of biodiversity	328	582	586
Social services	–	–	–
Multiple purpose	1,476	1,746	1,757
No or unknown function	708	–	–
Total forest	2,564	2,376	2,391

Source. FAO, 2005.

through a long-term process that enabled the establishment of an institutional framework for forest policy with a solid legal, organizational, and social base (Miranda, Dieperink, & Glasbergen, 2006; Miranda, Porras, & Moreno, 2003). In 1997, Costa Rica launched a program of PES under which the government provides financial compensation to private forest landowners through multiyear renewable contracts paid via the *Fondo Nacional de Financiamiento Forestal* (FONAFIFO). According to FONAFIFO (2007), the most important feature of this program is that it has changed the traditional concept of a “subsidy” or “incentive” for the forestry sector, replacing it with the idea of “economic compensation” for the environmental services provided by forests; thereby recognizing their ecological, social, and economic value. Table 2 shows the amount of land and payments assigned to the different modalities of the Costa Rican PES program.

A recent evaluation of the Costa Rican PES program (Hartshorn, Ferraro, & Spergel, 2005) identified several important accomplishments including maintenance of privately owned forests in areas of conservation; facilitation of transfers of private funds to rural landowners who agree to protect their forests; encouragement of female landowner and indigenous community participation in conservation activities; direct payments to a relatively greater number of small rural landowners; and, most importantly, broad public recognition that intact forests and their environmental services have economic value.

Previous studies of the Costa Rican PES have focused on program impacts on specific program outcomes (e.g., poverty alleviation and avoided deforestation) with non-conclusive results. Studies have generally found that the land enrolled in the program has more forest cover than non-enrolled land (e.g., Ortiz, Sage, & Borge, 2003; Zbinden & Lee, 2005; Sierra & Russman, 2006); but these results are not conclusive, as they may be due to sample selection bias (Sills et al., 2006). Econometric tests of the extent to which the PES program has affected forest cover (e.g., Pfaff, Robalino, & Sánchez-Azofeifa, 2007; Sills et al., 2006; Tattenbach, Obando, & Rodríguez, 2006) have generated mixed results because these studies apply to different areas, different time periods, different dependent variables, and use different methodologies (Pagiola, 2006). Most other studies of the Costa Rican PES program have focused on the program’s impact on rural poverty (Miranda et al., 2003, 2006; Ortiz et al., 2003; Zbinden & Lee, 2005). To be able to estimate the causal effect of the Costa Rican PES program on land use or cover, we first need to understand how landowners come to participate in the program, so that we can control for differences between participants and nonparticipants (Sills et al., forthcoming).

In order to assess the program’s impact on some outcome of interest (e.g., forest cover), it is critical to understand landowner motivations for participating in the program, together with a detailed description of the enrollment process. In fact, the key elements that are critical to the success

TABLE 2 Distribution of Hectares and Payments Among Costa Rican PES Modalities Between 1997 and 2006.*

Year	Forest protection**		Forest management		Reforestation		Forest plantation		Total (ha)
	Hectares	Payment*** (Colones/ha)	Hectares	Payment (Colones/ha)	Hectares	Payment (Colones/ha)	Hectares	Payment (Colones/ha)	
1997	88,830	50,000	9,325	80,225	4,629	120,000	—	—	102,784
1998	47,804	60,000	7,620	94,000	4,173	154,000	319	60,000	59,916
1999	55,776	60,000	5,125	94,000	3,156	154,000	724	60,000	64,781
2000	26,583	66,000	—	—	2,457	169,000	—	—	29,040
2001	20,629	72,600	3,997	113,300	3,281	185,900	—	—	27,907
2002	21,819	79,160	1,999	123,540	1,086	202,700	—	—	24,904
2003	65,405	87,100	—	—	3,155	223,000	205	87,100	68,765
2004	71,081	95,800	—	—	1,557	245,000	—	—	72,638
2005	53,493	29,880	—	—	3,602	380,990	—	—	57,095
2006	19,972	31,840	—	—	4,866	405,960	—	—	24,838
Total	471,392	—	28,066	—	31,962	—	1,248	—	532,668

*PES modalities also include agroforestry systems (1,404,021 trees were planted between 1997 and 2006).

**PES forest protection contracts are signed for 5 years and may be renewed.

***1 U.S. Dollar = 538 Costa Rica Colones (May 30, 2007).

Source: FONAFIFO, 2007.

of incentive-based programs include ensuring effective demand and a thorough understanding of participants' motivations to enroll. Information with regards to these issues can help to ensure the future sustainability of the Costa Rican PES program.

