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Payment for Hydrological Services Programme Effects in Rural and Peri-urban Communities: Comparison of Two Experiences in Mexico

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Abstract

Payment for Environmental Services (PES) has been analysed in many countries, but few studies address the influence of urban and rural characteristics on the perception of PES results. The aim of this study is to compare the perceptions of Mexican hydrological PES programme results in a peri-urban community close to Mexico City and in a rural community on Oaxaca state. Despite some similarities between the two communities, we find evidence of some differences in their peri-urban and rural characteristics, in their PES understanding, operation and effects. Those differences are related to individuals' close contact with natural resources in the rural area, opportunity costs, income diversification, and intermediaries. The reflections also suggest that it is important to analyse deeper the PES programme context, because there are differences in environmental, economic and social aspects that influence the effects of PES in terms of motivations, economics and institutional arrangements.

Key Words: *Payments for Environmental Services, Rural and Peri-Urban Characteristics, Mexico.*

Introduction

Ecosystems benefit society by providing goods and services for direct and indirect uses (MEA 2005) in rural and peri-urban contexts (Allen 2003). To compensate land tenures that conserve ecosystem services, the Payment for Environmental Services (PES) programme was created as an environmental public policy instrument (Rodríguez and Avila 2013).

PES is 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 is an economic tool that has been implemented in Latin America for almost two decades (Pagiola 2008; Engel *et al*. 2008). The importance of PES in public policy has been widely recognized (Perevochtchikova 2014); thus, politicians and scholars have been interested in improving the design, implementation and evaluation of this instrument. There are PES studies that examine institutional arrangements (Muradian *et al.* 2013; Hayes et al. 2015), other studies analyse the socio-environmental effects of the programme measured through the participation and permanence of beneficiaries (Kosoy *et al*. 2008; Lapeyre *et al*. 2015, the additionality of the programme with respect to conservation of the forest and conditionality (Engel *et al.*

2008; Alix-Garcia *et al*. 2011) and socioeconomic impacts (Wunder 2013). In addition there are studies that compare case studies in the same or different PES programmes (Brouwer *et al.* 2011; Mahanty *et al*. 2013; Sattler *et al*. 2013).

The literature evaluating the impacts and effects of PES raise issues related to the lack of institutional analysis in the design and implementation of PES (Corbera *et al.* 2009; Vatn 2010), the low level of additionality of the programme (the programme is not implemented in areas in which the vegetation cover will be reduced without payments) (Rico *et al.* 2011; Muradian *et al.* 2013) and the high opportunity costs of land in comparison with the amount of compensation (Neitzel *et al.* 2014; Bremer *et al.* 2014).

The Mexican Federal PES started in 2003 for hydrological services, but currently, the programme comprises multiple schemes (such as encouraging decreased for carbon emissions and biodiversity and local mechanisms) and has expanded throughout the national territory (with dominance in forest areas with collective ownership). The programmes are constantly evaluated as an institutional obligation or as an academic interest (PUMA - UNAM 2012). The main criticisms of the programme highlight the high opportunity cost, the low amount of compensation, the low level of additionality and administrative inefficiencies (Muñoz *et al.* 2011; Muradian *et al.* 2013); and the uncertain assumption that the preservation of forest cover does not always imply the conservation of ecosystem services (Madrid 2011).

In addition, it has also been noted that there is high heterogeneity in the effects of the programme and in the localities that receive payments, even though they are similar at the National Forestry Commission (CONAFOR) eyes, because all share the same selection criteria among others having at least 50% forest cover and high levels of marginalization (Alix-Garcia *et al.* 2010). The diversity of beneficiaries is due in part to the social inequalities in the rural sector but is also related to the heterogeneity of the social and environmental contexts in which the beneficiaries are immersed (communities, ejidos and small landowners). Hence, PES communities are located in peri-urban and rural contexts, which have different biophysical, socioeconomic, cultural, institutional and infrastructural conditions. In this regard, no evidence in the literature exists comparing the effects of PES in peri-urban and rural areas (Bremer *et al.* 2014). Neitzel *et al.* (2014) have shown that opportunity costs and additionality are key aspects in peri-urban areas. Indeed, beneficiaries decision to participate is influenced by the context because the opportunity cost for conservation is generally higher in peri-urban areas due to the elevate price of land as a consequence of urban expansion and real estate investments. Moreover, additionality could be higher in urban context since deforestation pressure increase constantly to due urbanisation, especially in developing countries. On the other hand, rural communities can be more attentive to their natural resources and they can have greater interest in PES programme and the goals could be achieved quickly. But, in addition, transaction costs related to information bias and equity could depend on other context aspects such as the intermediaries or the institutional arrangement more than to the urban proximity.

Therefore, this study aims to analyse whether community's characteristics influences the perception of the effects of the federal PES programme related to hydrological services in two Mexican communities: a peri-urban community close to Mexico City and a rural community on the mountains of Oaxaca state.

PES Programme in Rural and Peri-urban Communities

The PES programme was created to conserve healthy ecosystems, and the providers of environmental services (ES) are usually located in rural areas with a high probability of having extensive forest cover. Meanwhile, the users (or buyers) of ES are located in the lower parts of basins where the hydrological ES are used by the population or other economic actors (industry). Brouwer *et al.* (2011) and Wunder (2013) noted that one of the factors that influence the success of PES is a clear definition of the participants. In addition, as noted by Newton (2012), it is important to analyse the heterogeneity of the suppliers and buyers, their characteristics, and the contexts where the programmes are implemented. In the case of suppliers, it is particularly important to understand socioeconomic, environmental and cultural differences.

