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Payments for ecosystem services and rural development: Landowners' preferences and potential participation in western Mexico

Arturo Balderas Torres [a,b,*], Douglas C. MacMillan [c], Margaret Skutsch [a,d], Jon C. Lovett [a,e]

[a] CSTM, Twente Centre for Studies in Technology and Sustainable Development, University of Twente, Postbus 217, 7500 AE Enschede, Netherlands
[b] Ingenieria Ambiental, PTI Instituto Tecnológico y de Estudios Superiores de Occidente (ITESO), Tlaquepaque, CP 45090, México
[c] Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, CT2 7UH, England, UK
[d] Centro de Investigaciones en Geografía Ambiental, Universidad Nacional Autónoma de México (UNAM), Antigua Carretera a Pátzcuaro 8701, CP 58190 Morelia, Michoacán, México
[e] School of Geography, University of Leeds, Leeds, LS2 9JT, UK

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ABSTRACT

Incentive-based mechanisms can contribute to rural development and deliver environmental services, but need to be attractive to landowners and communities to ensure their participation. Here we study the views of landowners and agrarian communities (*ejidos*) from central Jalisco in Mexico to identify characteristics that payment for environmental services (PES) programs conserving/enhancing forest cover could include in their design. A choice experiment was applied to 161 landowners and ejido-landowners. Results show that importance and dependency on cash payments can decrease if interventions to promote local development through improved health and education services and generation of employment and productive projects are included. Responses indicate that communal forested areas in ejidos would be most likely to enroll into PES. In some cases grasslands could be afforested. Agroforestry practices providing other environmental services could also be implemented (e.g. windbreaks). Potential enrollment is lower in agricultural and peri-urban areas due to higher opportunity costs. Higher payments favor enrollment but may compromise the program's efficiency since aggregated cash-flow over long periods can exceed the present value of the land itself in some areas. Offering a mix of cash and non-cash benefits based on local developmental needs might be the best way to promote participation in PES.

1. Introduction

In recent years interest has increased in improving our understanding of the institutional and economic arrangements needed to maintain ecosystem services (Balvanera and Cotler, 2007). These ecosystem or environmental services include regulation, habitat, production and information functions (de Groot, 1992; de Groot et al., 2002). They are present at local or transboundary scales (López-Hoffman et al., 2010), and include benefits such as protection of water catchments and biodiversity habitat, sites for recreation and climate change mitigation (Canadell and Raupach, 2008). However, many of these benefits are public goods, hence landowners and communities protecting the ecosystems providing them are often not compensated. In other words, there is a market failure as the value of the services is not recognized by the consumers and the producers may opt for land uses other than those that provide the services. As a result, environmental services and functions can be lost when they are not factored into landowners' land use decisions (e.g. Grieg-Gran et al., 2005; Pagiola et al., 2002).

Recent environmental policies have aimed to solve the problem of market failure by creating positive incentives for landowners through a number of approaches including market based mechanisms and subsidies (e.g. Kinzig et al., 2011; Landell-Mills and Porras., 2002; Muradian et al., 2010). These policies seek to support practices that maintain and enhance provision of environmental services through payments to the service providers. Usually these payments are designed to match the opportunity costs of some alternative land uses that imply reductions in the flow of environmental services (Pagiola and Platais, 2007). Programs of payments for environmental services (PES), carbon sequestration projects financed through carbon markets and policies to incentivize reductions in emissions from deforestation and forest degradation in developing countries (REDD+) are examples of these schemes. It is important to identify the context within which these policies are to be applied. Lack of property rights over land, incomplete information on management

* Corresponding author at: CSTM, Twente Centre for Studies in Technology and Sustainable Development, University of Twente, Postbus 217, 7500 AE Enschede, Netherlands. Tel.: +31 53 489 3203.
E-mail address: a.balderastorres@utwente.nl (A. Balderas Torres).

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practices, benefits and costs, or lack of access to capital markets (e.g. credit) need to be assessed first to evaluate the appropriateness of a PES or incentive-based approach in a policy mix (Engel et al., 2008).

Incentive-based schemes are often considered to have the potential to contribute to poverty alleviation and poverty prevention (Daw et al., 2011; Grieg-Gran et al., 2005; Landell-Mills and Porras, 2002; Muradian et al., 2010; Pagiola et al., 2002; Wunder, 2005). Contributions to poverty alleviation come from direct benefits derived from maintenance and access to the environmental services; and co-benefits associated with the projects such as cash-income and labor opportunities (Daw et al., 2011). These types of schemes may only succeed in the long term if the benefits generated are considered adequate by local communities and landowners (Engel et al., 2008; Grieg-Gran et al., 2005; Landell-Mills and Porras, 2002). Theoretical and empirical research has shown that rural landowner participation in incentive programs is influenced by different factors including the characteristics of the schemes, the characteristics and attitudes of the individuals and the activities developed on the land (e.g. Ma et al., 2012; Putten et al., 2011).

In addition to direct environmental services and direct payments, other benefits can also be considered in a broader developmental context in the valuation of ecosystem services. According to the livelihoods approach, the level and potential for development is related to the levels and changes in social, human, productive, financial and natural capital (e.g. Carney, 1998). As described by Landell-Mills and Porras (2002) PES can have positive effects in the five dimensions of capital through enhancement of local environmental services which are enjoyed locally by the providers; by strengthening local institutions; building capacity and transferring specific know-how; by the creation of specific infrastructure associated with human and productive capital (e.g. tree nurseries, roads, health care centers, schools); and through cash payments and increased access to markets that increase financial capital. Yet most incentive programs offered as part of PES have focused primarily on financial compensation only, for example the Mexican PES program (Muñoz Piña et al., 2008). In a review of 47 PES schemes worldwide for watershed services, Brouwer et al. (2011) report that in around 70% of the cases analyzed the main mode of compensation was through cash payments. Low payments may represent small contributions to the landowner's total income; and adoption of PES is likely to indicate the low opportunity costs of enrolling in the programs (e.g. PES contributed from 1% to 3% of yearly income to participants in Coatepec Mexico) (Scullion et al., 2011).

