



Indigenous communities' perception regarding payments for environmental services programme in Oaxaca Mexico



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ABSTRACT

Payments for environmental services (PES) programs have been implemented during the last 10 years in Mexico, and nearly 20 percent of the beneficiaries are indigenous communities; however, little has been said regarding the impact of these interventions on indigenous groups. This study analyses the link between PES outcomes and the characteristics of indigenous communities, such as identity and language, world view and territory, government, collective work and household economy. The study includes four Zapotec communities located in the state of Oaxaca. The main results suggest the importance to adapt the PES programme to indigenous communities that preserve their identity and language; and the possibility that PES programme is crowding in the relation between household and natural resources and certain variables related to government and collective work.

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1. Introduction

Mexico is widely known for its biological, cultural and ecosystem richness. More than 71 per cent of its territory is covered with forest vegetation, and 39 per cent of this territory is inhabited by communities that depend on the forest for their livelihood (Carabias et al., 1994; Torres, 2010).

Payments for environmental services (PES) are one of several instruments that Mexico has designed and implemented to protect its natural resources. PES is a volunteer economic instrument, defined by Wunder (2015) as “voluntary transactions between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services”.

PES has been implemented in Mexico since 2003, and it is considered one of the main instruments for natural conservation in that country (Rodríguez and Ávila, 2013).

Additionally, in Mexico, 9.5 per cent of the population is indigenous (CDI – PNUD, 2000) and in 2008, 20 per cent of the PES programme was implemented within indigenous communities (UNAM, 2012). Moreover, Shapiro (2013) argues that the programme has been oriented to indigenous communities highly marginalised.

Although some researches show positive relationships between natural resource conservation and indigenous communities knowledge (Kosoy et al., 2008; Muller, 2008; Juanwen et al., 2012), there are some remarks that market instruments could generate negative

changes in attitudes towards natural resource conservation (Locatelli et al., 2008; D'Adda, 2011; Narloch et al., 2012; Rico et al., 2013).

Despite this evidences, minimal work has been performed analysing the effects of the economic incentives such as PES programmes on indigenous communities. This study proposes to analyse the link between the perception of PES outcomes and certain characteristics of the indigenous communities involved, such as identity and language, world view and territory, government, collective work and household economy. This relation seeks to establish certain considerations for discussing some elements of crowding in and out effects.

1.1. The analysis of Mexico PES Programme

The Mexican PES programme has been implemented for the last 12 years and has changed in this period of time. First the programme was designed just for hydrological services, and one year later the programme included biodiversity conservation, agro-forestry systems and carbon sequestration (Muñoz-Piña et al., 2008). The beneficiaries and the State through The National Forestry Commission (CONAFOR for its acronym in Spanish) signed an agreement for a payment conditional to natural resource conservation in the areas selected based on vegetation type and conservation status criteria. The agreement expires after five years, but can be extended for five years more (Balderas et al., 2013). CONAFOR do the monitoring through satellite images or field visits (McAfee and Shapiro, 2010).

Different types of land tender can apply to the programme,

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thus, communities and private proprietary land are committed to do activities such as fire brigades, firebreaks, trenches, etc. According to the forest type and conditions CONAFOR pays between US\$ 19–73 per hectare per year. Recently (2015), the beneficiaries must invest the 50% of the money received in conservation activities, but some years ago each one invests it as they wanted.

The PES programme in Mexico has evolved in the last 10 years (Rodríguez and Ávila, 2013). Despite constant changes in terms of reference designers are looking for a better programme. However, the diversity of territories and conditions has not been recognised in the design or programme implementation.

The effects of PES have been evaluated with different objectives and methodologies. Three main topics of evaluation can be identified: programme participation (Balderas et al., 2013; Kerr et al., 2012; Kosoy et al., 2008; Neitzel et al., 2014), outcomes through avoided deforestation and community perceptions.

The avoided deforestation has been constantly analysed. De Janvry and Sadoulet (2006) note that PES programs have failed to prompt the additionality, because payments are provided to people who, without incentives, would preserve their forests. In addition, Muñoz-Piña et al. (2008; 2011) and Alix-García et al. (2008, 2009, 2011) note that the objective of implementing the PES programme in areas with important water scarcity problems or with high deforestation risks has not been achieved.