In the Mexican experience, the federal PES programme is mostly implemented in rural areas but can also be found in peri-urban areas (PUMA-UNAM 2012; Neitzel *et al.* 2014) because the land tenure system in peri-urban areas remains collective (ejido or community), with high levels of forest cover and marginalization, thus fulfilling the eligibility requirements (Perevochtchikova 2014). In the case of hydrological PES implementation, the programmes have focused on the upper parts of watersheds because it is assumed that forest cover contributes to the preservation of the water cycle (Cortina and Saldaña 2014). In this regard, we have no evidence of comparative PES studies of peri-urban and rural areas and generally very few addressing peri-urban areas (Pérez *et al.* 2012). Such comparisons are important because proximity to cities modify environmental, socioeconomic and cultural community characteristics, it can affect the opportunity costs of land as its value increases and economic activities become better compensated. In addition, urban pressure generates high rates of deforestation, and the PES programme may have higher additionality in peri-urban areas than in other areas.

Conversely, in rural communities, indigenous languages are often used, and there is usually a high level of illiteracy. Thus, the opportunities for diversification to non-agricultural activities such as the service sector may be lower.

Peri-urban concept is relatively easy to identify, but it is difficult to conceptualize (Lerner and Eakin 2011). Nonetheless, there is consensus in three elements: peri-urban zones are placed around a city, they cannot be used for urban development, neither for exclusively rural activities. On the other hand, rural zone definition is related to localities inhabited by populations of less than 2500 people (www.inegi.org.mx), where the main economic activities are agriculture, forestry and environmental conservation (Avila 2009).

Peri-urban areas are as important as rural areas in term of environmental services that they provide to the cities: water runoff conservation, carbon capture, biodiversity preservation, and natural aesthetics enjoyment (Vejre *et al.* 2011). The federal PES programme in Mexico does not use urban proximity as criteria for selecting areas, because the objective is to protect forest cover independently to their location. But as we noted before the context as "the cultural, social, economic, political and spatial settings and processes that shape the environments in which communities live, and that constrain and/or enable the life" (Panelli 2002) could be different in peri-urban and rural communities and it could affect PES programme outcomes.

PES Perception Studies

Internationally, PES studies have been developed using different conceptual frameworks and have followed different theories and approaches (Perevochtchikova and Oggioni 2014). These studies have been supported by a host of methodological tools, given their different objectives and contexts. For example, documentary analysis has been used as well as reviews of official reports and project evaluations (Muñoz-Piña *et al.* 2008). In addition, the perceptions of actors based on interviews and surveys have also been widely examined (Kosoy *et al.* 2008; Barsimantov 2010; Castro-Diaz 2014; Rodríguez *et al.* 2016). Some studies examine the perception of PES from a socioeconomic perspective include Martinez and Kosoy (2007), which analysed the economic impact of PES. Brunett *et al.* (2011) determined the willingness to pay for environmental services. The study conducted by Daniels *et al.* (2010) evaluated the impact of PES on forest regeneration.

PES perceptions appear to be a useful approach for analysing opinions and effects of the programme (Perevochtchikova and Rojo 2015). In addition, perceptions provide information to understand PES implementation processes at the local level and lessons learned for implementing environmental conservation programmes more broadly. PES perception studies generally use interviews, surveys and questionnaires. For example, Silvano *et al.* (2005) and Lamb (2008) analysed the perceptions of beneficiaries using PES measurement variables such as the percentage of income for PES, beliefs about management problems and environmental awareness. Kosoy *et al.* (2008) and Corbera *et al.* (2009) interviewed both sides of a PES scheme, users and providers, to understand the organization, social

perception and institutional work involved in such a programme. Therefore, in this study, we decided to analyse the perceptions of ES providers about the federal programme in Mexico in two communities with different social, economic and environmental characteristics.

Methods

Study Areas

The analysis was conducted in two study areas (Figure 1.), La Merced del Potrero (hereafter La Merced) is a rural community located in the south-western of Mexico, in the highlands of Oaxaca, in the upper watershed of Rio Copalita and Zimatán, which is one of the most important watersheds of the state's coast. And San Miguel and Santo Tomas Ajusco (hereafter El Ajusco), which is located in the territory named as Conservation Land of Mexico City. Geographically, its position corresponds to the upper part of the south-western fringe of the Mexico Basin.

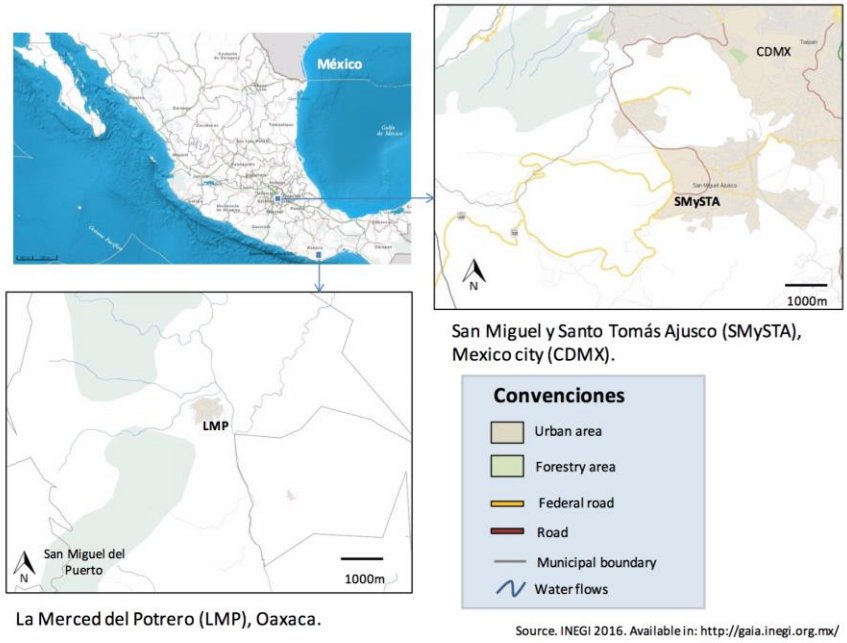

Figure 1. Study area.