METHODS

Integrating Qualitative and Quantitative Approaches in Program Evaluation

Development economics has a rich tradition of field research. Within this broad tradition, iterative field research methods—in which the collection of data through surveys is combined with detailed observation and conversation to elicit knowledge about an institution—is becoming more common (Udry, 2003). When the question of interest is clear (e.g., what are the driving forces in PES participation?), but the economic environment within which agents live is not well-documented, then iterative field research becomes particularly useful. In the context of program evaluation, qualitative evidence from case studies and interviews can draw out the social and institutional context within which the program operates. For our evaluation of the implementation of the Costa Rican PES program in the Sarapiquí region, we use qualitative evidence to develop a detailed understanding of the program (e.g., identifying main actors among government, private, and nonprofit sectors), and of how landowners perceive their benefits and costs from the program. This complements our quantitative regression analysis of the participation decision, which established broad patterns showing the factors that influence the enrollment decision. This mixed method approach generates a contextualized understanding of PES participation in Costa Rica.

Our approach parallels recent calls for participatory econometrics (Rao & Woolcock, 2003; Swann, 2006), in which the investigator returns to the field to clarify questions and resolve anomalies. Data collection is combined with detailed observation and conversation to elicit knowledge about participant motivations. By using visits to PES participants and non-PES participants, we also seek to clarify aspects of the quantitative data (e.g., motivation to participate) to better define the economic environment and to collect complementary data (e.g., data on land characteristics and georeferenced data of property boundaries). Collectively, these lead to better answers to a key research question: *What factors motivate participation in the PES program?*

As Rao and Ibáñez (2005) emphasize in their study of the social fund program in Jamaica, in-depth data on participation is traded off with the size and representativeness of the sample. Thus, our findings should not be read as a comprehensive evaluation of the Costa Rican PES program that can be applied to the rest of the country.

Case Studies

The main factors that might affect a household's decision to participate in a PES program are grouped into three factors: factors that affect eligibility to participate, factors that affect their desire to participate, and factors that affect their ability to participate (Pagiola, Arcenas, & Platais, 2005). In general, opportunity costs, household strategies, and current farming practices are likely to be fundamental determinants of whether an eligible participant in fact wants to participate. However, it is difficult to separate out a priori exactly what factors influence desire and ability. Within this context, the case study is an ideal methodology (Feagin et al., 1991 cited by Tellis, 1997).

Qualitative interviewing techniques such as the prototypical case-study approach draw on the results of small-sample surveys (Miranda et al., 2003, 2006; Ortiz et al., 2003) and explore key elements of program participation. In general, case studies are designed to bring out details from the viewpoint of the participants by using multiple sources of data (Tellis, 1997). Thomas (2004) suggests that there are three main purposes in conducting a case study: exploratory, explanatory, and theory-testing. Our case studies are exploratory. We use the exploratory case when we know little or nothing about the phenomenon of interest. The explanatory case produces grounded theory that can carry more conviction than a theory developed in the abstraction of what happens in the field. Finally, the theory-testing case is used to test a prior theory. In a situation where we have little understanding of the phenomenon of interest, the numbers of mechanisms for research are limited (Swann, 2006).

During the summer of 2005 and spring of 2007, a series of in-depth interviews were carried out in the northeast part of Costa Rica. Interviews and field observations were developed with participants and nonparticipants in the Costa Rican PES program with the main purpose of trying to understand the main motivations behind enrollment within the program. We also interviewed government officials, forest professionals, and local authorities; and carried out a review of documentation (e.g., titling documents and PES contracts), observation of properties, which included the collection of GPS points throughout property boundaries in order to follow recommendations from Yin (1994), Rao and Woolcock (2003), Udry (2003), and Berg (2004).

Within the recognized qualitative techniques that use interview methods, the key-informant interview, which is an extended one-on-one exchange with someone who is unique (e.g., PES participants and nonPES participants), was selected as the most appropriate approach for use in this study. Our participatory econometrics approach tackled a key hypothesis: *“only landowners whose opportunity cost of participation is low will enroll in the PES program.”*

The classical, or sequential, approach to participatory econometrics entails three key steps that were followed during the implementation of the case studies:

1. In-depth interviews to obtain a grounded understanding of factors that could help to explain PES participation/nonparticipation. These interviews focused on the process of PES program enrollment. Specifically topics of conversation included:

- reasons for personally not participating or why others are not participating, including the benefits and costs of participation in PES;
- beliefs about environmental issues and enforcement of environmental laws. Landowners were directly asked about engaging in activities like illegal logging to assess their perception of environmental and legal impacts of this kind of activities.
- determinants of current/past land use on the properties. For each property, we asked landowners to specify the primary and secondary land use and the factors influencing this selection into land uses (e.g., soil quality, slope, road access).
- understanding of program administration, including official and de facto guidelines for accepting/rejecting/waitlisting applications, canceling contracts, and renewing contracts;
- perceptions on program impacts related to quality rather than quantity of forest (e.g., is PES land exposed to less hunting, better protection from fire, less fuel wood extraction?).