On the other hand, using perception analysis, Corbera et al. (2009) find that the Mexican PES programme has increased household income, improved forest management and strengthened social organisations. Perevochtchikova and Rojo (2015) have evaluated the perception on PES program in the peri-urban area of Mexico City finding differences between the authority and the beneficiaries.

Rico et al. (2011) argue that the PES programme prompts positive attitudes towards natural resource preservation, reduces deforestation and prevents fire. Nevertheless, when PES is compared with integrated conservation and development projects, Rico et al. (2013) find that a PES programme promotes minimal social capital, and the preferences for the PES instrument are associated with short-term monetary and utilitarian reasons.

Although there is evidence regarding PES programme outcomes, the PES programme impacts on indigenous communities and on crowding in/out effects remain unknown.

1.2. PES programmes in indigenous communities

Where traditional livelihoods are supported by natural resources use, there is a relationship between cultural aspects and biological diversity (Hong, 2013).

In Mexico, 9.5 per cent of the population is indigenous (CDI – PNUD, 2000), in 2008, 20 per cent of the PES programme was implemented within indigenous communities (UNAM, 2012), and in 2013 Shapiro argues that the programme has been oriented to indigenous communities highly marginalized.

Indigenous is defined by the Indigenista National Institute (INI, 2000) as a group of people who share pre hispanic cultural traditions, preserve a native language, and accept and recognize their identity as indigenous. In Mexico, Navarrete (2008) suggest five elements that characterize and define indigenous communities: close relationship with the territory, the existence of an assembly where decisions are taken, free service for community needs, collective work and rituals.

The previous elements show that indigenous communities have a strong link with their territory and consequently with their natural resources.

Although there are some studies of PES in indigenous communities, there is few evidence about PES programme outcomes related to indigenous communities characteristics.

Muller (2008) analyses a PES scheme in indigenous communities in Australia. The author emphasises that indigenous communities have knowledge and unique values that must be recognized by PES programmes, and find that PES has the potential to reduce poverty in those communities. In the same country, Zander et al. (2013) show that PES has empowered indigenous communities and it has improved natural resource management.

Redd (2011) analyses the ideological problems in indigenous communities associated to Reducing Emissions from Degradation and Deforestation (REDD) in Ecuador, where they feel that payments for global environmental services could reduce their culture, territory and autonomy.

In the Mexican experience, Kosoy et al. (2008) finds that “Iacandona” indigenous communities have positive perception about PES program. Corbera et al. (2009) include in their analysis one “zapoteca” indigenous community, but no specific results are mentioned about indigenous aspects. On the other hand, Muradian et al. (2010) and Pascual et al. (2010) argue that PES programme in Mexico has not additionality because it is implemented in indigenous communities that always preserve their resources.

2. Methods

PES programmes were analysed in four indigenous communities (Zapotec), located in Oaxaca State (Mexico). Oaxaca is the State with the greatest biological and cultural richness of Mexico (Escalante et al., 1993; García-Mendoza et al., 2004), 60 per cent of their population are indigenous of 16 different ethnicities, and the Zapotecs are the first indigenous group in Oaxaca and third in Mexico (De Ávila, 2004; Schrader-Kniffki, 2004). In addition, Oaxaca had the greatest area under PES programme in the period 2003 – 2011 (SEMARNAT et al., 2012).

The communities selected are: San Miguel del Puerto, La Merced del Potrero, San Juan Ozolotepec and San Francisco Ozolotepec (Table 1). The criteria for selecting those communities are as follows: years as a beneficiary of the PES program, the number of indigenous households in relation to the total population, and communities with different socio-cultural characteristics that are part of “Sistema para la conservación de la biodiversidad” (SICOBI), which is a network community system implemented by an NGO for sustainable production.

These communities have been participating in the programme since 2003/2004 to 2013/2014, that is, approximately 9–10 years. Therefore, the programme perception to PES is measured in the same period of time. These communities are located in Oaxaca, approximately two hours from cities such as Huatulco, a national tourist location, and Miahuatlan, an important city in Oaxaca's mountains. Therefore, these communities are influenced by the same regional activities, tourism, trade and agriculture. Nevertheless, on a municipal scale, the national statistics indicate that the average annual per capita income is \$US 138 (CONEVAL, 2012), and the main economic activity is agriculture. Some research in Oaxaca has shown that these communities preserve certain economic, organisational and ritual traditions (Joyce, 2010). As in our study area, we can find different levels of traditions (language, collective work, trust, and governance).