According to the literature available Table 1 highlights the main similarities and differences between the two study areas selected, in environmental, social and economic characteristics and in the PES programme implementation.

The main differences between communities are that El Ajusco is a peri-urban community due to the proximity to Mexico City, with a lower illiteracy rate and greater economic diversity to the service sector. La Merced in contrast is a rural community with a high illiteracy rate, and its economic activities are predominantly agricultural.

On the other hand, La Merced is part of SICOBI (Community System for the Management of Biodiversity), which is a community network that was formed with the support of GAIA NGO (Autonomous Group for Environmental Research). SICOBI is the intermediary in the PES programme and promotes sustainable productive activities in nine communities to maintain ecosystem services in the Copalita - Zimatán - Huatulco hydrological system (GAIA 2001).

In El Ajusco there are no intermediaries between the community and the Federal government, just a forest technician who is in charge of managing the participation of the community in the programme, he organized and verified the PES compliance.

Table 1. Similarities and differences in the study areas

Features			El Ajusco	La Merced
Communities' characteristics	General information	Community location	Upper part of Mexico Basin	Upper part of Rio Copalita watershed
		Community area	7,619 ha	7,521 ha
		Community and cities	The community is around the city	The distance to the nearest city is 3 hours (Dirt road)
	Environmental	Dominant vegetation	Temperate forest (pine, oak, fir)	Deciduous, cloud and pine-oak forest
		Annual precipitation	1,086mm	1,500 – 2,500mm
	Social	Population estimated	29,781	2,500
		Landowners	604	570
		Level of education	8 years of study	The rate of illiteracy is 40%
		Native languages	No body preserves native languages	More than a half of households heads preserve it
	Economic	Income	The average income is US$ 300	The income per capita (2012) is US$144
		Economy sector	The 61% of the population is in tertiary sector	Agriculture is the main economic activity in the region

Source: Authors based on SIDESO (2000), GAIA (2001), INEGI (2010) and CONEVAL, (2012).

Method for comparing the two case studies of La Merced and El Ajusco

The perception of the PES programme's effects on the beneficiaries in the two selected communities was examined using data from two face to face surveys that were developed independently in each area. In El Ajusco, 108 surveys were applied in March 2012 to locals directly involved in the activities in the PES programme (90% of direct beneficiaries). In La Merced, 87 surveys were applied in June 2012 to PES programme beneficiaries within the community (which, based on the probability of being a beneficiary of the programme, represents an error of less than 10%).

The methodological sequence followed highlights three steps. The first step was defining the topics of analysis: Description of the environmental and socioeconomic characteristics that highlights the differences between the communities in terms of which community is peri-urban and which is rural. The operation of the PES programme that provides evidence of the perception of programme functioning in each community. And description of the effects of the PES programme, that examines the perceptions regarding the programme's effects in terms of environmental, social and economic developments in each community.
In the second step, we identified the variables to be used from each study to describe the three analysis categories defined above (Table 2). And, we selected the variables and the questions to be quantitatively compared. For the comparison, we considered similar questions, and when the answers were qualitative, we categorized them.

Finally, in step 3, the data analysis was conducted using descriptive statistics for the selected variables. Hypothesis testing was based on the variables analysed to confirm the existence of significant differences between the groups (communities).

For the continuous variables, we estimated the global mean differences (in groups - communities) using Student's t-test by following the null hypothesis (H_0) of no differences between the means of the variables in the groups analysed at a 10% level of significance. For the categorical variables, we estimated the global proportion differences (in groups - communities) using the statistical "z" (standardized value for large samples) by following the null hypothesis (H_0) that there was no difference in the proportions of a variable between groups at a significance level of 10%.

Table 2. Variables selected for the description of overall results.

Analysis categories		**Variables**
Socioeconomic and environmental description	*Environmental*	Perception of goods and services that forests provide to the community Use of natural resources and problems associated with them in the community
	Social	Household characteristics (household size) Age, education and position of the participant in the community
	Economic	Productive activities in the household Average monthly household income Government transfers
Programme operation		Knowledge and definition of the programme's objectives Motivation for participating in the PES programme Activities in the PES programme
Effects of the programme	*Environmental*	PES programme conservation outcomes Environmental contributions of the PES programme
	Social	Capacity building Cohesion Confidence Cooperation
	Economic	Income generated by the programme per household PES income vs. Total revenue (per household)

Source: Authors.

Results

The results are presented according to the three topics of analysis defined previously: 1) environmental and socioeconomic description, 2) PES programme operation and 3) PES programme effects and 4) Community comparison.

Environmental and Socioeconomic Description

The environmental context indicates that in La Merced, 75% of the participants perceive their forests to be in good or very good condition, and 100% of them recognize that their forests provide environmental benefits to society. In addition, 97% of the participants recognize that there are agreements in the community for ecosystem protection. However, 44% of them highlighted that there are no sanctions when the agreements are breached. The main environmental issues identified in this community are related to the strong pressures from uncontrolled fires, commercial hunting and illegal logging.

In El Ajusco, we highlight that 100% of the surveyed participants recognize the importance of the Conservation Land of Mexico City, and 68% of them note that community forests provide environmental services to the city and to society in general (60.2%). The environmental issues identified in El Ajusco are related to water resources, 94% of the respondents recognize lack of service or poor management or pollution. Moreover, 38% of the participants highlight problems associated with soil resources (pollution and mismanagement), and 35% note problems with forest resources (mismanagement, illegal logging, and forest fires) and air quality.

