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Payments for Water Ecosystem Services in Latin America: Evidence from Reported Experience

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Abstract

Payments for Ecosystem Services (PES) schemes are attracting increasing interest as policy mechanisms to improve conservation and sustainable development outcomes. PES initiatives aim to reach mutually beneficial agreements between providers and users of ecosystem services. In Latin America, with Costa Rica as the frontrunner, there are now more than two decades of experience in the implementation of PES schemes, which potentially represent a valuable source of knowledge for the improvement of the efficacy of conservation programs. Reviews and special issues dedicated to the study of PES exist, but they remain to most of their extent descriptive and qualitative. This paper presents the first study that systematically analyses the PES experience on the basis of a descriptive analysis of existing programs. The objective is twofold: (i) understanding the key features of existing PES mechanisms based on reported evidence; and (ii) identifying information needs for evidence-based policy design and implementation. We focus on water-related services since this type of service is involved in the majority of schemes. A database was constructed with 287 observations from 39 studies, from 1984 to 2011 in 10 Latin American countries. We find evidence confirming some known facts, such as deforestation and forest management as the main drivers of PES establishment, and revealing new ones, such as that average income for sellers is 60% larger than average buyers' payment for the service.

Keywords: PES, water ecosystem services, Latin America.

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1. Introduction

Payments for Ecosystem Services (PES) schemes are attracting increasing interest as policy mechanisms to improve conservation and achieve sustainable development outcomes. PES initiatives aim to reach mutually beneficial agreements between providers and users of ecosystem services, for instance, those related to watershed management, biodiversity protection, carbon sequestration or cultural services. PES agreements entail a reward mechanism for ecosystem managers (land users) for maintaining or improving the provision of environmental services valued by beneficiaries. For example, within a catchment, downstream water users would compensate managers upstream for land use change resulting in improved water quality or supply. Ecosystem services are increasingly reaching economic decision making through the widespread of PES (Gómez-Baggethun *et al*., 2010).

The most cited definition of PES is that given by Wunder (2005), by which a PES is defined as: "(a) a voluntary transaction where (b) a well-defined environmental service (or a land use likely to secure that service) (c) is being 'bought' by a (minimum one) service buyer (d) form a (minimum one) service provider (e) if and only if the service provider secures service provision (conditionality)". This is a practical definition that serves us here as a starting point. However, as it will be discussed further on, we show how evidence from existing literature raises some concerns over the applicability of certain of these criteria. For example, many hydrological PES are based on assumptions that have not being verified, like the belief that forests always increase total flows of water (Kosoy *et al*., 2007; Locatelli and Vignola, 2009). As a result, there have been very few PES schemes correctly fulfilling all the criteria above (Muradian *et al*., 2010; Van Hecken and Bastianensen, 2010).

Engel *et al*. (2008) discuss a number of reasons why PES are considered to overcome some of the limitations of other policy instruments for conservation. Face to command-and-control regulation, PES offer alternative livelihoods for local communities, are more flexible and allow for better targeting (focusing on areas/ecosystems with higher value in terms of service provisioning) and are also said to be more efficient and apply better in context of weak governance settings in developing countries. Face to integrated conservation and development projects, PES are said to overcome their main limitations: the fact that new activities often represent complements to existing activities rather than substitutes, failing to reduce pressures, and that, due to the fact that incentives are often delivered upfront, no recourse is available if environmentally damaging behaviour does not occur. Engel *et al*. (2008) also comment on the limitations PES face to environmental taxes (they assimilate them to subsidies and consider them second best options), and advocate for the 'policy mix'. But on the other side, PES are also receiving criticism (Muradian *et al*., 2010), where some authors have recently raised the concern

that marketing ecosystem services can modify the way humans perceive and relate to nature, and that this can be counterproductive for conservation purposes (Kosoy and Corbera, 2010).