The in-depth interviews also provided an opportunity to visit each property with the landowner or manager, see the forest area under the PES contract, and observe and discuss forest use and protection. Further, we obtained documentation for each case, including copies of the PES contract, cadastral maps, payments, and monitoring reports from FONAFIFO and the *Fundación para el Desarrollo de la Cordillera Volcánica Central* (FUNDECOR), which is a very active NGO that operates in the study region and that has helped landowners apply to the PES program.

2. Semistructured, in-depth interviews with forest officials and local professionals to enhance our understanding of the administration of the PES program. We focused on application procedures, applicant selection methods, rejection/waitlisting criteria, cancellation of contracts, and renewal process. Specifically, topics of conversation included in these interviews included:

- details of program administration, including official and de facto guidelines for rejecting/waitlisting applications, canceling contracts, and renewing contracts during 1997–1998 and currently;
- official perceptions of landowners' motivations to participate in the PES program;

- factors affecting land use on properties (e.g., soil quality, slope, titling, and road access);
 - suggestions for landowners to include in our case studies, including possible sampling frames of representative non-PES landowners.
3. Development of hypotheses about motivations to participate in the PES program, which can then be tested with quantitative (survey) data.

For the case studies, we sought a range of landowners representing various categories, including on-site and absentee landowners with PES contracts, and landowners who had never applied, been rejected, waitlisted, or not renewed PES contracts. FONAFIFO records generated a sampling frame of pending, canceled, rejected, and awarded PES contracts in 1997–1998 (renewed in 2001 or 2002). Candidates for our case studies were classified according to ownership type, hectares owned, biophysical characteristics, and location. FUNDECOR's personnel also helped identify representative or typical PES participants in the region. To find nonparticipants in the PES program, FONAFIFO's personnel, local forest officials, and local forest professionals were asked to nominate representative landowners who did not have PES contracts but would be willing to participate in the in-depth interviews. Thus, in general, we relied on local informants with good knowledge and contacts with forest landowners to find representative landowners for our case studies.

Caution is needed in interpreting the qualitative evidence because this data draws on interviews with a few landowners in the study region. Since these landowners were not selected on the basis of a probability sample, it is possible that their opinions are not representative. The qualitative evidence should be evaluated in conjunction with the quantitative analysis, which is based on a random sample of participants and non-participants, to get a comprehensive sense of the main determinants of program participation.

Landowner Survey

The ideal database for a rigorous empirical evaluation of PES would include observations on land use and characteristics of both participant and nonparticipant landowners and their properties, both before and after the program (Sills et al., 2006). In this case, where the main purpose is to identify driving forces that affect PES participation, a household survey is the most appropriate methodology given that landowners are the economic agents making decisions about participation, and thus are the most suitable unit of analysis.

In this study, PES participant and non-PES participant households were randomly selected from the cantons of Sarapiquí, Guacimo, and Pococí

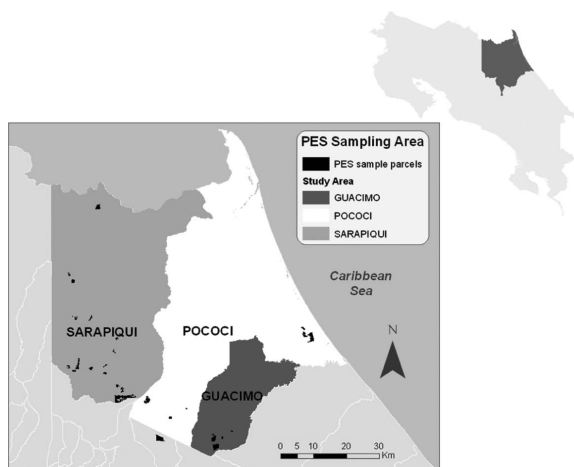


FIGURE 1 Study area of household survey.

Source: Sills et al., forthcoming.

(see Figure 1). This region was selected because it has a sufficient number of PES contracts (a total of 154 PES contracts assisted by FUNDECOR), and excellent records on PES participants maintained by FUNDECOR. The quantitative survey included 50 program participants and 150 nonparticipants. The survey elicited information on socio-economics and property characteristics (e.g., soil quality and slope), including land cover, in 1996 and 2005.