The results for the social aspects in La Merced show that the average number of household members is 4, the average age of participants is 51 years, and their average level of education is 4 years. In addition, only 9% of the participants hold a position in the community (cargo system). In El Ajusco, the average household size is 4, the average age of the participants is 33 years, the average level of education is 7.5 years and the percentage of participants who hold a position in the community is 4.6%.

Finally, the economic variables show that in La Merced, the average number of economic activities per household is 3. Those activities mainly include agricultural, livestock and other activities as informal employment or apiculture. Those activities generate an average monthly income[1] of US$ 360 (2012 year dollars). This income does not include government transfers, which are received by all households.

In El Ajusco, we find evidence that on average, households practice between one and two economic activities. Only 33% of the participants practice agricultural activities and 14% practice livestock production. The economic activities yield an average monthly income of US$ 283 (2012 dollars). This amount does not include government transfers, which are received by 21% of the households.

PES Programme Operation

Regarding PES programme operations, from 2003 to 2012, La Merced was a beneficiary of the PES programme in hydrological services from CONAFOR, which was implemented on a total of 3,000 ha. La Merced is part of the Community System for the Management of Biodiversity (SICOBI in Spanish), which is a community network that was formed with the support of the non-governmental organization the Autonomous Group for Environmental Research (GAIA in Spanish). GAIA promotes sustainable productive activities in nine communities to maintain ecosystem services in the Copalita - Zimatán - Huatulco hydrological system. GAIA has acted as the intermediary for the PES programme since 2003, and SICOBI guided decision-making regarding expenses and investments of the federal programme. In general, the PES income spends on wages for those who perform the activities described in the programme regarding best management practices (PMPM in Spanish) and also for the development of productive projects such as beekeeping, agroforestry, organic farms, and community shops, among others.

In addition, in La Merced, 93% of the respondents are familiar with the program, 83% can correctly define its objectives and 58% consider the programme to be relevant for the protection of natural resources, among other benefits. Between 1 and 2 members of each household participate in activities under the PES programme, and they perform an average of three activities listed in the better practices management programme (PMPM), such as digging ditches, creating gabion dams and firebreaks, reforestation, and participation in workshops, among others.

Since 2004, El Ajusco has participated in the PES which was implemented until 2012 on a total of approximately 5,000 ha. El Ajusco was the first area involved in the federal PES programme in Mexico

[1] It is important to note the methodological differences in income estimation that conduce to the results obtained. In El Ajusco the monthly income was estimated with the next question, what is the monthly household income? And in La Merced is the sum of annual income estimated for each economic activity of each household member, divided by twelve months

City. There are no intermediaries between the community and the Federal government, with the exception of a forest technician from 2010-2013 who was in charge of managing the participation of the community in the programme and organizing and verifying compliance based on the programme's best management practices (PMPM in Spanish); the practices were made by a group of volunteer participants (community members, family and friends).

In El Ajusco, we find evidence that 65% of the participants are familiar with the programme's objectives, and of these, 76% can accurately define them. Moreover, 39% consider the programme to be relevant for natural resource protection. In addition, another 76% can correctly define the activities to be performed for the programme, and 56% have participated in programme activities this year.

PES Programme Effects

Regarding the environmental effects of the programme in La Merced, we find that 90% of the respondents believe that the results of the programme are positive, and 98% note that the programme has contributed to the conservation of natural resources in the community. In addition, 90% note reductions in the pressure on ecosystems (illegal logging, commercial hunting and uncontrolled fires), 77% indicate that the programme has helped to preserve the forest area or to conserve biodiversity in protected ecosystems, but only 13% perceive contributions from the programme to the quality or quantity of water available in the community. The results for the environmental effects in El Ajusco show that all of the participants recognize that the programme promotes the conservation of natural resources, and 95% see direct outcomes in conservation; nevertheless, when we ask for a description of the results, 54% fail to provide specific examples.

The social effects in La Merced show that the programme has succeeded in promoting social organization based on the creation of committees, which 82% of the respondents participate in (including reduced consumption of firewood, vegetable gardens, community space trading, agroforestry, and raising chickens). In addition, 50% of the participants highlight that some PES activities are carried out as a voluntary action called tequio; hence, the programme promotes community cooperation and the preservation of traditional practices of collective work. Regarding trust, only 64% of the respondents are familiar with the distribution of PES programme resources, but 84% know about the activities carried out with such resources.

In El Ajusco, the results for the social effects indicate that 99% of the respondents believe that the programme has strengthened the internal capacities of the community to make better use of the forest. In addition, 96% emphasized that the programme generates social cohesion (in relation to contributions to collective work and conflict resolution) inside and outside of the community. Finally, 95% note that the programme has generated greater environmental awareness.

The results regarding the effects of the programme on household economics in La Merced show that 60% of the participants receive payments for temporary days worked in conservation activities, but the average annual household income generated by PES wages is US$ 63 (2012 dollars), which is equivalent to five working days per year on average (US$ 13 per day). Thus, the income generated under the programme represents an average of 2% of the respondents' monthly household income. However, it is important to note that 82% of the respondents engaged in productive committees through different activities to generate additional monetary resources for households. Thus, 52% recognized positive results for the generation of household income (among other reasons).

In El Ajusco, the results for the effects on household economics reveal that on average, each household that participates in the programme receives US$ 179 (2012 dollars) monthly for a period of 2 to 3 months per year, and they perform different conservation activities defined in the PMPM (US$ 8 in 2012 dollars per day). Thus, the income provided by the programme represents on average 17% of the monthly income generated by the households in one year. However, during the months in which they participate in the program, it provides on average 84% of the household income.