In addition, during the national revolution, the territory in Mexico was divided and communal landownership was created, as in our area of study. The particularity of that kind of property is that landowners have private land and common land; the latter is shared with the community. Decisions regarding the common land are conducted via an assembly; therefore, the governance system is particularly important to study.

Finally, in the region, SICOBI was created ten years ago by an NGO to promote sustainable diversification; it has an important

Table 1
Total and Benefited PES Programme Area.
Source: Prepared by the authors

Community	Total area (ha)	Program area ^a (ha)	Program area (%)
San Miguel del Puerto	8.188	1.626	19,9
La Merced del Potrero	7.521	3.000	39,9
San Juan Ozolotepec	7.006	1.191	17,0
San Francisco Ozolotepec	1.811	403	22,3
Total	24.526	6.220	25,4

^a Data provided by CONAFOR - Oaxaca, 2012.

Table 2
Dependent Variables Selected.
Source: Prepared by the authors

Nº	Variable	Type of variable	Range
1	Change in time spent on protection	Continuous	[–5,60]
2	Pressures on ecosystems	Discrete 0: No pressure has decreased 1: One of both pressures has decreased 2: Both pressures have decreased	0–2
3	Forest conservation	Discrete 0: PES has not contributed to natural resource conservation 1: PES has contributed in one of the two characteristics 2: PES has contributed in both characteristics	0–2
4	Water availability	Categorical 0: The quantity of water available has not increased 1: The quantity of water available has increased	0 / 1
5	PES outcomes	Categorical 0: PES has not produced any results, or the results have been solely monetary 1: PES has produced positive results in natural resource conservation	0 / 1

role in the region in terms of organisational and financial support. SICOBI is a community network with a common fund that is used for investments in all communities; this allows a more efficient use of funding and subsidies. Technical assistance is provided by the NGO, which also provides recommendations on sustainable production. This network guides the PES programme in the communities (implementation and investment); therefore, to have homogeneity in the sample, we solely include those communities with a SICOBI PES programme in operation.

2.1. Approach to PES programme outcomes and variables selection

It is important to recall that, to achieve this study's objective, we are not proposing to perform an evaluation of the PES programme impacts; instead, our objective is to analyse the households' perception regarding the performance of the PES and how it relates to key characteristics of the community such as identity and language, world view and territory, governance, collective work and household economy.

The perception of PES programme results is measured using five variables, which attempt to capture changes in actors' behaviours and the perceptions of PES results. The type and range of each variable are presented in Table 2.

The selection of dependent variables was supported by previous researches (Corbera et al., 2009; Rico et al., 2011; Rico et al., 2013) and technical studies (COLPOS, 2004, 2008; UNAM, 2012) made in Mexico. The reason for considering five dependent variables is to capture the variety of possible PES outcomes in the indigenous communities.

The first variable, "Change in time spent on protection", is the difference between the number of days the household spent on

forest conservation, before and after the implementation of a PES programme and was measured with the following two questions: How much time (days/year) did you spend in natural resource protection (planting, vigilance, preventing or extinguishing fires) before PES programme implementation? Additionally, how much time (days/year) do you spend in natural resource protection (planting, vigilance, preventing or extinguishing fires) after PES programme implementation?

The second variable "Pressures on ecosystems" examines the household perception of PES outcomes in relation to the decrease of commercial hunting and uncontrolled burning in community forests. The variable uses a Likert scale for the answers to the following questions: The commercial hunting in community forests is less, the same or larger than 10 years ago (before PES programme implementation)? Additionally, the uncontrolled burning in community forests is less, the same or larger than 10 years ago (before PES programme implementation)?

The third variable "Forest conservation" is the household perception of PES outcomes regarding: Forest cover conservation and Biodiversity conservation within the community territory. This variable is a Likert scale of the answers to the following questions: Do you agree (yes/no) that the PES programme has contributed to preserving the traditional plants and animals used by locals in the community forests? Additionally, do you agree (yes/no) that the PES programme has contributed to preserving the forest cover area?

The fourth variable "Water availability" is the household perception of water resource availability in the dry season. This variable is the answer of the question: Do you agree (yes/no) that the PES programme has contributed to increased water availability in the dry season?