The growing policy interest in PES is supported by an increasing attention on the scientific literature. The increasing experience of PES in the field and the accompanying literature is a very valuable source of knowledge for the improvement of the efficacy of conservation programs. Reviews and special issues dedicated to the study of PES exist to date. The journal *Ecological Economics* dedicated a full special issue to this topic in 2008 (Engel *et al*. (2008) set the stage for it), looking at new insights on design and implementation and discussing these in the light of environmental economics. The same journal released another special issue on PES in 2010 with different perspectives on the market instrument: from an environmental economics traditional perspective which encourages efficiency, to an ecological economics view that looks at the service flows (Farley and Costanza, 2010), and a more critical position where PES are seen as provoking nature's commoditisation (Kosoy and Corbera, 2010; Mcauley, 2006). More recently, the Spanish journal *Revista de Estudios Agrosociales y Pesqueros*, also produced an special issue on the perspectives and challenges of PES (editorial from Pascual and Corbera, 2011). While being very valuable, these reviews remain theoretical, or qualitative. Also, existing studies tend to focus on specific aspects of PES, such as their impact on poverty (Kosoy *et al*., 2007) or on deforestation (Daniels *et al*., 2010); with fewer studies discussing a wider range of issues.

The objective of this article is twofold. Firstly, we aim at increasing the understanding of key characteristics defining existing PES mechanisms based on reported evidence. For that, we focus on aspects such as the driving forces enabling the establishment of the schemes, the existence of intermediaries, the characteristics and types of service buyers and sellers, and the type of water services targeted in currently existing schemes, through a quantitative descriptive analysis. Secondly, in order to increase the potential of the PES experience for the improvement of conservation strategies, we look at identifying information needs for future PES designing and reporting for evidence-based policy design and implementation. As pointed out by Engel *et al*. (2008), the effectiveness and efficiency of PES depends crucially on program design. Therefore, a deeper understanding of the design elements of existing PES programs, as proposed here, is crucial for more effective design of future PES.

To meet the above described objectives, a database of 280 observations was constructed from 39 studies dating from 1984 to 2007[1]. The database covers 38 different PES schemes in 10 Latin American countries. Observations were obtained both from peer reviewed literature as well as grey

[1] 1987 to 2007 is the time period of the PES studies. Published papers analyzed here range from 2003 to 2011.

literature[2]. To our knowledge, this represents the most comprehensive compilation of PES studies in the literature. Previous studies include Landell-Mills and Porras (2002) that compiled 18 cases in Latin America and the Caribbean; and Porras *et al.* (2008), who updated the analysis up to 35 schemes.

Latin America has now more than two decades of experience in the implementation of PES schemes (Pascual and Corbera, 2011). Costa Rica, which is the clear frontrunner, has been implementing a national PES program known as PSA (Pago por Servicios Ambientales) since 1997. Its first phase, which lasted until 2000, it covered more than 300,000 hectares (Sánchez-Azofeifa *et al.*, 2007).

We focus on water related ecosystem services for several reasons. First, water services are involved in the large majority of current existing PES schemes (Locatelli and Vignola, 2009). Second, the water cycle embraces the ecosystem services heuristically, as presented in the Millennium Ecosystem Assessment (MA, 2005). From supporting, regulating, provisioning and cultural services, the water cycle provides a unique context to express the state of natural capital and flows between different ecosystem and the effects they produce on human wellbeing. It is not casual that the provision of water ecosystem services and the upstream-downstream dynamics are often used to illustrate the principles of the PES notion.

The remaining of this paper is as follows. Next, Section 2 describes the structure of the database and the main key components of PES. Section 3 presents the analysis of PES schemes, while Section 4 discusses these results. Finally, conclusions are drawn in Section 5.

2. Database Structure and Key PES Components

A database of 280 observations was constructed using information from 39 studies conducted from 1984 to 2011, and published between 2003 and 2011. Studies include both peer-reviewed (44.7%) and grey literature (55.3%). PES schemes appear in 10 different countries in South, Central and North America.

The selection of the studies was based on two criteria: (1) that the program is ongoing; and (2) the study is self-declared as PES[3]. The following diagram in Figure 2 illustrates the structure of the

[2] The choice of including also grey literature comes from the fact that we are interested in the actual schemes that are currently running, from which a significant number are only described in reports from agencies, environmental organization or government units (as Engel *et al.* (2008) point out, the discussion of PES mechanisms has very largely taken place in the grey literature).