Community Comparison

To identify whether the results obtained for each community are similar or different, in Table 3, we present the overall differences in the means or proportions for each variable. It must be noted that there are significant differences in the socioeconomic and environmental communities descriptions. The results show that in the rural community of La Merced, the population relates more to the natural resources and their production of goods and environmental services. They have lower levels of education and a high degree of diversification, although agriculture and livestock production are dominant. In contrast, the peri-urban community of El Ajusco has younger participants in the programme who have more education, and activities in the services sector in particular have become more relevant than agricultural activities.

Nevertheless, the two communities have implemented the PES programme under the same terms and conditions, both communities share some physiographic and climatic characteristics, and they also share the importance of natural resource protection to ensure the availability of water resources for Federal District populations and important tourist centres such as Huatulco.

Despite the marked differences in socioeconomic and environmental characterizations, the results regarding PES operations in terms of programme definition by the beneficiaries and motivations for participating associated with income generation and natural resource conservation are similar. In addition, the environmental and social effects highlight positive outcomes in both communities. However, significant differences were observed in the importance or motivation to participate, which are strictly associated with conservation goals and the programme's economic effects in the two communities.

Table 3. Categories of analysis and criteria applied.

Variables			**Diff**	**La Merced**	**El Ajusco**
Socioeconomic and environmental description	**Environmental**	Beneficiaries who perceive that forests provide environmental services (%)	***	100	58,3
	Social	Household size	ns	4	3,7
		Age	***	51	33
		Education	***	3.8	7.5
		Position (Cargo) (%)	ns	9,2	4.6
	Economic	Households with agricultural activities (%)	***	100	32.6
		Households with livestock activities (%)	***	88.5	13.7
		Households with commercial activities (%)	ns	36.8	29.5
		Households with different activities (%)	ns	63.2	59
		Number of economic activities per household	***	2.9	1.4
		Average monthly household income ($US)	**	360	283
		Households that receive government transfers (%)	***	100	20.7
PES operation		Beneficiaries who correctly define the programme and its objectives (%)	ns	82.8	75.7
		Beneficiaries who associate the importance of the programme or	ns	41.4	48.5

		their motivation to participate in the programme to the generation of income (%)			
		Beneficiaries who associate the importance of the programme or their motivation to participate in the programme to the protection of N.R. (%)	***	36.8	17.5
PES effects	**Environmental**	Beneficiaries who perceive programme effects on N.R. conservation (%)	ns	97.7	95.1
	Social	Beneficiaries who perceive programme effects on community cohesion (%)	**	87.4	95.7
	Economic	Monthly average revenue generated by the programme (US$/month)	***	5.2	44.8
		Ratio of income generated by the programme to the average monthly household income (%)	***	2.1	17.4

Source: Authors.

Note: Differences are "ns" not significant, * 90%, ** 95%, and *** 99% levels of significance.

Discussion

The comparison of the two case studies reaffirm that one community has peri-urban characteristics and the other rural ones. Then, PES perceptions are analysed and discussed in terms of their environmental and socio economics differences.

The perception of environmental services is used as a variable that describes the environmental awareness of households, and we note that in La Merced, all of the households are aware of the importance of these services. This result likely reflects that the residents of La Merced have more contact with nature, and their livelihoods are based on the use of natural resources (Madrid 2011). In contrast, in El Ajusco, only half of the interviewed participants show awareness of the importance of environmental services.

Social description shows that age and education are significantly different between the programme participants. El Ajusco has a higher level of education. Moreover, in La Merced, the average age of the participants is 51 years, which reflects the process described by other authors regarding the aging of rural households (Yúnez and Taylor 2001; Dyer *et al.* 2005).

Regarding economic aspects, we note that a greater number of households in La Merced depend on agricultural activities, and at the same time, this community is more diversified. In El Ajusco, agricultural activities are much less important, and the members of the households perform fewer economic activities. In this community, 59% practice other activities in the tertiary sector, followed by the secondary sector. This result is related to providing services to the inhabitants of Mexico City, who view El Ajusco as a place of recreation, and/or performing activities in the urban area, given the wide range of work available in the city.

Finally, we note that the economy of La Merced relies heavily on government transfers, which is similar to other areas of the country (Yúnez and Taylor 2001; Dyer *et al.* 2005). With this brief description of the communities, we can show that the socioeconomic conditions of El Ajusco are linked to Mexico City, and

we can confirm that living in a peri-urban community reflects different conditions that could influence PES programme perceptions.

The similarities in PES perceptions between communities are associated with a high percentage correctly understanding and defining programme operations. Additionally, approximately 50% of the sample in both communities associate the importance of PES with household income. These results are in accordance with Caro-Borrero *et al.* (2015) for peri-urban communities. We showed that, even if the residents of rural and peri-urban communities have different levels of education and perform different economic activities, the PES scheme constitutes an interesting alternative that different actors can understand and that could positively affect the household economy, thus generating interest in participation (Bremer *et al.* 2014).

In addition, households in both communities believe that the programme has had positive effects, which is similar to other case studies (Kosoy *et al.* 2008; Muñoz *et al.* 2008; Rico *et al.* 2011; PUMA-UNAM, 2012; Rodríguez and Avila, 2013, Caro-Borrero *et al.* 2015). Positive effects are associated with best management practices, the promotion of attitudes in favour of conservation, environmental awareness and reductions in pressure on forests.