Finally the fifth variable, "PES outcomes", is the general household

Table 3
Independent Variables Modelled.
Source: Prepared by the authors

Group	Variable	Description	Expected relation
Identity and language	Indigenous	Self-recognition as indigenous people	(+)
	Language	Understand their native language	(+)
	Condition	Perception of natural resource conservation	(+)
	Frequency	Number of times the household visits the forest	(+)
	Number of reasons	Number of reasons (associated with the use of natural resources) to go to the forest	(+)
	Home Remedies	Knowledge and use of home remedies	(+)
	Corn Blessing	Traditional practice of blessing the agricultural plot	(+)
	Hunting	Preserve hunting traditions	(+)
	Festivities	Participate in traditional festivals	(+)
Governance	Positions	Participate in "sistema de cargos" (Unpaid religious and political positions that confer prestige within the community)	(+)
	Sanctions	Perception of sanctions following the breach of agreements	(+)
	Accountability	Perception that the government is transparent and accountable to the community	(+)
Community work	Tequio	Preserve the "tequio" practice (The entire community works voluntarily toward common goals)	(+)
	Organisations	Participate in local organisations	(+)
	Cambio Mano	Preserve the "cambio de mano" practice (reciprocal community work on a volunteer basis)	(+)
Household economy	Size	Household size	(+)
	Annual Income ^a	Household annual income	(+)
	Agricultural Income ^a	Annual agricultural income of the household	(+)
	Non-agricultural Income ^a	Annual non-agricultural income of the household	(+)

^a The income was estimated using two methods. The survey includes the direct question. "In which of the following ranges is your family's annual average income?" In addition, for each activity and for each member of the family, we estimated the annual income by requesting agricultural, livestock and apiculture production, commercial, employment and remittance (The survey does not include government transfers).

Table 4
Population and Survey's Number by Community.
Source: Prepared by the authors

Community	Population	Households	Surveys	Households surveyed (%)	Error (%)
San Miguel	1.500	375	100	26,7	6,6
La Merced	2.500	625	111	17,8	6,7
San Juan	875	219	45	20,6	10,3
San Francisco	1.000	167	50	30,0	9,2
Total			306	23,7	8,2

perception of PES outcomes in the community; it is the answer to the question: Do you think that PES programme outcomes are positive or negative? If they are positive, could you explain why?

The selection of independent variables was performed according to INI (2000) and Navarrete's (2008) definition of the indigenous communities and the hypothesis to be tested. Navarrete argues that characteristics such as territory, government forms, individual and collective free work, and cultural reality (rituals, worldview) can help to define indigenous communities, and from INI we incorporated identity and language aspects.

Additionally, we use the social capital theory for analysing some elements such as cognitive ones (attitudes, shared values, beliefs, customs, code of conduct, trust, and reciprocity) and structural aspects (governance and conflict resolution rules, social participation, law enforcement and community commitment), that have been previously studied and might have an important influence on PES outcomes (Pretty and Ward, 2001; Grootaert and van Bastelaer, 2002; Westlund, 2006; Liu et al., 2014). Finally, we include socioeconomic variables (Table 3).

In Table 3, we include the relation expected (positive, negative or neutral) between PES programme outcomes and the characteristics of the households. The hypothesis to test is if there is a positive relation between the independent variables and the perception of PES programme outcomes. For instance, to preserve identity and language, customs related to world view and territory,

governance and collective work increase the probability that PES programme results will be perceived positively (analysed across the five dependent variables selected).

2.2. Survey design and fieldwork

In a first stage we made seven interviews to key actor from: CONAFOR Oaxaca, GAIA (a non governmental organisation that has helped the communities with PES programme), SICOBI (a local community organisation that coordinates PES programme in the localities) and CIESAS (Center for Research and Higher Studies in Social Anthropology) in order to define clearly the variables and survey format.

In a second stage, in June–July 2012 and April 2013, we conducted the survey with 306 households. We surveyed, on average, 23 per cent of households in the four communities, generating an estimated level of error below 11 per cent (Appendix A). Households were selected from a non-random convenience sample (Kelley et al., 2003). Table 4 shows the number of surveys in each community.

The household survey included 54 structured (dichotomous and Likert scale) questions divided into six sections: general household information, beliefs, household – natural resources relation, institutional development, the household economy and PES perception (Appendix A). The differences between communities and households in the variables defined previously could be captured using polls as analysis technique.