It is possible to design programs to conserve environmental services based on the livelihoods approach. An example of such a program is Bolsa Floresta in the Brazilian Amazon (Viana, 2008). This program provides four types of support to participants engaging in forest conservation: a fixed monthly payment per household; community payments for income generation activities; community payments for the development of local infrastructure such as water sanitation, health or education centers or roads; and resources to strengthen local institutions and organizations (Newton et al., 2012; Viana, 2008). It is a governmentally mixed program in which international development agencies and locally based non-governmental organizations also participate (Newton et al., 2012).

The aim of the study presented here is to explore the potential participation of landowners in a project using incentive-based mechanisms for the conservation of forests with a region in western Mexico as a case study. We developed a choice experiment to elucidate the effect that cash payments, project duration and potential access to other co-benefits promoting local development as part of the project, might have in potential participation. Based on participant responses we discuss the implications for PES design and the contribution to rural development and provision of environmental services. First we present background information about participation of landowners in incentive-based programs. Then we describe the methods used and study area, followed by the results and discussion. Finally, we present our conclusions.

2. Background

2.1. Forestry incentive-based programs and landowner participation

Concern over relative scarcity of natural services is leading to promotion of policies for the creation of incentives to conserve diminishing ecosystem functions (Kinzig et al., 2011; Kroeger and Casey, 2007). PES was initially defined by Wunder (2005) as a voluntary agreement between at least one buyer and one seller, based on provision of a specific environmental service. A more recent definition considers PES as the transference of resources among social actors, through markets, incentives or subsidies, to align the management of natural resources with a wider social interest (Muradian et al., 2010). Benefits for the providers participating in PES can include cash and in-kind payments, capacity building, income diversification, reliable and stable payments and improved organization (Grieg-Gran et al., 2005). As opposed to command and control policies, PES and market based mechanisms generally rely on voluntary participation of landowners in environmental management, thus the incentives offered by these projects need to be of a type and level which attracts participation (Engel et al., 2008). Economic theory assumes that if landowners decide to participate in incentive-based programs, it is because the benefits received make them at least as well-off as they were without the program (Grieg-Gran et al., 2005).

Previous research indicates that there is a range of factors promoting or preventing participation of landowners in incentive-based schemes. Theoretical and empirical studies indicate a greater potential for participation when payments are higher (e.g. Dickinson et al., 2012; Lynch et al., 2002; Markowski-Lindsay et al., 2011; Putten et al., 2011). However there may be landowners already interested in conservation who are willing to participate and for whom the flexibility of the scheme might be more important (e.g. Horne, 2004; Putten et al., 2011; Scullion et al., 2011; Stevens et al., 2002). In general, landowners prefer simpler projects without additionality requirements (Markowski-Lindsay et al., 2011), with lower compliance costs (Putten et al., 2011), not requiring specific management programs and not including penalties for non-compliance or early withdrawal (Dickinson et al., 2012; Markowski-Lindsay et al., 2011). Schemes offering upfront payments might be preferred (Putten et al., 2011) as they maximize net present value (Balderas Torres et al., 2010). There is also a preference for shorter project lengths since this allows more management flexibility in the future, especially when inter-generational aspects are considered (Dickinson et al., 2012; Horne, 2004; Markowski-Lindsay et al., 2011; Putten et al., 2011; Stevens et al., 2002).

Participation in PES schemes has been linked with higher income, off-land income, youth and education level and low levels of household debt (Dickinson et al., 2012; Dupraz et al., 2003; Greiner et al., 2003; Lambert et al., 2007; Loftus and Kraft, 2003, Petrzelka et al., 2012; Putten et al., 2011). Positive participation has also been related to larger property size (Kilgore et al., 2008; Ma et al., 2012, Putten et al., 2011), and also previous knowledge of the program and positive attitudes towards the environment (Ma et al., 2012; Putten et al., 2011). Landowners may have different reasons for owning their land and they may be positive about pro-conservation incentive programs as long as these do not conflict with their core interests or business objectives (Church and Ravenscroft, 2008; MacMillan and

Phillip, 2010). In areas with more pro-development land use regulations, relatively lower participation in incentive-based conservation programs is expected since more profitable activities would be considered by landowners (Markowski-Lindsay et al., 2011).

2.2. PES in Mexico and land tenure

The federal Mexican government started the national PES program in 2003 to compensate landowners and communities monetarily for conserving forests (Muñoz Piña et al., 2008; Rico Garcia-Amado et al., 2011). The payment level was estimated by the government according to a deforestation risk map and does not cover opportunity costs (Corbera et al., 2007; Rico Garcia-Amado et al., 2011). Incentives to landowners consist of yearly payments over five years; participation can be renewed depending on performance and the budget available. In addition to the federal program, other PES programs have been created including a number developed jointly with the private sector and others at the municipal and state levels. The payment levels range from $22.2 per hectare per year in the federal program to $111 for the PROBOSQUE program in the State of Mexico (Estado de México, 2011; Muñoz Piña et al., 2008; all monetary figures presented in this paper are in U.S. dollars, the exchange rate used is $13.50 Mexican pesos per dollar).

In Mexico land tenure comprises public (government property), private and community or *ejido* property regimes. Nationally, approximately 53% of the territory is *ejido* land, 37% is private property, 4% public property and the remaining corresponds to other regimes (e.g. agrarian colonies) (Reyes-González et al., 2012). In the private property regime potential enrollment into PES or other conservation programs constitutes an individual decision. Under the ejido or community regimes, a group of individuals is given entitlement to an area of land by presidential decree. One part of this is divided into individual parcels, usually with potential for agricultural activities, so that each ejidatario decides how to use this for him/herself. Another part of the land becomes a common area and usually this remains as forest. Decisions regarding the activities in common areas, such as enrollment into PES, are taken communally in the official ejido assemblies. As a rule, ejidatarios transfer the entitlement of their individual plots to single heirs only after they die (the parcels are therefore not subdivided). However, individual certificates can also be transferred and sold to other people provided this is approved by the ejido general assembly. Since 1992 when the Constitution was changed, these parcels can be unincorporated from the ejido (privatized) (Cornelius and Myhre, 1998; Rico Garcia-Amado et al., 2011). This reform permitted more rapid land use change in specific areas, such as those close to the coast with potential for tourism, or for housing where the ejidos are adjacent to urban areas. Although the figures are dynamic due to reforestation, deforestation and privatization of land, previous studies indicate that ejidos own around half the territory of the country and 80% of Mexican forests (Barnes, 2009; Rico Garcia-Amado et al., 2011). There are parts of the territory remaining as government property. In a few cases public areas result from the public purchase or private donation of land for the creation of natural protected areas. In these cases, the provision of environmental services can make use of policy options other than incentive-based mechanisms (e.g. management of protected areas).