Analysing the statistically significant differences (99%), we note that in La Merced, more households decide to enrol because they believe that the programme is important for environmental conservation. This result might be analysed in two ways. It could be due to a closer relationship between the rural community and its natural resources based on the residents' multiple uses of such resources (using fuel wood for subsistence; gathering berries, fungi and comestible plants called quelites; collecting medicinal plants; and walking to reach their plots). Hence, the frequency with which the forests are visited can strengthen the relationship between a household and its natural resources and therefore strengthen the motivation to be a beneficiary of the programme by following conservation objectives, as Lapeyre *et al.* (2015) and Bremer *et al.* (2014) noted.

On the other hand, it is possible that the high opportunity costs of the land and to invest time in conservation activities in peri-urban areas reduce the probability to participate in PES programme just for intrinsic motivations. As Neitzel *et al.* (2014) argue that the implicit assumption that in peri-urban areas the PES adequately cover the opportunity costs seems rather unlikely. According to that, the probability to gain additionality in peri-urban areas through federal PES programme seems equally unlikely.

The main differences in the PES effects between the communities are related to the economic aspects. The average monthly income generated by the programme and the percentage that it represents of total household income is very different in each community. This result is surprising because both communities have a similar number of landowners and a large number of hectares subject to the PES scheme. According to Muñoz *et al.* (2008), there is wide diversity in how communities invest monetary resources derived from the programme. There is no clear evidence in the field of consistent payments, investments and conservation activities. Each community independently decides the distribution of the amount it receives, either for community or household needs. Rico *et al.* (2013) showed that the money is distributed and spent individually based on household decisions.

When comparing the results, it appears that in La Merced, the income from the programme is significantly lower than in El Ajusco. The rural community invests in productive activities (ecotourism, apiculture, agroforestry, community stores, etc.) because the residents believe that in the future, those projects could offer them an important economic alternative. In contrast in the peri-urban community the financial resources are spread as wages in the landowners, and authors as Balderas *et al.* (2013) noted that PES programme revenues need to be oriented towards productive activities in peri-urban areas.

It is probably, that those findings are related to institutional context. In La Merced the PES programme is implemented by SICOBI (Community System for Biodiversity Conservation) a legally established regional organization, with rules, social control and incentives, constituted in 2000. In accordance with Clements *et*

al. (2010), who showed that benefits are spread more widely within communities that are linked and coordinated by local organizations.

Institutional aspects are recognized as being crucial to PES outcomes. Vatn (2010) argued that PES reconfigures the relationships between the market, the state and communities. Similarly, Petheram and Campbell (2010) and Kosoy *et al.* (2008) noted the importance of understanding the whole context and local dynamics.

In that sense, differentiating environmental and socio economic characteristics between rural and peri-urban areas is only a first step in analysing the context. But our results suggest that other elements as such institutional arrangements might also explain PES programme outcomes. Thus, these variables must be addressed in detail in rural and peri-urban communities.

Some analyses oriented towards PES beneficiaries only consider hectares enrolled in the programme and property rights (Muñoz *et al.* 2008). Other authors such as Clements *et al.* (2010) have proposed incorporate in the context description, actors and the institutional conditions in terms of organization, property rights, contracts, and local governance into the analysis. Bremer *et al.* (2014) identified elements such as opportunity costs, attitudes towards conservation and network importance. Thus, we highlight the importance of expanding the description of communities' characteristics for a better analysis of the environmental, social, economic and cultural realities.

In particular, we propose to consider environmental and socioeconomic characteristics, the institutional arrangements specifically the role of intermediaries. For La Merced, as mentioned previously, the organization that guides the PES programme has been essential to the programme's outcomes. As Neitzel *et al.* (2014) noted that intermediaries must collaborate extensively and create awareness in the community. Moreover, Kosoy *et al.* (2008) highlighted the importance of understanding the relationship between communities and intermediaries. And Petheram and Campbell (2010) have argued that brokers are actors who must recognize the dynamics of the context in which the programme is implemented.

Conclusion

We conclude that although La Merced and El Ajusco present different environmental and socio economic characteristics that allow us to affirm that one is rural and the other one is peri-urban, in both communities the PES programme has reached some results, the scheme is well defined in both communities, it represents an interesting alternative to local people, it has been understood by actors, and the outcomes have been perceived positively.

Moreover, we can argue that the rural community has more intrinsic motivations to participate in conservation activities than peri-urban community, likely because the residents of La Merced are closer to their natural resources and they maintain the traditions of their use in everyday life. For the peri-urban community, we find that the high opportunity cost to participate in the programme is a contextual factor that increases the general lack of interest in conservation in the community.

In addition, there are significant differences in the income obtained under the PES program, which is higher in El Ajusco. This result is partly explained by the institutional context and it needs to be analysed deeply.
The analysis of PES experiences in Mexico after 10 years of implementation in a peri-urban and a rural community allows us to reflect about the importance of community context in the programme design, implementation and effects. We highlight that although La Merced and El Ajusco have been part of the PES programme for almost a decade, their ecosystems share similar characteristics and they are national priorities for conservation. It is relevant to consider the whole context in the analysis of PES programme. As Ostrom (2009) and Mc Ginnis and Ostrom (2014) have noted in their proposal for socio ecological

systems analysis that include governance (institutional arrangements and specifically the intermediaries' role) among other characteristics.

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References

Alix-Garcia, J., Shapiro, E. and Sims, K. (2010). *The environmental effectiveness of payments for ecosystem services in Mexico*: Preliminary lessons for REDD. Draft Paper. Department of Agriculture and Applied Economic, University of Wisconsin, Madison.

Alix-García, J., Shapiro, E. and Sims, K. (2011). *Forest conservation and slippage: Evidence from Mexico's national payments for ecosystem services program*. working paper, University of Wisconsin, Madison.

Allen, A. (2003). Environmental planning and management of the peri-urban interface: perspectives on an emerging field. *Environment and Urbanization, 15*(1), 135-148.