Table 5
Summarised Descriptive Statistics by Community.
Source: Prepared by the authors

Variables	San Miguel	La Merced	San Juan	San Francisco
Indigenous identity	< 50%	>80%		
Preserve the language	< 10%	50%	< 10%	> 80%
Perception of forest condition	Good >60%			Regular > 40%
Frequency of forest visits	Frequent (40%) (1-5 times in a week)	Less frequent (> 35%) (Once - twice a month)		Sporadically (40%) (1-4 times in a year)
Ritual hunting subsistence (Thanks to nature for hunted animals)	No thanks (>60%)	No thanks (< 50%)		Thanks (> 30%)
Preserve ritual cornfield blessing	< 50%	> 50%	< 50%	
Currently has a “cargo” (position in the community)	< 10%		10 – 40%	> 50%
Perception of accountability	<70%	> 80%		
Known sanctions	< 70%		> 90%	
“Tequio” practice	> 80%	< 70%	> 80%	
“Cambio de mano” practice	> 70%	< 70%		> 70%
Participate in organizations	< 70%	> 70%	< 70%	> 70%

In the San Francisco Ozolotepec Community, the survey was conducted with an interpreter because not all who were interviewed spoke Spanish.

2.3. Data analysis

First, descriptive statistics are presented to analyse the context of the communities and the dependent and independent variables. Then, we estimated five econometric models using STATA software. The general form of the model is:

$$Y_{ij} = \mathcal{F}(IL_i, WT_i, G_i, CW_i, HE_i)$$

Y_{ij} The perception of PES outcomes of household “i”, measure by the dependent variable “j”

i: 1,2,3,...306 households

j: 1 (*Change in Time spent on protection*), 2 (*Pressures on ecosystems*), 3 (*Forest conservation*), 4 (*Water availability*), 5 (*PES outcomes*)

IL_i Identity and language variables, from household i in dependent variable j

WT_i World view and territory variables, from household i in dependent variable j

G_i Governance variables, from household i in dependent variable j

CW_i Collective work variables, from household i in dependent variable j

HE_i Household economy variables, from household i in dependent variable j

Depending on the characteristics of each dependent variable, econometric models use different specifications ranging from lineal multiple regressions, to logistic regressions (binomial, multinomial and ordered), to capture the particularities of each model related to the nature of the dependent variable.

3. Results

As we indicate in the methods section, the description of communities' context includes certain elements of identity and language, world view and territory (perception of forest conservation, frequency of forest visits, hunting, and cornfield rituals), governance and collective work practices (accountability, sanctions, organisations and traditional collective work practices) and household economy.

When analysing the independent variables across the communities, important differences among these were observed, as summarised in Table 5. San Miguel exhibited the lowest percentage of people preserving their indigenous customs (indigenous identity and language, hunting and cornfield rituals and collective work practices), whereas San Francisco showed the largest percentage of people preserving their traditional indigenous characteristics. In addition, La Merced and San Juan are communities that preserve more traditions than San Miguel but less customs than San Francisco.

Finally, the total annual income per household was similar among communities (US\$4.185 dollars of 2013). Agricultural activities produced 33%, and 51% was the result of non-agricultural activities (tourism, employment in the second and third sectors, and familiar trades).

The analysis of dependent variables show that, after implementation of PES programmes, the households increased, on average, 5,6 days the time spent in natural resource conservation, and San Francisco is the community that spent more time in those activities (7,2 days). The variable, *Pressures on ecosystems*, shows that 65 per cent of households perceived that the PES programme has contributed to reducing commercial hunting and uncontrolled burning in community forests; San Francisco and San Juan are the communities that perceived more changes in term of pressures reduction.