We decided to sample participant properties that had forest protection contracts facilitated by FUNDECOR because government records from the 1997 to 2000 period are difficult to access for this region, due in part to a flood that destroyed records held in the regional offices. We sampled only forest protection contracts that had been renewed and active in 2006. For the non-PES properties, our goal was to find a sampling frame that included properties similar to the PES sample. To the extent possible, we wanted to “pre-match” the sample, identifying non-PES properties similar to the PES properties. The selection procedure followed a combination of a geographic sampling rule to select 50 immediate neighbors (cf. Zbinden & Lee, 2005) and national land registry (*Catastro Nacional*) records for a sample of 100 landowners selected by district and by buffer zones around the PES properties in our sample. In all cases, interviewed landowners also had to have (a) owned or managed the property in the sampling frame since 1996; (b) at least some natural forest cover on that property in 1996; and (c) never held a PES forest protection contract. This sampling method was designed to pre-match landowners for characteristics that are spatially correlated, including biophysical factors and access to markets and public services, but to avoid spillover effects due to communication among neighbors or stricter enforcement of environmental laws near properties with PES contracts (see the appendix for a graphical representation of the buffer sampling).

UNDERSTANDING THE MOTIVATIONS TO PARTICIPATE IN THE COSTA RICAN PES PROGRAM

Determinants of Participation in the Costa Rican PES Program

In total, seven landowners were included in the in-depth interviews. Most of their properties are located in Sarapiquí, which is the biggest canton in Costa Rica. Although in subsequent years many more landowners applied to the program than could be accepted, in the initial years of 1997 and 1998, very few applications were rejected or waitlisted, and the record keeping on these contracts was poor. In those initial years of the program, it was also rare for private companies and corporations to apply for the program. Thus, no corporations and no waitlisted properties were included in the case studies. We could locate and interview only one landowner who had applied to and been rejected by the program; this property is located in the Central Canton.

Table 3 describes the case study of landowners. The average property sizes for participants and nonparticipants were 68.5 and 63.6 hectares, respectively. Using a Student *t* test and assuming equal variances between the groups, we found that these are not statistically different. Table 3 also shows the different types of participants found in the study area. Landowner decision to live on their properties depends on factors such as road access, off-farm job, and availability of family labor.

Direct observation of the farms indicates that land characteristics and land use differ between participants and nonparticipants, although both engage in some form of forest conservation regardless of their participation in the PES program. Table 3 shows a summary of the main land uses for every landowner included in this study. In general, forest conservation is the most common land use even within properties that are not enrolled in the PES program. Note, "forest conservation" does not necessarily imply specific conservation activities; instead, it can also suggest lack of any management or "unmanaged" lands.

The situation is more complex with regards to the main sources of income. In some cases the main sources of income have nothing to do with properties and come from jobs people have external to the farm (off-farm labor income). Table 3 summarizes the different sources of income for the case studies included in this study. As Table 3 indicates, in the case of the PES participant that lives on his property, PES payments represent a large proportion of the total source of income and in this situation the family does not receive any income not related to their property. For the case of the absentee PES participant, the main sources of income are not related to PES and part of the income comes from sources not related with the farm. This situation helps to explain why forest conservation (i.e., nonmanaged forested land) is present in almost all the case studies. Some landowners told us that they do not manage their forest simply because they do not

TABLE 3 Type of Landowners Included in Case Studies

Type of PES participant*	Property size (ha)	Location	Main land use	Others land uses	MainSource of income	Others sources of income
Participant landowner on-site	29	La Virgen District, Sarapiquí Canton	Forest conservation	Pepper crop	Pepper crop, PES payment	n/a
Participant absentee landowner	108	La Virgen District, Sarapiquí Canton	Cattle	Plantain crop, forest conservation	Cattle, off-farm job	PES payment
Nonparticipant absentee landowner	50	Horquetas District, Sarapiquí Canton	Forest conservation	n/a	Off-farm job	n/a
Nonparticipant absentee landowner	126	Horquetas District, Sarapiquí Canton	Forest conservation	Cattle	Off-farm job	n/a
Nonparticipant landowner on-site	20	La Virgen District, Sarapiquí Canton	Forest conservation	Vegetables and cattle	Off-farm job	n/a
Nonrenewed landowner on-site	29	La Virgen District, Sarapiquí Canton	Forest management, forest conservation	Cattle and pepper crop	Off-farm job	Pepper crop, land renting
Rejected absentee landowner	93	Vara Blanca District, Central Canton	Forest conservation	Abandoned prairies	Off-farm job	n/a

*Absentee landowner refers to people that own the property but do not live in their farms.

have time away from their off-farm jobs. Others expressed that they don't need income from their properties because their off-farm income is enough, and so they prefer to conserve their forest.

In general, off-farm labor income is the main source of income for non-participants: Interviewed landowners said that they work on other landowners' land or for the municipality in activities like road maintenance. In fact, only one of the non-PES participants mentioned receiving some income from his land. This was the case for the nonrenewed participant, who was a 5-year PES participant until 2002. He currently grows pepper and rents portions of his land. The forest that was protected by PES is currently unmanaged, suggesting that he stopped participating simply because he did not want to participate any more and not because he was planning to manage his forest.