Ávila Sánchez, H. (2009). *Periurbanización y espacios rurales en la periferia de las ciudades*. Procuraduría Agraria. México.

Balderas, A., MacMillan, D., Skutsch, M. and Lovett, J. (2013). Payments for ecosystem services and rural development: landowners' preferences and potential participation in western Mexico. *Ecosystem Services*, 6, 73-81.

Barsimantov, J. (2010). Vicious and Virtuous Cycles and the Role of External Non-Government Actors in Community Forestry in Oaxaca and Michoacán, Mexico. *Human Ecology*, 38, 49-63.

Bremer L., Farley, K., and Lopez-Carr, D. (2014). What factors influence participation in payment for ecosystem services program? An evaluation of Ecuador's SocioPáramo program. *Land use policy*, 36,122-133

Brouwer, R., Tesfaye, A., and Pauw, P. (2011). Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. *Environmental Conservation*, 38, 380–392.

Brunett, E., Baró, J., Cadena, E., and Esteller, M. (2011). Pago por servicios ambientales hidrológicos: caso de estudio Parque Nacional del Nevado de Toluca, México. *CIENCIA ergo sum*, 17(3), 286-294.

Caro-Borrero A, Corbera, E. Neitzel, K. and Almeida, L. (2015). We are the city lungs": Payments for ecosystem services in the outskirts of Mexico City. *Land use Policy*, 43,138-148.

Castro-Díaz, R. (2014). Implicaciones territoriales de los esquemas de pago por servicios ambientales (PES) en cuencas norandinas. *Cuadernos de Geografía*, 23(1), 61-74.

Clements, T., John, A., Nielsen, K., An, D., Tan, S. and Milner-Gulland, E. (2010). Payments for biodiversity conservation in the context of weak institutions: Comparison of three programs from Cambodia. *Ecological Economics*, 69, 1283–1291.

CONEVAL. Consejo Nacional de Evaluación de la Política de Desarrollo Social. (2012). *Informe de pobreza y evaluación en el estado de Oaxaca 2012*. Mexico: CONEVAL.

Corbera, E., González, C., and Brown, K. (2009). Institutional dimensions of payments for ecosystem services: an analysis of Mexico's carbon forestry programme. *Ecological Economics* 68, 443-761.

Cordero, D. (2008). Esquemas de pagos por servicios ambientales para la conservación de cuencas hidrográficas en el Ecuador. *Investigación Agraria: Sistemas y Recursos Forestales* 17(1), 54-66.

Cortina, S. and Saldaña, A. (2014). *Retos de la evaluación del programa de Pago por Servicios Ambientales de la Comisión Nacional Forestal*. En: Perevochtchikova, M. (coord.) Pago por Servicios Ambientales en México. Un acercamiento para su estudio. Mexico: Colmex.

Daniels, A., Bagstad, K., Esposito, V., Moulaert, A., and Rodríguez, C. (2010). Understanding the impacts of Costa Rica's PES: Are we asking the right questions? *Ecological Economics*, 69, 2116–2126.

Dyer, A., Taylor, G., Edward, J., and Yunez-Naude, A. (2005). Disaggregated Rural Economy-wide Models for Policy Analysis. *World Development*, 33(10), 1671-1688.

Engel, S., Pagiola, S and Wunder, S. (2008). Designing Payments for Environmental Services in theory and practice: an overview of the issues. *Ecological Economics*, 65, 663-674.

GAIA. Grupo Autónomo para la Investigación Ambiental. 2001. *Ordenamiento Comunitario del Territorio de La Merced del Potrero, Oaxaca.* Documento interno de trabajo. Procymaf, Fundación Ford, México.

Hayes, T., Murtinho, F. and Wolff, H. (2015). An institutional analysis of Payment for Environmental Services on collectively managed lands in Ecuador. *Ecological Economics,* 11,: 81-89.

INEGI. Instituto nacional de estadística y geografía. (2010). *Censo de Población y vivienda 2010*. Instituto Nacional de Estadística y Geografía, México. Available on line: www.inegi.org.mx

Kosoy, N., Corbera, E., and Broen, K. (2008). Participation in payments for ecosystem services: case studies from the Lacandon rainforest, Mexico. *Geoforum, 39*, 2073 – 2083.

Lapeyre R., Pirard, R. Leimona, L. (2015), Payments for environmental services in Indonesia: what if economic signals were lost in translation? *Land use policy*, 46, 258-291.

Lerner, A., and Eakin, H. (2011). An obsolete dichotomy? Rethinking the rural–urban interface in terms of food security and production in the global south. *The Geographical Journal, 177*(4), 311-320.

Madrid, L. (2011). Los pagos por servicios ambientales hidrológicos: Más allá de la conservación pasiva de los bosques. *Investigación Ambiental, Ciencia y Política Pública*, 3(2), 52 – 58.

Mahanty, S., Suich, H. and Tacconi, L. (2013). Access and benefits in payments for environmental services and implications for REDD+: Lessons from seven PES schemes. *Land use policy*, 31, 38-47.

Martínez, M., and Kosoy, N. (2007). Compensaciones monetarias y conservación de bosques. Pagos por servicios ambientales y pobreza en una comunidad rural en Honduras. *Revista Iberoamericana de Economía Ecológica*, 6, 40-51.

McGinnis, M. and Ostrom, E. (2014). Social–ecological system framework: initial changes and continuing challenges. *Ecology and Society*, 19 (2),30.

MEA. Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis. Milennium Ecosystem Assessment*. Island Press, USA.

Muñoz-Piña, C., Guevara, A., Torres J., and Braña, J. (2008). Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecological Economics*, 65,725–736.