In accordance with the variable related to *Forest conservation*, 44 per cent of households perceived that the PES programme has contributed to forest cover conservation and biodiversity conservation,

Table 6
Econometric Models for measuring PES programme and Household Characteristics.
Source: Prepared by the authors

Variable		Model 1 TIME	Model 2 PRESSURES		Model 3 FORESTS	Model 4 WATER	Model 5 RESULTS
		MLR (Coeff)	Mlogit ^b (Mg Eff)	Ologit ^b (Mg Eff)	Ologit ^b (Mg Eff)	Blogit (Mg Eff)	
Identity and language	Indigenous Language	– 1,17*	0,05* ^a		– 0,17***	– 0,21***	
World view and territory	Good Conditions		0,11*	0,12*			
	N Reasons		– 0,07***	– 0,07***	0,08***		– 0,12***
Governance	Festivities		0,32***	0,27***			
	Position	1,62*					
	Account	2,71***	0,14*	0,15*			
Collective work	Sanctions		0,22***	0,25***	0,11*		0,16**
	Tequio			0,14*			0,26***
Household economy	Cambio de mano	2,26***				0,10**	0,21***
	Organisation	2,09***			0,10*		
	Size	0,37***				0,03***	
	Nagrop_Income	– 0,03***					– 0,001*
N		306	306	306	306	306	306
Pseudo R ^b		0,1500 ^c	0,1122	0,0929	0,0480	0,0850	0,1603

Significance:

M: Model, MLR: Multiple linear regression, Mlogit: Multinomial logit, Ologit: Ordered logit, BL: Binomial logit

^a Significance for variables in the marginal effects of category 0 (no pressures have reduced).

^b Significance for variables in the marginal effects of category 2 (both pressures have reduced).

^c For Lineal multiple regression models, this presents an adjusted R².

* 90%

** 95%

*** 99%

and San Miguel is the community with the highest percentage of recognition of such change (76%).

Conversely, the variable related to *Water availability* showed that the 73 per cent of households perceived that the programme has not contributed to increase the quantity of water available in the dry season.

Finally, the variable related to *PES outcomes*, shows that 69 per cent of households recognized that the PES programme has contributed to natural resource conservation, San Francisco was the community that presented the highest percentage (96%).

The next step was to examine the effects that those variables have on the dependent variables regarding PES perceptions. The estimated regressions are summarised in Table 6, which shows relevant variables and their significances.

The multiple linear regression related to *Change in time spent on protection* showed significance for seven independent variables. The positive signs obtained in governance and collective work showed that those groups of variables increase the time spent in natural resource conservation. The negative signs obtained for indigenous identity and non-agricultural income reflect the inverse relation between those variables and ecosystem conservation.

The results of *Pressures on ecosystems* multinomial model and ordered logit models showed the significance of six variables. The signs obtained in the models again indicate a positive relation between governance variables and the perception of PES outcomes in the pressure reduction on the ecosystems. In addition, we found that positive perceptions of natural resource conservation and participation in traditional festivities increase the probability of perceiving PES outcomes in reductions on ecosystem pressures. Additionally, the negative sign obtained for the indigenous variable reflects that preserving identity reduces the probability of perceiving reductions on ecosystem pressures.

The results of *Forest conservation*, through an ordered logit model, showed relevance of four independent variables. There was a positive relation between governance and collective work variables and the perception of PES outcomes related to forest and biodiversity conservation. The negative sign obtained for the language variable showed that preserving language reduces the

probability of perceiving forest conservation.

The fourth model (binomial logit) related to *Water availability* reflected the relevance of three independent variables; we found a negative sign for the language variable and positive relations between the traditional practices of collective work and the probability of perceiving PES outcomes in water availability.

Finally, the *PES outcome* model (binomial logit) returned five significant independent variables. According to the previous results, we found that governance and collective work variables increase the probability of perceiving positive PES outcomes in natural resource conservation. Additionally, as we found in the first model, this model identified an inverse relation between non-agricultural income and PES outcomes in ecosystem conservation.

In four models, identity and language variables showed that the self-acknowledgement of indigenous people does not guarantee the achievement of PES goals of environmental conservation. Although the variables were not significant in all five models, the sign obtained in all was negative.

In the World View and Territory group variables, we found no significance for the home remedies, cornfield blessings and hunting rituals variables. These variables should be analysed in communities that maintain such traditions.

The relevant variable, “Conditions”, showed that the perception of a strong conservation status is related to positive PES outcomes. Additionally, the Festivities variable indicates that respect for traditions corresponds to positive PES results.

The significance and signs of Governance variables (cargo, accountability and sanctions) showed that recognized, respected and trusted governance contributes to positive PES outcomes. Similarly, the Collective Work variables emphasised that cooperation and commitment favour positive PES results.