People expressed different reasons for why they decided to participate or not throughout the in-depth interviews. The most frequent answers about reasons to participate include:

- lack of more profitable land use alternatives due to land characteristics (e.g., poor soil quality, high slope);
- legal restrictions to manage forest. The Costa Rican Forestry Law 7575 prohibits forest management (e.g., logging) on steep slopes or near water streams and land use changes (e.g., landowners that own a forest can't apply to the *Ministerio del Ambiente y Energía* (MINAE) for a change in land use to engage in another productive activity like agriculture or cattle ranching).
- depressed returns to cattle farming (reduced prices of export beef has influenced decisions to abandon cattle ranching activities to plant trees);
- program payment as an incentive (PES payment may represent an important source of income);
- simple application process (suggesting the impact of local NGO's through their assistance with the PES application process);
- human biology/productivity limits: at a certain age, the PES represents an attractive alternative because forest protection does not involve a high level of working in the field compared to agriculture or cattle ranching.

Reasons mentioned for not participating include:

- eligibility problems (e.g., disputes for legal property rights);
- costs outweigh the benefits (e.g., application and maintenance costs versus payments);
- private property rights (e.g., people think that participation implies impossibility to touch the forest which affects their property rights);
- insufficient payments;
- high cost associated with technical assistance.

Participation in the Costa Rican PES program requires the preparation of a forest management plan that must be signed by a forest engineer, who in turn must monitor and certify compliance with these plans. Forest engineers must also prepare annual reports that are submitted to FONAFIFO, which are essential for payments to be made to landowners. In 1997 and 1998, FONAFIFO allowed people to apply even if they did not have property title. In our case studies, the only rejected application was due to a legal fight with another person that was alleging land ownership and had nothing to do with lack of technical assistance to prepare the management plans.

In general, low payments and high maintenance costs are the main motives that make an eligible person decide not to participate. In our case, all the nonparticipants receive off-farm income, so they do not depend on income from the farm. For cases where people do not live on the farm, the opportunity cost of participation has a great influence since landowners believe that time is critical for applying and maintaining the forest according to the standards required by the PES program. Some of the interviewed people said that they rarely visit their properties due to lack of time.

In the case where people live on their farms but decide not to participate, motives are similar given that they have to spend most of the day outside of their property. In general, it seems that off-farm income is driving the decision to not participate in the program amongst the group of landowners included in our case studies.

For the case of people that decide to participate, a lack of profitable land use alternatives and program payments have the greatest influence in the decision. Landowners who live on-site and depend largely on farm income are more likely to participate because of cost reasons; that is, their costs of forest management are low because they are already managing their forests and can share some of the costs with other land-related activities, such as cattle farming, because of economies of scale.

The motives for participation by absentee landowners are more complex. Because they are often wealthy farmers and already involved in some forest maintenance and surveillance due to the existence of productive forest areas, the extra costs for participating in the program are minimal. Another important reason was the lack of a better alternative land use (in the case study included in our report, the contracted area was located in a sector of his property not suitable for an alternative land use) and this matches the case of participants that live on their farms.

Figure 2 shows the data gleaned from the in-depth interviews regarding decisions to participate in the Costa Rican PES program during 1997 and 1998.

Government officials can give a more general view of program enrollment process, and can also describe the de-facto program implementation in the study region. Interviews with forest officials and local forest professionals included three employees of MINAE, two employees of FONAFIFO,

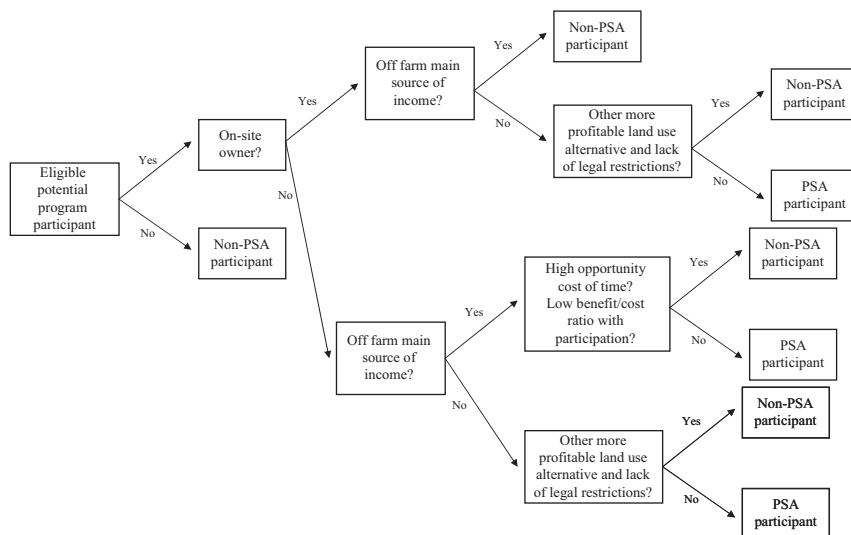


FIGURE 2 Decision tree involved in participation in the Costa Rican PES program.

and five employees from FUNDECOR. If we consider their opinions, many of the results derived from the in-depth conversations with landowners about motivations to participate are confirmed.