Muñoz-Piña, C., Rivera, M., Cisneros, A. y García, H. (2011). Retos de la focalización del programa de pago por los servicios ambientales en México. *Revista Española de Estudios Agrosociales y Pesqueros* 228 (1), 87 – 113.

Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G., Garcia-Frapolli, E., Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J.F., Leroy, P., May, P., Méral, P., Mibielli, P., Norgaard, R., Ozkaynak, B., Pascual, U., Pengue, W., Perez, M., Pesche, D., Pirard, R., Ramos-Martin, J., Rival, L., Saenz, F., Van Hecken, G., Vatn, A., Vira, B., and Urama, K. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation Letters*, 6, 274–279.

Neitzel, C., Caro-Borrero, A., Revollo-Fernandez, D. Aguilar-Ibarra, A., Ramos, A. and Almeida-Leñero, L. (2014). Paying for environmental services: Determining recognized participation under common property in a peri-urban context. *Forest Policy and Economics, 38*, 46-55.

Newton, P., Nichols, E., Endo, W., and Peres, C. (2012). Consequences of actor level livelihood heterogeneity for additionality in a tropical forest payment for environmental services programme with an undifferentiated reward structure. *Global Environmental Change, 22*,127–136.

Ostrom, E. (2009). A general framework for analyzing sustainability of social–ecological systems. *Science* (New York, N.Y.), 325 (5939), 419–422.

Pagiola, S., (2008). Payments for environmental services in Costa Rica. *Ecological Economics*, 65, 712–724.

Panelli, R (Editorial). (2002). Young rural lives: strategies beyond diversity. *Journal of Rural Studies*, 18, 113-122.

Perevochtchikova M. (coord.). (2014). *Pago por Servicios Ambientales en México. Un acercamiento para su estudio*, COLMEX, México.

Perevochtchikova M., and Rojo Negrete I. (2015). The actors' perception about Payment schemes for Ecosystem Services. Study case of San Miguel and Santo Tomás Ajusco Community, Mexico. *Ecosystem Services*, 14, 27 – 36.

Perevochtchikova, M. and Oggioni, J. (2014). Global and Mexican analytical review of the state of art on Ecosystem and Environmental services: a geographical approach. *Investigaciones Geográficas*, 85, 47-65.

Pérez, E., Perevochtchikova, M., Avila, V. (coord.). (2012) *¿Hacia un manejo sustentable del Suelo de Conservación del Distrito Federal?* IPN, MA Porrúa, México.

Petheram, L., and Campbell, B. (2010). Listening to locals on payments for environmental services. *Journal of Environmental Management*, 91, 1139–1149.

PUMA-UNAM. Programa Universitario del Medio Ambiente. (2012). *Evaluación complementaria del ejercicio de los Programas Pago por Servicios Ambientales Hidrológicos S-110 y Pago por Servicios Ambientales derivados de la Biodiversidad S-136*. Ejercicio fiscal 2010. Informe Final. México D.F.

Rico, L., Ruiz, M., and Barraza, S. (2013). Motivation for conservation: Assessing integrated conservation and development projects and payments for environmental services in La Sepultura Biosphere Reserve, Chiapas, Mexico. *Ecological Economics, 89:* 92-100.

Rico, L., Ruiz, M., Reyes, F., Barraza, S., and Contreras, E. (2011). Efficiency of payments for environmental services: equity and additionality in a case study from a Biosphere Reserve in Chiapas, Mexico. *Ecological Economics, 70*, 2361-2368.

Rodríguez, K., and Ávila, S. (2013). Instrumentos económicos voluntarios para la conservación: una mirada a su surgimiento y evolución en México. *Sociedad y Economía, 25*, 75-106.

Rodríguez, K., Ávila-Foucat, V., Maldonado, J. (2016). Indigenous communities' perception regarding payments for environmental services programme in Oaxaca Mexico. *Ecosystem Services*, 17, 163-171.

Sandoval-Palacios, E., Gutiérrez Cacique, J. (2012). *Servicios Ambientales, experiencia federal en el Distrito Federal*. En: Pérez E., Perevochtchikova, M., Avila, V. (coord.). 2011. Suelo de Conservación del Distrito Federal ¿hacia una gestión y manejo sustentable?. México: IPN, MA Porrúa: 94-118.

Sattler, C., Trampnau, S., Schomers, S., Meyer, C. and Matzdorf, B. (2013). Multi-classification of payments for ecosystem services: How do classification characteristics relate to overall PES success?. *Ecosystem Services*, 6, 31-45.

SIDESO. Sistema de información del desarrollo social. (2000). Files TLP_12-112-1_C y TLP_12-117_1_C. Available online: http://www.sideso.df.gob.mx/index.php?id=68

Silvano, R., Udvardy, S., Cerony M., and Farley, J. (2005). An ecological integrity assessment of a Brazilian Atlantic Forest watershed based on surveys of stream health and local farmers' perceptions: implications for management. *Ecological Economics*, 53, 369– 385.

Vatn, A. (2010). An institutional analysis of payments for environmental services. *Ecological Economics*, 69, 1245–1252.

Vejre, H., Sondergaard, J., Thorsen, B. J. (2011). Demonstrating the importance of intangible ecosystem services from peri-urban landscapes. *Ecological Complexity, 7*(3), 338-348.

Wunder, S. (2013). When payments for environmental services will work for conservation. *Conservation Letters*, 6, 230–237.

Wunder, S. (2015). Revising the concept of payments for environmental services. *Ecological Economics*, 117, 234-243.

Yúnez A. and J. Taylor. (2001). The determinants of non-farm activities and incomes of rural households in Mexico, with emphasis on education. *World Development*, 29(3), 561-572.