[3] Note that it is the publication that refers to the study as a PES, it could be that the program itself does not self claim to be a PES.

database. This structure not only serves the analytical purposes of this study, but it also represents the structure and relationships of the key elements present on a PES. Given the complex structure of PES schemes, we have tried to synthesize programs dividing their components in four different categories: (i) context of the program; (ii) stakeholders; (iii) targeted service and actions; and (iv) contract details.

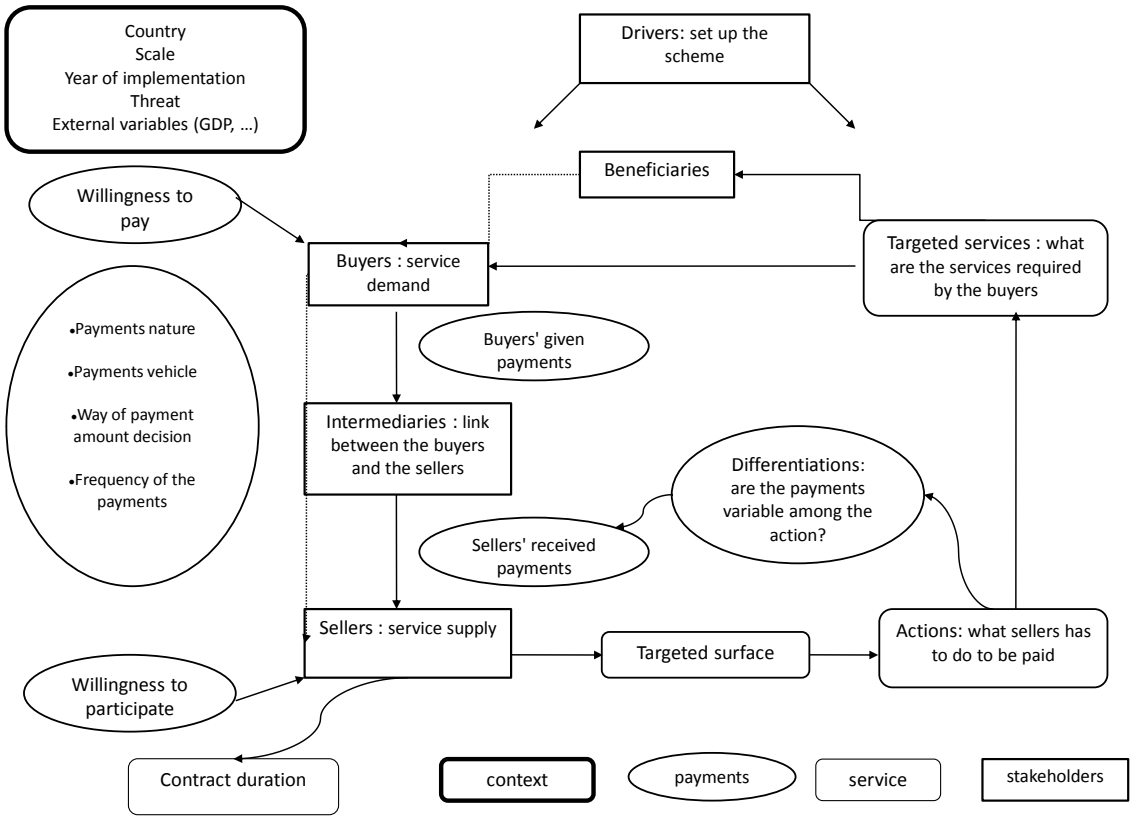

Figure 2: Database structure representing the key elements of a PES scheme

Next we describe each of these components and the way they have been included in the database:

i) Context: includes information about the country and the place where the PES is implemented (e.g. specific watershed), the scale of the program or scheme and the year of implementation. We have distinguished between local and national scale, by local we mean concerning one or several locations within one country, but not the whole country. We have also looked at the threat that is at the origin of the ecosystem service loss.