2.3. Case study

The study area is the La Primavera forest in Jalisco, together with surrounding areas of forest patches up to 80 km away in order to include the wildlife corridors connecting La Primavera to other forested areas (Fig. 1). The total area is around 1.5 million hectares, of these, around 728,800 ha are forested, 155,480 ha are grasslands and 560,700 ha are under agriculture (INEGI, 2010a). The main vegetation types in the area are oak-pine mixes, dry tropical deciduous forests and grasslands interspersed with agriculture. La Primavera forest (30,500 ha) was established in 1981 as a protected area and in 2006 it was declared a Biosphere Reserve

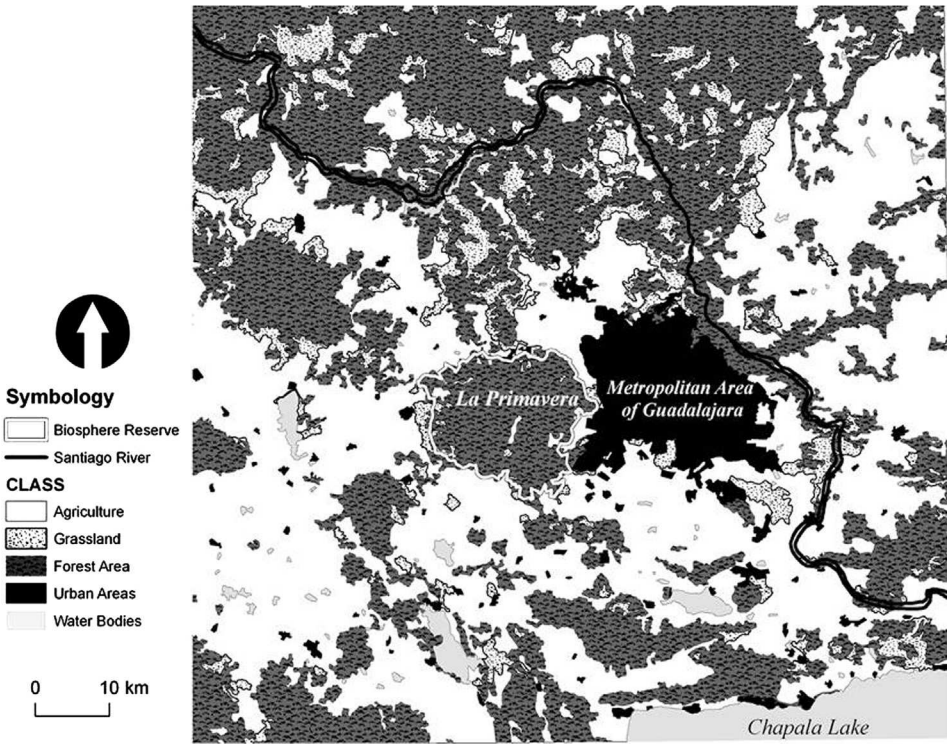

Fig. 1. Study area showing La Primavera and the Metropolitan Area of Guadalajara. Land use and vegetation types grouped into broad classes based on INEGI, 2010b.

by MAB-UNESCO (CONANP, 2000; UNESCO, 2011). On the eastern border is the city of Guadalajara, the capital of Jalisco and the second most populated metropolitan area in Mexico, with around 4.4 million habitants (INEGI, 2010b). The metropolitan area of Guadalajara includes eight municipalities (INEGI, 2005). Proximity to and accessibility from the city increases the perception and valuation of environmental services (e.g. contribution to air quality) and recreation among the local population. However it also increases the value of the land for housing development in the parts of La Primavera with access to the city.

The metropolitan area of Guadalajara has been urbanized rapidly in recent decades, particularly in the municipalities of Zapopan, Tonala and Tlajomulco. For example, Zapopan's population has increased by one million between 1970 and 2010 (INEGI, 1990, 2000, 2010b). In the same period the Tesistan Valley in Zapopan, once one of the most productive agricultural areas in Mexico, saw its agricultural area shrink from 28,000 ha to around 13,000 ha (Inforural, 2007). Tonala's population grew almost twenty fold from 1970 to reach 478,789 in 2010 (INEGI, 1990, 2000, 2010b) and urbanization buried the best clay mines from which traditional local artisan pottery was made, and for which the region is famous (Loera, 2005). Most recently, urbanization has been focused in the southern municipality of Tlajomulco, where the population increased at a mean yearly rate of 12.5% from 2000 to 2010 (INEGI, 1990, 2000, 2010b). During 1997–2007, around 4300 ha of ejido land were sold, mostly to non-ejido buyers in the peri-urban municipalities of the metropolitan area of Guadalajara and about 4200 ha were privatized (INEGI, 2007).

In regions more distant from the urban area, grazing and commercial agricultural practices are common (e.g. sugar cane, agave for tequila production and maize). The cumulative effect of these land use changes outside the protected core part of the reserve, and the construction of roads around it, is to isolate La Primavera and interrupt important natural wildlife corridors to other forested areas, compromising the long-term viability of populations of vulnerable wildlife species (e.g. large wide ranging carnivores such as the Puma, *Puma concolor*). The research presented here aims to identify the potential of incentive-based mechanisms to promote the provision of environmental services in the region and is part of a broader project funded by the Darwin Initiative, investigating the role that market-based mechanisms might have in the conservation of wildlife corridors and rural development (Balderas Torres et al., 2009).