According to forest officials, before the initial notification of application acceptance during 1997 and 1998, negotiations between the *Sistema Nacional de Areas de Conservación* (SINAC) and FONAFIFO decided priority areas based on different criteria (e.g., being close to a particular protected area or to a biological corridor). After defining these priority areas, the first applications to be approved were inside these areas, and after exhausting applications inside priority areas, the approval process continued with the earliest applications submitted to FONAFIFO until they had exhausted the total area assigned to PES for that region in that year.

During 1997, all applications were accepted. In fact, in 1997 MINAE had to call for applications twice within the annual period as the first call did not generate sufficient applications to exhaust the area assigned for that year. In 1998, the number of applications increased and the selection of applicants was based on priorities defined by MINAE and SINAC and the timing of applications (priority areas and then early applications were given the highest preference for acceptance; see appendix with a graphical representation of the PES application process followed during 1997 and 1998).

Because land title was not a factor for eligibility in 1997 and 1998, the main reasons for rejecting applications had to do with priority areas defined by MINAE to be included into the program and legal conflicts between landowners (e.g., disputes for land possession). Furthermore, initially MINAE was not directly involved in any kind of program promotion and so

the early applications came from people already involved in some way with MINAE (e.g., landowners with forest management plans approved by MINAE) or applications assisted by NGOs (e.g., FUNDECOR). Some promotion external to MINAE did exist during these years as a result of the creation of the *Oficina Costarricense de Implementación Conjunta* (OCIC). OCIC was created as a cooperative effort between the government (MINAE, as the rector entity), a private organization specialized in the attraction of foreign investment CINDE (Costa Rican Trade and Development Board), and two nongovernmental organizations—FUNDECOR (forest management) and ACOPE (electricity production). OCIC's goal was to develop the legal and administrative framework to consolidate the national "Forest Environmental Services Payment" (FESP) program, which is separate from PES.

To sum, the forest professionals and government officials believe that the following factors explain why some landowners are more likely to participate in the program:

- no alternative land use due to topography or poor soil quality. In some cases, PES became the only feasible and legal alternative (e.g., given legal restrictions to land use changes).
- land ownership (owners without legal title deeds for their property cannot present forest management plans to MINAE);
- PES payment was seen as an easy way to earn an income, especially for poor farmers;
- landowners with higher levels of environmental consciousness tended to enroll in the program, although officials strongly believe that the environmental protectionism was not a key factor that influenced decision to enroll in the program (exceptions were applications from NGOs);
- collective factor. A kind of "collective fever" to participate and see what will happen (neighbor effect in some cases).
- absentee landowners tend to have more interest in the forest and consider PES participation as a convenient land use alternative due to a lack of understanding of agriculture or livestock.
- owners of big properties are enrolled in PES "to protect" their land from aggressive land "development" policies by the Costa Rica *Instituto de Desarrollo Agrario* (IDA). IDA believed in those years that forests were "useless lands," so unmanaged forests were available for seizure by farmers, subdivision, and sharing with IDA's assistance.

Quantitative Results

Self-reports of landowners suggest that PES properties have significantly more forest cover than non-PES properties, both prior to and after participation in the PES Program. As shown in Table 4, 88% and 47% of the properties correspond to some kind of forested land (i.e., mature forest, forest

TABLE 4 Land use as Reported by Landowners

	PSA	Non-PSA
Average percent of property in different land uses		
Mature forest	81.2	35.1
Forest regeneration	5.3	7
Forest plantation	1.9	4.4
Agricultural crops	0.3	8.4
Pasture	11.3	45.1
Percent of total area of property in forest		
	89	54
Percent of properties with agricultural crops and pasture		
	10	25
	40	76

regeneration, and forest plantation) for participants and nonparticipants, respectively. This result is consistent with our qualitative results shown in Table 3 where forest conservation was identified as the main land use in both participants and non-participants.

During the household survey, landowners were asked what they would have done with the forested area if it were not under contract with PES. Table 5 shows the responses of the 50 PES participants in our study region. According to these results, 62% of the interviewed landowners said that they would have engaged in some kind of activity related with keeping the land forested, which indicates that forest management and/or conservation would have been the main land use. This result is again consistent with our qualitative results.