ii) Stakeholders: refers to the different parties involved in the PES, from which we distinguish two different categories: (1) 'implementation and management'; and (2) 'participants'. Among the *implementation and management* stakeholders we distinguish between 'drivers' (who are at the origin

of the PES initiative, promoting it) and 'intermediaries' (who mediate between buyers and sellers). Among the former, we are interested in the type of agent (e.g. international/national NGOs, municipalities, water utility companies, etc.) and the quantity (i.e. whether there is one or various drivers). Regarding the *intermediaries*, we look at whether they exist or not and if yes, what is their nature (e.g. NGO, municipality). Regarding the *participants*, two distinct categories exist: those who act for the service provision ('sellers') and those who demand the service ('buyers'). In both cases, we looked at their nature (i.e. farmers, domestic water users, hydropower producer, etc.) and how many are there. It should be mentioned that, in some cases, a distinction between 'beneficiaries' and 'buyers' exists[4]. However, this distinction is either not always clear or not present in all of the studied PES; therefore, in this analysis we focus on the buyers.

iii) Targeted service and action: A distinction needs to be made between the '*targeted service'*, i.e. the service that the buyers pay for, and the '*action'* that the sellers need to undertake to ensure the provisioning of the targeted service (and for which they are paid for). This distinction is important since, while for the buyers the payment is determined by the service provided (e.g. improvement of water quality), what determines the payment for the seller is the action that he/she needs to undertake (e.g. change on agricultural practices).

iv) Contract details: Includes information on the land (land use and the surface under PES contract), and on the duration of the contract. We also look at the amount of payment for buyers and sellers; if there exists different payment amounts for different sellers' actions (we call this '*differentiation'*), the frequency (one-off or periodical payments) and type of payment (e.g. cash or in-kind, etc.) and payment vehicle (e.g. water fee). We also look at how the amount was decided (i.e. negotiations including the participants or top-down decisions). Additionally, we look at whether a willingness to pay/participate study was carried out previous to the implementation of the scheme.

Table I in Annex summarizes the water PES studies analyzed here. Each PES scheme has information providing from at least one source (published paper or report). Some of the main characteristics of the scheme are shown in the table: the year of the study reporting the PES, the country and name of the site, and the geographical scale. The main agents and targets for the transactions are also indicated, including the targeted service, the action, and who are the sellers and buyers for those services.

[4] For example, in the case of Los Negros (Bolivia), the actual service buyers are the municipality, a NGO and an external donor, while the beneficiaries are the local population more broadly (Asquith *et al.*, 2008). As discussed by the authors, the program was intended for the final beneficiaries to actually make the payments, but (up to the date of publication) this had not yet happened.

3. Analysis of Latin American Reported PES Schemes

Following the structure previously defined, a descriptive analysis of the variables on the database is undertaken in order to better understand the key characteristics defining existing PES mechanisms based on reported evidence. We distinguish 3 levels in the descriptive analysis: the study level, the program or scheme level and the transaction level. The study level corresponds to those variables that are analyzed as varying across studies (e.g. whether a study is peer reviewed or not, or which is the year of publication). The program or scheme level corresponds to those variables that are interesting to be observed across programs (e.g. whether there is an intermediary or who the driver is). The transaction level corresponds to each of the observations included in the database and the characteristics of each particular transaction. One study can include several PES programs and each program can include a number of transactions (or observations). For example, variables such as the payment level or the action are observed at the transaction level.

a. Context of the Program

A quarter of the studies analyzed here are from Costa Rica (10). Ecuador follows, with 6 schemes. Bolivia, Brazil, Colombia and Mexico have four programs each. El Salvador and Nicaragua host 2 programs each, while there is one in Guatemala and Honduras.