3. Methods

3.1. Choice modeling

Choice modeling (CM) is a stated preference technique founded on demand, welfare and consumer theory (Lancaster, 1966) and the random utility model (RUM) (McFadden, 1974). It was first developed for marketing and transportation studies and is now increasingly used in environmental non-market valuation (Bennett and Blamey, 2001; Hoyos, 2010). It allows the valuation of changes in environmental goods and services, or policies modifying their level of provision. In CM, respondents choose between hypothetical scenarios that vary in their specific characteristics, which are described by different attributes. In this case we investigated how the payment level, the length of the PES contract and the offer of other co-benefits increasing local human and productive capitals affect the preferences of landowners for PES programs.

In CM it is assumed that choices made by landowners maximize their utility (Bennett and Adamowicz, 2001). The choices are analyzed in econometric models representing the utility of an individual. Most econometric models consider an additive utility function where the attributes used in the choice experiment, individual characteristics and alternative associated constants (ASC) describing different scenarios are used as independent variables (Bennett and Adamowicz, 2001; Hoyos, 2010). The RUM implies that there is a stochastic component denoted by an error term. The commonly used multinomial logit model (MNL) assumes that this term follows a Gumbel distribution (Louviere, 2001; McFadden, 1974). This assumption imposes the restriction of independence of irrelevant alternatives (IIA) that can be diagnosed through the Hausman–McFadden test (Hausman and McFadden, 1984; Maddala, 1983). Heterogeneity in the sample and tastes of the participants may cause violations to the IIA assumption, in which case the model may produce biased parameters (Ben-Akiva and Lerman, 1985; Bennett and Adamowicz, 2001). Although these violations need to be considered, if the information associated with the unobserved components is small, then the effect of any misspecification in the distribution of errors would be minor (Vojacek and Pecakova, 2010). In these cases the MNL model would be preferred to nested logit and probit models, reducing computational effort and facilitating the determination of the probabilities of choosing specific alternatives, thus reducing model estimation problems (Vojacek and Pecakova, 2010).

CM allows the assessment of trade-offs among the different attributes of the experiment (Bennett and Adamowicz, 2001). As one of the attributes in a choice experiment is a monetary component, this allows the estimation of implicit prices, by dividing the parameter of a given attribute by that from the monetary one (Rolfe et al., 2000). In this research we utilize a MNL model with an additive utility function including the attributes of the scenarios. For a more detailed description of CM please refer to Hoyos (2010) or Rolfe et al. (2000). We estimated an MNL model to obtain the implicit valuation of the co-benefits offered and the project duration (part worths); and used the bootstrap method of Krinsky and Robb with 7500 iterations to create 95% confidence intervals for these values (Krinsky and Robb, 1986).

3.2. Survey design and application

The survey posed a hypothetical situation in which a non-governmental organization (NGO) develops projects for forest conservation and rural development. The NGO would receive resources from private companies and citizens and invite landowners/ejidos to participate in a PES project. The benefits that the participants could receive were a cash payment and a set of co-benefits, over a given period of time. It was proposed that the NGO would help to improve the health and education services for the participants (by paying health insurance fees and hiring high school teachers for the service of the participants and families). Alternatively the NGO could help participants to get jobs and start small business by providing consultancy and financing. Conditions for participation in all cases included: (1) a specific forested area should be conserved or restored and monitored; and (2) measures should be taken to prevent and control fires/pests, grazing, hunting and illegal logging. The commitments and responsibilities would be specified in a collaboration agreement with the NGO and no penalties were referred to or included.

3.2.1. Choice sets

For the design of the choice sets the research team, including the authors, two market research technicians and a forester, selected the attributes and levels jointly with local experts (i.e. the managerial team of La Primavera and local researchers and consultants experienced working in the area). A pilot study was

done among key stakeholders and landowners to test the survey instrument, and these participants were interviewed to identify their interests and needs. Three attributes were chosen: cash payments, with four different levels ($31, $71, $117 and $165 per hectare per year); project duration (5, 9 or 17 years), and three levels for the potential co-benefits. The baseline was where no co-benefits were offered in terms of health and education services (level 2) and employment/productive projects (level 3).

An orthogonal main effects design generated 16 choice cards. Twelve choice sets each presenting two project proposals and one opt out for those deciding not to participate in the program were prepared in two questionnaires. Questions were designed to maintain a balance between the different levels of attributes. For this, eight cards were included two times. In order to reduce the presentation of dominant options, the choice sets were prepared aiming to present options generating similar aggregated economic values. Because of heterogeneity in property size, we decided not to include an attribute specifying the area of forest to be committed for these practices. Instead, this issue was explored in the follow-up questions.

3.2.2. Application

The survey was carried out among 161 *ejido* and non-*ejido* landowners located in La Primavera and related wildlife corridors up to a distance of 80 km from the Reserve. In the study area there are about 90 *ejidos*, nine of which were selected at different distances from Guadalajara for the study in order to include areas with different opportunity costs associated with urban development. Later, in a geographic information system (GIS), we estimated the Euclidean distance to the metropolitan area of Guadalajara. *Ejido* committees were contacted to present the research and invite them to participate. *Ejido* members were contacted in their monthly meetings. Non-*ejido* landowners were contacted through the regional association of private landowners of Jalisco. The list of representatives in each municipality in the study area was consulted to contact the registered landowners. Surveys were applied anonymously, in person, and on an individual basis.