Finally, the Economic variables indicated that households with large numbers of family members invest more time in natural resource protection. Additionally, in two models, the non-agricultural income variable (agriculture and livestock) with a negative sign showed that this income reduces positive PES results.

4. Discussion

The main objective of this study is to analyse the perception of PES programme and the link with certain characteristics of the indigenous communities. To address this objective, we analyse five dependent variables and their relation to identity and language, world view and territory, government, collective work and household economy. These dependent variables constitute a new approximation to quantitatively measure PES outcomes from household perceptions and changes on behaviour. The diversity of outcomes that a program can have, are difficult to measure using only one dependent variable, therefore, it was useful to use five different models. In addition, if one independent variable is significant in more than one model results can be more conclusive. In addition, different types of models can be applied depending on the kind of variable used. Changes in actors' behaviour are measured through changes in the household time spent on natural resource protection, and perceptions of PES outcomes is approximated by inquiring about pressures on ecosystems, forest conservation, water availability, and natural resources preservation.

This approach allows understanding the strengths and limitations of the PES programme implementation (Baird et al., 2009; Perevotchikova and Rojo, 2015). Nevertheless, it is important to be aware that perceptions do not ensure answers with total rationality (Oviedo, 2004). Next, we discuss the results obtained for each independent variable.

Results obtained reflect a negative sign or an inverse relation between the indigenous and language variables and PES programme outcomes. These results have two implications. The first implication is in accordance with Agrawal and Gibson (1999), who argue that successful environmental management in indigenous communities is not a guarantee. In our study, we find that San Francisco (the community that preserves more traditions than the others) is the community with the worst natural resource conservation status. The degradation of natural resources within indigenous territories is explained in this case by low levels of income and education, strong migration, and modification of the relationship between households and ecosystems. Pyrovetsi and Daoutopoulos (1997), Sah and Heinen (2001), Allendorf et al. (2006), Vodouhê et al. (2010) show evidence that natural resource degradation in indigenous communities are caused by low levels of education and environmental awareness and low participation in conservation programs. Despite, that San Francisco preserves indigenous customs; and the influence of environmental programs and environmental knowledge transmitted by SICOBI's, PES programme has not achieved the expected results. This result means that identity and native language are less important for PES perception and are replaced by other variables.

Moreover, Muradian et al. (2010) and Pascual et al. (2010) argue that the PES programme additionality is low in Mexico because the programmes are implemented in indigenous communities that preserve natural resources with or without payment. In contrast, we can argue that, in accordance with Holland et al. (2014), it is not possible to state a generalisation because the indigenous communities analysed prove that retaining the indigenous identity and the native language do not guarantee natural resource preservation. Additionally, San Francisco is a suitable example because the community preserves its identity, language, governance and collective work practices; however, they have exacerbated their natural resources more rapidly than the other communities. Although, San Francisco has much less land per household increasing the possibility of overexploitation of natural resources, they have proportionally more land in the programme (22%) than largest communities such as San Juan Ozolotepec (17%) or San Miguel del Puerto (19%). Therefore, outcomes of the programme could be similar. However, in San Francisco results show that other elements apart from customs and land have an influence.

The second explanation is related to the possibility that PES programme does not consider the cultural richness presented in the communities. The programme is not understood in indigenous households, and this reduces the probability to perceive positive PES programme outcomes. Descriptive statistics showed that indigenous households have lower knowledge of the program, resulting in an erroneous definition of the program's goals, compared with the non-indigenous households. In joint forest management, Matta and Alavalapati (2006) have obtained similar results; they argue that there is a gap between actor's perceptions of environmental problems and the environmental actions, given the differences among knowledge, personal and global benefits and the programme weakness.

As we previously cited, indigenous communities are constantly changing, all the communities studied here are indigenous; however, the characteristics between them are very different.

On the one hand we have that being indigenous does not guarantee conservation and on the other hand if economic instruments or environmental policies consider cultural richness and heterogeneity outcomes can be potentiated. Thus, it is crucial to re-think and adapt PES considering indigenous characteristics.