Almost two thirds (73.7%) of the programs are implemented at the local level, while around 8% are at the national scale. There are an important number of schemes (18.4%) for which the distinction between local and national is not straightforward. For example, this is the case of the PES scheme mediated by FIDECOAGUA in Mexico and presented by Porras and Neves *et al.* (2006), where sellers are partly paid by a national project and partly by a local program. In other cases, programs follow general national rules adapted to local specificities. In the overall, it can be said that in the very large majority of the cases (92.1%) there is a specific local component to the PES scheme, while only a quarter of the schemes (26.3%) can be fully considered as been of national-scale nature.

Regarding the environmental threat that is at the origin of the ecosystem service loss, there is a significant lack of information. For 42.1% of the schemes analyzed, the consulted sources do not offer information on what is the environmental threat. For those cases in which there is information, about half (52.2%) report on various threats acting simultaneously. Deforestation and land cover loss is by far the biggest threat (77.3%). This is followed by water pollution (31.8%) and water over use (22.7%). Cattle expansion is present in almost 10% of the cases. Other threats (13.6%) include lack of water

treatment facilities or lack of access to water and sanitation and forest fires. Besides the missing information, in 13.6% of the cases, the threat is reported as un-specifically as "degraded ecosystem".

b. Stakeholders

In 65.8 % of the programs, various drivers promoted the start-up and implementation of the PES program. One reason driving this result can be that when different entities, with different capacities and knowledge, are involved, the program is more likely to get implemented. The leading type of driver is a NGO: for almost 40 % of the cases there is a national/local NGO at the origin of the scheme. This if followed by the municipality and the Government or Government Agency, which are present in 23.7 and 18.4 % of the programs respectively. Semi-autonomous agencies[5] follow as drivers with 16% of the cases. Water utility companies are drivers in 7.9% of the programs, as well as international organizations such as the World Bank, intervening for example in the case of the Lake Coatepeque in El Salvador (Porras *et al*., 2006). It is worth-noticing how the participants themselves (i.e. buyers and sellers) are among the promoters of the PES only in 15.8 % of the cases.

In the large majority of programs, there exists an intermediary (almost 78.9%). In the rest of the cases, there is a direct transaction between the buyers and the sellers. In 23.7% of the cases, various intermediaries are involved. Once again, local NGOs seem to lead PES programs: they are involved as intermediaries of payment in 26.3% of the programs. Trust funds, like the FONAG in Ecuador and the FIDECOAGUA in Mexico, play as intermediaries in 13.2% of the cases while the municipality is involved in 10.5% of the cases. Other type of agents, like semi-autonomous agencies, water associations, private agents and river basin authorities are present in slight above 5% of the cases. It is worth noticing that water companies are intermediaries only in 5.3%.

Regarding the participants (buyers and sellers), it is difficult to identify distinctive categories, since the papers analyzed report landowners generically or farmers, but it is not always clear from the studies whether the farmers are also landowners or not, and *vice versa*. In any case, the very large majority of transactions (96.4%) involve landowners and farmers (mostly private, but in some cases public landowners or cooperative of landowners). Farmers are explicitly mentioned as sellers in 14.6% of the studies[6], while landowners are reported in 77% of the observations. Other sellers are local and national NGOs and park administration, involved as sellers on less than 5% of the transactions. The

[5] An example of a semi-autonomous agency is FONAFIFO in Costa Rica, which a national fund with an independent legal status that has been created specifically for the implementation of the PES legislation (Pagiola, 2008).

[6] As explained before, it could be the case where a stakeholder is reported as a farmer in the original paper and it is also a landowner, so the actual number of farmers involved in PES schemes could be much larger.

number of sellers in one PES scheme ranges widely from 1 single seller to 879 sellers, with an average number of 55 sellers and a median of 18. Among the service buyers, the most numerous transactions occur within a hydropower producer or domestic water users, amounting to almost 60% of the total number of transactions. Farmers are service buyers in 6.3% of the transactions, and national or international NGOs in 7%. The rest of buyers (government, municipalities, external donors, water utility companies, cooperatives and fishermen) are each present in less than 5% of the transactions. The number of buyers involved in a PES contract also varies greatly from one single buyer (e.g. a hydropower company) to 18,700 buyers (in the case of an association of domestic water users), with a median number of buyers of 8.