Before applying the survey, background information and the proposed scenario were described to the participants. The information presented included, firstly a brief background about the goods and services produced by forests, and then the problems due to deforestation and land use change and initiatives developed through public and private PES programs in Mexico and different countries. The scenario and conditions for participation were also described. Participants were then presented with the choice sets. After the choice sets follow-up questions were included to ask if the respondent would participate if the project became operational, in which case they were asked how much land they would like to include in the project. They were also asked if they would reforest non-forested areas (i.e. agricultural lands and/or grasslands) in order to integrate them in the project, or if they would be willing to adopt other agroforestry practices (i.e. living fences, windbreaks). Respondents from *ejidos* were asked if they would agree to include communal forested areas in the project. In order to get proxies for opportunity costs, we asked about the activities their properties are currently used for, and the expected prices at which land is sold in the area where the land is located. Other questions captured general socioeconomic and demographic information. Participants were asked the price of their land in the real estate market as a proxy for land opportunity costs. Surveys were carried out between March and August 2011, involving landowners in the La Primavera Biosphere Reserve ($n=28$) and in the biological corridors ($n=133$); 127 surveys were completed by *ejidatarios* who owned a total area of 2029 ha (median 7 ha per respondent) and 34 by private landowners who encompassed a total area of 2686 ha (median of 28 ha per respondent). The total area held by the participants was 4715 ha. The total area belonging to the nine *ejidos* visited was 34,440 ha of which 11,440 ha are common land (RAN, 2011). This data reflects the differences in the scale of land ownership in the region; the proportion of *ejido* to private land in the sample is similar to that in the region, however the size of the plots in the *ejido* regime is far smaller. Assuming that each *ejidatario* has only one plot of land or *parcela*, the selected *ejidos* would have 5887 members. It is difficult to obtain exact figures on membership because of migration and the dynamic linked with sale and privatization of land as mentioned in Section 2.2. However it is estimated that the number of *ejido* members interviewed represented around 2% of the population within the ejidos selected, which would represent around 0.2% of all the *ejidos* in the region. However, cultural, climatological and economic conditions are more or less homogenous in the study area, apart from distance to the city, which we believe allows the results to be generalized. Even when participants did not have forested properties, they were interviewed to investigate their preferences and to explore if they would reforest their properties in order to participate. When these participants were part of an *ejido* they were asked about the potential enrollment of communal forest areas. Factors affecting the possibilities for reforestation can be used to analyze the potential to restore wildlife corridors and sequester carbon.

4. Results and discussion

4.1. Sample characteristics

Table 1 presents the basic characteristics of the sample.

In our sample 55.9% of the respondents held forested land; the remaining percentage did not have forested areas but agricultural parcels and/or grasslands. With respect to current use, 75.8% of the respondents indicated that they used their land for productive cash activities (e.g. sugar cane, agave—tequila, maize); 47.2% indicated that part of the production was also for their own consumption in the household and 7.7% had participated in the national PES program. In our sample 6.3% of the participants were females, 9.4% were single and 96.2% were economically active. The participants were, therefore, predominantly relatively old, married males, which is consistent with other studies of Mexican landowners in rural areas in Mexico and other countries (e.g. in the U. S., Dickinson et al., 2012).

4.2. MNL model and implicit prices

Table 2 presents the MNL model, no violations with the IIA assumption were detected after the Hausman–McFadden test was applied; moreover the pseudo R^2 value is 0.425 which is considered similar to a coefficient of determination (R^2) above 0.6 to 0.8 for an equivalent linear regression (Vojacek and Pecakova, 2010); thus the estimation of alternative models is not justified. The exercise asks the participants for the willingness to accept in a simple way, since the values are expressed on a per hectare basis and do not require making a specific commitment about which particular piece of the parcel might be devoted to the project. In this sense, the decision-making process was homogenous and the different alternatives presented were considered to be independent from each other. An ASC for the *status quo* alternative was included (opt out), this permits differentiating the effect of the options offering only the cash payment from that of the opt-out. Responses of participants who found the questions confusing (3.1%) or those deciding not to participate in the PES in the six

Table 1
General statistical information of the sample.

	Mean	S.D.	Range
Age (years)	58.1	13.3	20–87
Household size (members)	4.3	2.0	1–14
Education (Class)[a]	1.88	1.46	0–5
Income (Class)[b]	2.00	1.02	1–4
Income ($/cap-day)	5.10	4.54	1.39–36.43
Distance from Guadalajara City (km)	42.4	21.0	0–74.9
Land price forest ($) ($n=42$)	83,000	331,500	1500–2,200,000
Land price non-forest ($) ($n=100$)	66,500	269,700	1100–2,600,000
Forest area owned (ha) ($n=82$)	33.7	75.4	0.2–450
Agricultural area owned (ha) ($n=139$)	11.6	20.8	0.1–180
Grassland (ha) ($n=23$)	14.5	15.7	1.0–56
Total Area (ha/respondent)	30.6	71.1	0.1–550
How much area would you commit if the project was implemented? (ha)	14.5	34.1	0–225

[a] Education classes: (0) None, (1) Elementary School, (2) Jr. High School, (3) High School, (4) Technical Studies, (5) Undergraduate.
[b] Monthly income classes (1) below $295; (2) $295–$590; (3) $590–$1100; (4) > $1100.

Table 2
MNL model.

	Coefficients
ASC status quo (Not to participate)	−2.5576*** (0.1307)
Payment ($/ha-yr)	0.0069*** (0.0012)
Duration (yr)	−0.1176*** (0.01155)
Co-benefit 1 (None)	−0.0049 (0.2452)
Co-benefit 2 (Health and education)	0.4080** (0.1868)
Co-benefit 3 (Employment and productive projects)	0.7093*** (0.1843)
Valid (n)	2915
pR^2	0.425
Model fitting information (d.f.)	1010 (6)***

Standard Error in Parenthesis.
*** Significant at 99% level.
** Significant at 95% level.

Table 3
Implicit prices for the different attributes with 95% Intervals, Krinsky and Robb method.

Attribute	Implicit prices (95% C.I.)
Duration	−$17.04 (−$27.72, −$11.38)
No co-benefits (None)	−$0.71 (−$56.68, $93.25)
Health and education	$59.13 ($5.68, $156.17)
Employment and productive projects	$102.79 ($40.92, $216.75)

Table 4
Answers to questions exploring the potential for participation.