The qualitative research (summarized in the previous subsection) provides a picture of how landowners come to participate in the program. For a PES contract to be established, landowners must volunteer to participate in the program and the program administrators must accept their applications. In Sarapiquí, FUNDECOR also played a fundamental role as an intermediary organization. From the household survey, 72% credited their

TABLE 5 Alternative Land use if not Under Contract

Alternative use	Percent of respondents*
Crop cultivation	6
Pasture/Cattle ranching	34
Wood Production	36
Would not have used	26
Protection of the forest/conservation	6
Make fence posts (potreros)	2
Ecotourism	2

*Sum of percentages is greater than 100 because some landowners chose more than one alternative land use.

participation to environmental factors, rather than economic factors, which is not consistent with our qualitative evidence that showed that the lack of an alternative use for the contracted land appeared to have the greatest influence on the decision to participate in PES.

Conversations with forestry professionals and government officials in northeastern Costa Rica indicate that during the years 1997 and 1998 no applications that met all of the requirements were rejected, and contracts processed by FUNDECOR targeted particular zones that had been identified as facing a greater threat of deforestation. More contracts were therefore written in these zones (Guapiles, Horquetas, Virgen Del Socorro, and Guácimo). This description of the administrative selection process is consistent with survey results from nonparticipant landowners, many of whom say that they do not participate in PSA simply because they lack information about the program (Table 6). However, this finding on “information effects” contradicts the qualitative findings (which suggest that low payments and participation costs were the main factors). It is possible that because our case-study sample was based on recommendations by forest officials, we might have ended up with non-PES landowners who had some knowledge about the program and therefore there is no information effect from this subsample. Table 6 also shows the level of payments, application process, and technical assistance cost (main cost involved in the application process) that were also mentioned in the qualitative section.

Measuring Causal Effect of the Costa Rican PES Program

FONAFIFO defines its PES program as a mechanism whereby the State provides financial compensation to owners of forests and forest plantations for the environmental services that their lands provide, directly contributing to the protection and improvement of the environment. If we draw a simple model of the environmental policy process involved in the creation, functioning, and impact of the Costa Rican PES program, we see that the main purpose of this program is to create incentives for landowners to change their behavior in ways that will solve the problem of excessive deforestation.

TABLE 6 Reasons for not Enrolling Land in PES

	Percent of respondents
Lack of information	66
Payment too low	9
Distrust system	2
Too complicated	15
Cannot pay for application	2

The Costa Rican PES program is a nonexperimental (nonrandom) program where people voluntarily decide to participate. Sample selection is a generic problem in social research that arises when an investigator does not observe a random sample of a population of interest (Winship & Mare, 1992), which is the case with participants in the Costa Rican PES program. The qualitative and quantitative results discussed above suggest that program participants and nonparticipants are systematically different in terms of land use preferences, socioeconomic characteristics, etc. Therefore, direct comparison of participants and nonparticipants can produce biased estimates of program impacts.

Matched sampling is a method of data collection and organization designed to reduce bias and increase precision in observational studies; i.e., in those studies in which the random assignment to treatment to units (subjects) is absent (Rubin, 1973). Matching methods pair program participants with members of a nonexperimental control group who have similar observed attributes. Treatment impacts are then estimated by subtracting mean outcomes of matched comparison group members from the mean outcomes of matched participants (Heckman, Ichimura, & Todd, 1998). A principal constraint exists in that, as the number of characteristics used in the match increases, the chances of finding a match reduce (Bryson, Dorsett, & Purdon, 2002). This obstacle is overcome by invoking a key finding by Rosenbaum and Rubin (1983) that suggests that matching on a single index reflecting the probability of participation is equivalent to matching on all covariates. This index is the propensity score and this variant of matching is termed "propensity score matching."

Thus, our next step is to estimate a propensity score equation of the probability of participating in the PSA program, as reported in Table 7. The explanatory variables were selected based on prior literature and the case studies. In this preliminary quantitative analysis, we have a sample of 184 properties because of a relatively few missing values due to landowner non-response. The estimation of the participation model shows that PES forest

TABLE 7 Estimated Marginal Effects on the Propensity of a Property to have a PSA Contract

	Coefficient	St. Error	<i>p</i> Value
D—Resident on property in 1996	-0.633	0.246	0.010
Land size (ha)	0.002	0.001	0.027
D—Forest logged in past 50 years	0.024	0.221	0.915
Age of respondent (years)	-0.003	0.010	0.744
Years of owner education	-0.031	0.022	0.158
City of origin (1 = central)	0.780	0.225	0.001
Percent family who are women	0.074	0.545	0.140
Intercept	-0.576	0.566	0.309

Note. $N = 184$. Log likelihood = -92.002. Pseudo $R^2 = 0.145$.

protection contracts are most likely on large properties with absentee landowners originally from the Central Valley (cf. Zindben and Lee's [2005] finding that property size is an important determinant of participation in the PES program).