Related to natural resources and community relations, we find that, when the relationship between household – forest has changed (in terms of absence of forest in household lands, low levels of forest visits, few non timber forest products uses), market instruments such as PES can crowd in a positive relation. The results of the *Change in time spent on protection* variable showed that, after the implementation of a PES programme, households spend more time in natural resource protection, on the one hand, because the community must achieve the agreements established by the PES program; on the other hand, they perform these activities as a "tequio", a volunteer collective work practice. In addition, the *PES outcomes* variable showed that, in San Francisco (the community with the highest percentage of population with indigenous identity and language), PES outcomes are 96 per cent related to the perception of natural resource preservation. These results are in accordance with Locatelli et al. (2008) and Wunder (2013) who argue that PES can contribute to environmental awareness.

This finding is opposed to the argument that instrument affects negatively ancestral cultural processes based on the human – nature relationship, since market instruments can generate changes in conservation attitudes because monetary incentives can replace intrinsic motivations (Martin et al., 2008; Kosoy and Corbera, 2010; Vatn, 2010; Gómez-Baggethun, 2011; Rico et al., 2013). We suggest that it is possible that market instruments do not replace intrinsic motivation for conservation, instead promote it, when the instrument hosts some relevant social practices such as tequio, socialize the information in the assembly, and take important decisions about the financial resources investment as a consensus with landowners.

In all the models, we find a positive relation between governance and collective work and PES programme outcomes. Elements such as the participation in a cargo system, the positive perception of account and sanctions, the preservation of traditional practices such as tequio and cambio de mano, and the participation in community organisations increases the perception of positive PES outcomes (the variables sanctions and cambio de mano practice were significant in three models).

Our findings are in accordance with some authors (Behera, 2009; van Hecken and Bastiaensen, 2010; Bouma and Ansink, 2013; Bennett and Dearden, 2014; Bremer et al., 2014) who note the importance of social capital in environmental protection. The existence of structural and cognitive social capital increases the probability of perceiving better PES programme results. Additionally, after 9 or 10 years of implementing the PES programme in the four communities and the communities' consequent movement around the PES programmes across SICOBI work, which reflect high levels of knowledge and

participation, we can argue, in accordance with Tai (2007), that the efforts in conservation crowd in social capital and collective action and strengthen the institutional development. Hence, we provide evidence of a two-way relation when communities have a governance system, have trust, cooperation and organisation, and there is a structured intermediary that strictly conducts PES implementation; they increase the possibility of positive PES programme outcomes.

In addition, we also find that because the PES programme was implemented a long time ago, and the means for this implementation (PES programmes promote: organisation through productive committees, collective work through “tequio”, PES programme accountings in assemblies and the economic incentive to increase household income through participation in new productive activities), the programme can promote social capital and institutional development.

Frequently, the economic variables include total income, and the findings have shown that a higher income level is related to positive programme results (Jones et al., 2012; Matta and Alavalapati, 2006; Neitzel et al., 2014). Nevertheless, in the household economy variables, we find that the non-agricultural income (remittance, manufacture, commercial, and formal employment in second and third sectors) in those communities is paramount because the high level of migration, particularly to the United States, and the proximity to an important touristic centre make the non-agricultural income a variable that must be analysed in more detail. Non-farm income represents a high proportion of total income in Mexican rural households, due to push factors such as poverty or pull factors, and few studies have evaluated the relevance for environmental policies (Cerón-Monroy and Yúnez-Naude, 2015). In this study, diversification provides income and probably assets to the communities moving their interest to other livelihood strategies than the ones related to conservation.

5. Conclusion

The findings of the case studies analysed show that it is possible to approximate to PES outcomes throughout different variables, and a diverse game of variables provides stronger results. The evidences show that the indigenous communities analysed perceive positives PES programme outcomes, and the positive outcomes in forest preservation are related to the recognition of multiple actors and interests (negotiation, rule-making, conflict resolution), and imply the need to understand their different institutional arrangements and social capital. The results emphasise the importance to adapt the PES programme to indigenous communities that preserve their identity and language and the possibility that PES may lead to a crowding in the relations between household – natural resources, government and collective work elements in indigenous communities.

The question of whether PES leads to crowding in/out effect in indigenous communities remain addressed; a first step is to understand the importance of the heterogeneity of socio-economic and cultural variables. For Mexico, the answer to this question is that, according to the cultural richness of the country, PES has made enormous progress (most likely the results are related to the role played by NGOs, which are promoting the programme in the communities); however, a better focalisation of the programme considering this heterogeneity remains necessary.

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Appendix A Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.ecoser.2015.11.013>.

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