If the Project becomes operational would you participate:	Response (%)
Certainly yes	82.6
Probably yes	8.1
Probably not	0.6
Certainly not (Not answered)	8.7
Plans for the future (10 years)	
Agriculture	71.4
Business/Development	8.1
Environmentally friendly productive projects[a]	22.4
Would you support that communal areas join the project (*ejidos*)? ($n=127$)	97.6

[a] Ecotourism, vermicomposting, reforestation.

choice sets (protests) (6.2%) were not included following standard methods (e.g. Glenk and Colombo, 2011; Scarpa et al., 2009).

The pseudo-R^2 is within the recommended values and the coefficients obtained are highly significant and with the expected signs, i.e. higher payments and shorter project periods are preferred. The projects offering co-benefits are more highly valued than the option where only the cash payment is offered (the coefficient for the option with no co-benefit is close to zero and statistically not significant).

Considering the coefficients obtained in Table 2 as the proxy for probability of participation, the odds of joining the PES increase by about 0.7% per dollar offered per hectare per year. Respondents preferred shorter projects to the certainty of predictable payments over larger periods of time; this is in agreement with other cases reported in the literature (e.g. Markowski-Lindsay et al., 2011). Offering health and education co-benefits increased the chances of participation by 40.8%, on the other hand offering aid for employment and productive projects increased the chances by 70.9%. The implicit prices for the different project attributes are presented in Table 3 by considering the magnitude of the coefficients for each attribute and of the payment.

By considering the inverse of the coefficient of the payment, it can be seen that if a project were to rely only on cash payments, the yearly payment per hectare should be $144.92 for the odds on participating to increase to100%. The additional payment required to increase the chances of participation in a project, including support for employment and productive projects, would be of $42.13/ha-year, since the valuation of the co-benefits offered under this option already accounts for $102.79. For a scheme that provides health and education benefits the average required payment would be $85.79.

4.3. Opportunity costs and potential participation

Table 4 shows the potential for participation among respondents across the whole sample if the project proposed became operational. There is high potential for participation among landowners, although 9.3% expressed overall negative opinions on participation. The potential for participation was explored in relation to the distance to Guadalajara (Fig. 2). Responses suggest that when landowners are located close to the urban area, the higher opportunity costs of land would have a negative effect on prospects for participation. These landowners have better access to services and economic opportunities offered in the city, which would reduce the relative value of any in-kind co-benefits offered.

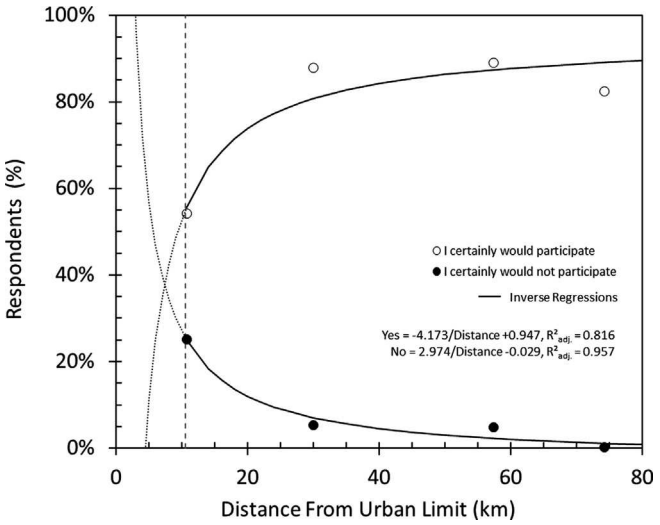

Fig. 2. Potential participation as function of distance to the urban area limit. The dashed lines represent the trend expected in the peri-urban area between La Primavera and the city of Guadalajara where forested areas have been cleared to open space for other land uses.

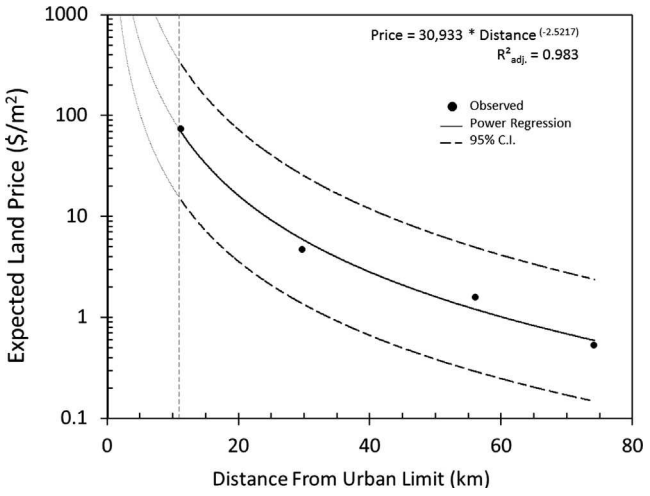

Fig. 3. Land price and distance to the urban area (note logarithmic scale of the land price axis). The dashed lines represent the trend expected in the peri-urban area between La Primavera and the city of Guadalajara, where forested areas have been cleared to open space for other land uses.

The two curves in Fig. 2 are complementary and fit an inverse relationship well, indicating that landowners very close to the city are less likely to participate, i.e. the probability of participation increases with distance. Although no interviews were made in areas closer than 8 km to the city it can be seen that between the protected area and the western urban limit there is a buffer of around 5 km where there are no remaining forests (Fig. 1). These revealed decisions over land use support the specification forms presented in this figure. The regressions imply that at a distance of 5 km or less from the city there would be no interest in participating in PES; however the dashed lines are included to delimit the valid distance range for the data in the sample. The forest cover in La Primavera has been preserved thanks to the status of National Protected Area and Biosphere Reserve. This status prevented a proposed plan to create a large housing development within the reserve during the 1970s (Ciudad Primavera). Nevertheless private landowners and ejidos were not compensated in any form when La Primavera was declared a protected area. Pressures for development still persist; and there are various cases of illegal construction of country houses inside the Reserve that are under litigation (del Castillo, 2011). The data reported by respondents on land price was also classified by distance in order to assess land opportunity costs (Fig. 3).