Results of Table 7 represent the outcome of combining qualitative and quantitative methods to gain a better understanding of the factors that influence decisions to participate in the Costa Rican PES program. There are several reasons why this participation might fail to generate a net increase in conservation in Costa Rica. First, the PES program offers a uniform payment to every participant according with the number of hectares of forest protected. Only landowners whose opportunity costs of conservation are lower than this uniform payment will enroll in the program. Therefore, it may be the case that much of the forestlands enrolled in PES are unsuitable for alternative uses and thus would not have been deforested in the absence of the program. Second, payments could be made for forests that households would have protected without the payments. In this case, the household would accept a payment to protect the parcel, but the payment would not induce the household to protect additional forest. The results reported in this article represent a critical first step for evaluating these statements in future research and for estimating the causal effect of PES by providing a model of who participates in PES.

CONCLUSIONS

In general, program participation determinants will depend on the socioeconomic situation of the applicant. Participation factors can be grouped as follow:

1. People that are leaving their forests unmanaged tend to participate in the program. Given that almost none of the landowners included in this case study depend on their farms to survive, it seems that this could explain participation in many cases.
2. Legal issues also influence program participation. The only rejected application found from the period between 1997 and 1998 failed to participate due to a legal fight with another party that was also claiming ownership of the same property.
3. Property protection is also an important factor, especially for big farms. Land under PES is automatically protected by MINAE which means that the property cannot be occupied by anyone.
4. Farms in possession cannot be managed. According with the Costa Rican law, a title is the main requisite for MINAE to approve a forest management plan. This conclusion mainly comes from conversations with government officials and forest professionals. None of the case studies

- included in this survey said that this factor influenced their decision (given that all of them already had titles).
5. Farms that do not have good alternative uses on their land (because of steep slopes or poor soil quality) tend to be enrolled in the program. However, several people included in this study did not participate even when they did not have good alternative land uses. This finding may be confounded by the influence of the opportunity cost of participation and income source. Those with high opportunity costs of participation and significant off-farm sources are less likely to participate.
 6. Finally and less clear, government officials and local foresters believe that people with high environmental awareness should be more inclined to participate, but they do not believe that this is an important factor that influences participation. None of the people included in our case studies mentioned that they were influenced by such considerations; however, quantitative results show that environmental preferences are important when deciding about program enrollment.

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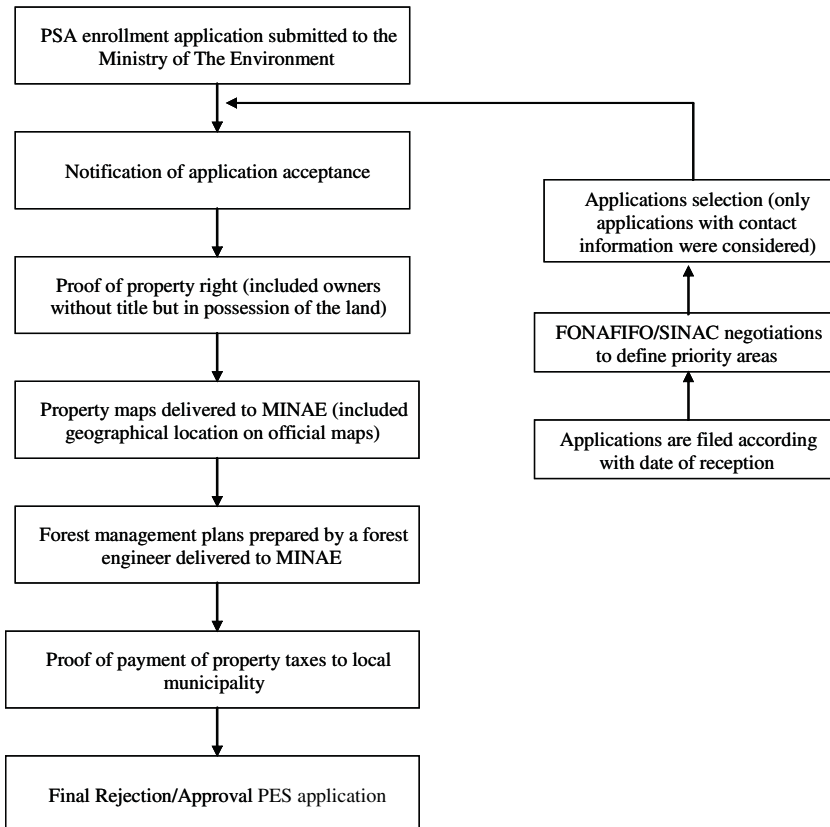
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APPENDIX

APPLICATION PROCESS TO ENROLL IN THE COSTA RICAN PES PROGRAM



PES PROPERTIES AND REGIONS OF PROXIMITY (BUFFER) SAMPLING.