The data shows a power relationship between distance and land price indicating that the pressure of urban development will be far more intense in areas closer to the city. This is in agreement with the implications of Fig. 2. The opportunity cost of land in the vicinity of the city would be extremely high in comparison with the incentives that could be offered by voluntary programs such as PES. The pro-development context prevailing in this area, in terms of access to services, markets and formulation of urban development plans, is correlated with lower expected participation in incentive based programs (e.g. Markowski-Lindsay et al., 2011). As in Fig. 2, there are no data points for distances below 5 km that could confirm the curve specification in areas closer to the city. Again, the dashed gray lines are included to describe the general trend that could be expected within the most proximate area to the city outside the distance range of the data collected. Although in practice it is unreasonable to expect that price for land will tend to infinity, it does increase considerably more in those areas closer to the city when urbanization has been authorized. Moreover, the function represents a price trend similar to other cases where the value of scarce resources has been estimated, (e.g. Costanza et al., 1997, assumed that the price of an environmental resource will tend to infinity when its supply approaches zero). However the equation in Fig. 3 performs well in estimating the opportunity costs associated with land price within the valid distance range.

Although the prices of new housing developments may not be comparable to land prices, since they include the cost of construction, from Fig. 3 it can be seen that even if the new houses were sold at the construction cost, the profit made when land bought at low prices is sold at the peri-urban market price is potentially enormous. Speculation in the real-estate market might contribute to the disordered peri-urban growth experienced in the last few decades. Effective controls over land use change, particularly close to urban areas, are an essential precondition for the provision of environmental services; otherwise the landowners' expectations of urban development will prevent participation in schemes aiming to value them. This is particularly critical in hotspot areas for biodiversity such as La Primavera and its unprotected wildlife corridors, given its proximity to Guadalajara. It is worth mentioning that land prices for development are affected by government decisions over where houses can or cannot be built, thus they are not pure market prices as usually considered for efficiency. Nevertheless some land use regulations can be changed to respond to the economic interests of landowners and allow development. In areas designated for conservation, high land prices can be an indication of possible conflicts and pressures for land use conversion that may threat biodiversity.

4.4. *Implications of offering higher payments in PES*

Landowner's participation in PES could be increased if higher cash payments are offered in areas with higher opportunity costs. However if higher payments are offered it can be the case that the net present value of the incentives paid can overcome land prices (Sullivan et al., 2005). This can compromise long term efficiency of the program if high enrollment rates are required, since purchase of land for conservation may be the least cost option in areas with low opportunity costs (Fig. 4).

In Fig. 4 the horizontal lines represent the land prices per hectare for the minimum land price reported, the lower 15% percentile and the median along with the net present value of payments in PES for different project durations as a function of yearly payment levels. The net present values are estimated

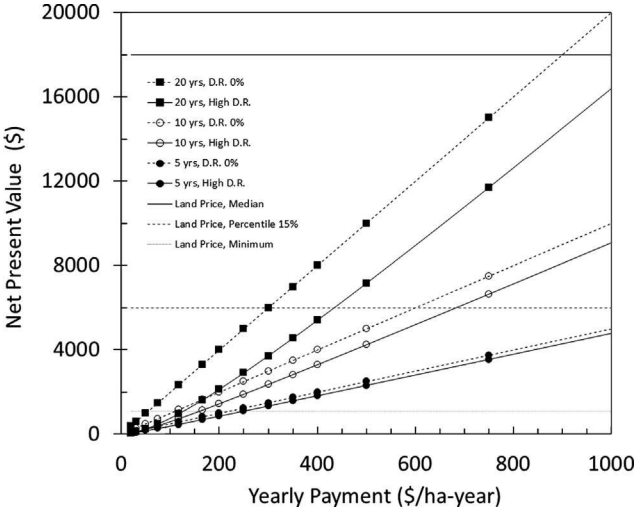

Fig. 4. Net present value of PES for different project durations and discount rates as a function of yearly payment and comparison with land prices.

without discounting, and using a discount rate of 7%. Discount rates from 4 to 6% have been used to estimate the net present value of incentives for forest banking (Sullivan et al., 2005); here we use a slightly higher figure to account for a lower economic development. The minimum price of land documented is equalized by PES projects paying between $55 to 250/ha-year depending on contract length and discounting; the payments made by some PES programs in Mexico are within this range (e.g. PROBOSQUE). Likewise the net present value of PES would match the value of the 15% percentile of land prices for payments in the range of $300 to $1250/ha-year.

Buying land for conservation may be a more cost efficient option in the long term in some cases, but will be highly controversial. In rural areas, especially in those located away from cities, land is one of the most important productive, social and cultural assets. The comparatively lower land prices will be influenced by the local poverty context (Martínez-Alier, 2004). If the payments set are a function of opportunity costs, they will systematically offer lower incentives in poor areas. Hence the search for lower payments when aiming for cost efficiency should be carefully assessed; especially when considering the benefits and savings that project intermediaries and buyers/users of the services may be obtaining (i.e. in carbon offsetting markets). The relative balance between cash and in-kind payments in incentive-based mechanisms should be also carefully balanced in such a way that the interests of the communities/landowners providing the environmental services and those of the financing bodies/users of those services are fulfilled; in any case the importance of each type of benefit could be negotiated as part of the PES agreement itself. How such win-win negotiations can be achieved in cases where the power relations may be very asymmetric is an important area for further research. Results presented here imply that although full opportunity costs are not covered, the value of pro-development interventions may increase the probabilities of enrollment. This would be more notable in rural areas away from cities where providing enhanced access to services associated with social, human and productive capital and employment would be more valued.

Although the general purchase of land for conservation can be contested on political, social and economic grounds, it must be borne in mind that when opportunity costs of land increase (due to urban expansion, or creation of infrastructure), landowners might sell the land. This is demonstrated by the process of urbanization in Mexico after the constitutional reform and the case of Guadalajara, as mentioned in Section 2.2. Under these circumstances, strict land use regulation is required otherwise voluntary participation in incentive-based mechanisms will not be sufficient to ensure provision. Purchase of land for provision of environmental services can offer a long-term solution in specific, limited, fragile or hotspot areas in exceptional cases e.g. wildlife corridors.

4.5. Potential enrollment into PES in the study region

Apart from the effect of Guadalajara's urban opportunity costs, there is a positive potential for participation in PES in forested areas in the region. This is particularly noticeable for *ejido* communal areas, as 97.6% of the responses were positive about their inclusion into PES. In the *ejidos* were the surveys were applied these areas represent one third of the *ejido* land, and there are up to around 100,000 ha in the region (RAN, 2011). When participants were asked if they would reforest areas not currently forested (i.e. private land and individual *ejido* parcels), 26.8% answered positively indicating they would afforest grasslands that are used for grazing. However, this could have been affected by a drought in 2011 which reduced livestock profitability (Toledo, 2012). Agricultural areas would not be afforested: in the region, prices for sugar cane were around $48/ton and for maize $400/ton and yields were 120 t/ha and 10 t/ha respectively. However the potential for agroforestry is high since 96.4% of those owning agricultural areas were positive about planting trees as windbreaks. This indicates that agroforestry practices may be attractive for landowners since they do not require full land conversion and may thus represent a viable option to enhance certain environmental services (e.g. carbon sequestration) (Balderas Torres et al., 2010). Afforestation of grasslands and establishment of windbreaks can be funded through alternative sources of income in carbon markets for forestry offsets.

Other than the external pressures of urban opportunity costs, factors that need to be considered for potential applicability of these results to other sites are related to the type of ecosystems and management practices developed by the forest-holders. Forests in dry environments similar to those in the La Primavera region offer relatively few options for productive uses that target cash-markets, the most common being seasonal agriculture and grazing. In more humid areas, *ejidos* and landowners may be already engaged in productive forestry practices which may not be eligible for participation in PES. Moreover, at the community level certain institutional conditions and local social capital are required for successful implementation (e.g. Bray et al., 2006). Nevertheless results from the surveys are mirrored by experiences observed in the national PES program and on-going projects in the voluntary carbon markets. Most of the land committed to PES by *ejidos* in Mexico corresponds to communal-use areas (Muñoz Piña et al., 2008). On the other hand agroforestry practices, such as windbreaks and shade coffee, are commonly practiced in the projects developed in the voluntary carbon markets (De Jong et al., 1995; Balderas Torres et al., 2010). In some areas they may represent up to 90% of committed land, as demonstrated by the Scolel Té project in Chiapas (Quechulpa-Montalvo, personal communication). This indicates that, in general, preference for inclusion of common-use areas and agroforestry practices under PES can be extrapolated to other sites once particular conditions (e.g. opportunity costs from urban development) are taken into account. Naturally this will depend on whether such forest management practices are considered eligible under the given PES scheme.

Currently there is a PES-like project under design in the La Primavera area based on the results of the project funded by the Darwin Initiative. The project includes the conservation of about 1100 ha, and reforestation of 100 ha more in one of the wildlife

corridors. It also includes pro-development interventions (i.e. a development community center, tree nursery, computer center and high school facilitation). The budget required for ten years of operation of this project is around $125/ha-yr. This is in line with the higher end PES programs in Mexico. Moreover it is important to note that, although the associated pro-development activities represent an important share of the costs (close to 50%), the social benefits expected from them can offset and exceed the overall costs of the project.

This research describes the general characteristics of an incentive based mechanism designed to finance conservation practices in the region. In the study area (Fig. 1), the development of a PES scheme targeting existing forested areas would require $16.3 million per year at the current payment level of the national PES program, ($22.2/ha-yr) or close to $90 million at the rate expected for the pilot project. Pro-development interventions could benefit over 250,000 persons living in around 400 rural settlements in the region (i.e. settlements of 100 to 2500 inhabitants). The total population in the area, excluding the metropolitan area of Guadalajara is around 720,000 (INEGI, 2010b). Maximum potential implementation for windbreaks through agroforestry projects would be around 112,000 km (considering the perimeter of average parcels of 4 ha). If one quarter of the grasslands were reforested this would represent around 40,000 ha of new forests. For the purposes of biodiversity conservation, particular attention should be given to the areas linking La Primavera to other forested areas as they are critical for the movement of wildlife; although these may represent only around a thousand hectares. The long term viability for these projects depends on the capacity to create the financing mechanisms to value the environmental services provided by the ecosystems and improved management practices. If these mechanisms adequately target demand, then there will be more chances of generating sustainable financial flows (Pagiola et al., 2002). The potential participation of landowners in incentive based schemes, as presented here, needs to be complemented by an assessment of the potential environmental services produced in the territory (e.g. hydrological, landscape, carbon sequestration, biodiversity), a study of the demand and valuation of these services among different users (i.e. local in Guadalajara and non-local in the carbon markets), and the creation of an institutional framework to link the producers and users (e.g. a public PES program or projects focused on the carbon markets).

5. Conclusions

Rural areas tend to maintain greater levels of natural capital while urban areas concentrate assets and expertise around financial, productive and institutional human and social capitals. PES and market mechanisms address this dichotomy, focusing on the valuation of natural capital to link the users of the environmental services in developed areas with the providers in rural areas. These interventions are devised to deal with the environmental externalities commonly considered by economists to represent market failures. However poverty can also be seen as a failure to generate and maintain adequate levels of human, productive, social and financial capitals. An integrated strategy to valorize environmental services could include mechanisms not only to ensure the flow of natural services from rural to developed areas, but also to transfer resources specifically linked to human, social, productive and financial capitals into rural areas appropriate to the local contexts, while ensuring the provision of environmental services. Results of this study show that landowners prefer PES schemes including co-benefits that increase local levels of human and productive capital. Including the co-benefits may reduce the importance and dependence on cash payments and would increase the chances for participation. However we consider that the mix of cash and in-kind compensation should be negotiated by the financing body and local providers as part of the agreement sought in a market based mechanism. The potential participation diminishes in the presence of high opportunity costs from urban areas. In these areas benefits and co-benefits offered by PES projects might not suffice to prevent forest conversion into other land uses. Thus other policy options, such as land use restrictions, monitoring and sanctions should be considered to capture the value of environmental services in these areas.

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