We have also looked at whether there was a study on the willingness to pay of potential buyers services previously to the implementation of the program. We have found that, of the 38 programs analyzed here, only 9 of them (23.7%) report a willingness to pay (WTP) study. In the rest of the cases, this information is missing, but it is likely that there was simply no WTP beforehand[7]. Similarly, the studies reviewed do not report any opportunity costs study.

c. Service Targeted and Actions

The large majority of programs reviewed indicate several actions for which the sellers are paid (73.7%). Forest conservation and reforestation are by far the most relevant types of actions for water PES (either of them is present in 50% of the schemes). Forest management is present in 23.7% of the programs. Watershed conservation and restoration is present in 10.5% of the cases, while changes in agricultural practice and agroforestry activities play a role in 18.4% of the programs. An important result from this analysis is the fact that in all cases, the payment is determined directly by the action (input related) and not by the results of the action on the ecosystem service (output related). As mentioned, one of the critical aspects of PES is conditionality, which means that it must be possible to verify that the action results on the provisioning or maintenance of the ecosystem service that is being paid for (Wunder, 2005). However, as Engel *et al*. (2008) discuss, most PES programs base payments on the adoption of land uses, and PES monitoring is based on undertaking such actions, and not on the outputs provide by those actions.

[7] From those cases where there is being a WTP study, information on the actual WTP values is only given for 9 transactions in total. It is therefore not possible to compare in any significant way the WTP values with actual payments. Technical studies prior to PES implementation are also not very frequent, but at least reported for a third of the studies (11 cases).

Regarding the types of services, three quarters of the transactions include a bundle of services, and about half of the total transactions include not only water related services, but also other types of services (e.g. carbon sequestration). It is important to mention that, although being a crucial element of the PES scheme (and described by Wunder (2005) as a PES defining element), the ecosystem service at stake is one of the less clearly defined elements of the reviewed studies. In the papers reviewed here, and looking specifically at the water related services, there is quite a variety of definitions of ES in the original papers. In some cases, the ecosystem services are very specific and well defined, such as hydroelectricity production or drinking water supply. But in some others, the services are defined less clearly, such as improving watershed protection. A systematic classification of ES was required for the current analysis. While the Millennium Ecosystem Assessment (MA, 2005), which distinguishes between provisioning, regulating, supporting and cultural services is often adopted, recent literature has started to criticize this approach (Fisher *et al*., 2009; Fu *et al*., 2011). Ojea *et al*. (2010) propose using an output-based classification, based on the actual benefits delivered by the ecosystems to people. Ojea *et al*. (2012) adapt Brauman *et al*. (2007) classification in the following categories: (i) improvement of extractive water supply (e.g. irrigation, human consumption, etc.), (ii) improvement of in-stream water supply (e.g. transportation, hydropower and fish production), (iii) water damage mitigation (e.g. flooding and sediment mitigation, saltwater intrusion, etc.), (iv) provision of water-related cultural services (e.g. spiritual uses, aesthetic appreciation and tourism).

The very large majority of the PES schemes are aimed at improving the extractive water supply (in 91.3% of the cases this service is involved). Around one third of the cases have specific focus on water quality or water quantity. Improving the in-stream water supply (for example, water flow regulation for the production of hydropower), is the target in half of the transactions (53.3%).

d. Contract Details

Within a program, we can find different levels of payments depending on different factors; this is the so-called 'differentiation'. Forty two percent of the programs analyzed here include some kind of action differentiation. The number of differentiations range from 2 to 12 (i.e. 12 different payments within one single program), with an average of 2.14 differentiations per program. We have distinguished five features determining differentiation: (i) the type of activity: the sellers may receive different payments depending on the practices they apply to the land (e.g. whether it is expanding coffee shade or whether it is converting the land to agro-forestry); (ii) the land feature: including type of forest (for example, if the intervention is over a primary or secondary type of forest) or slope (whether the intervention is in a steep slope or shallower slope); (iii) the number of practices involved; (iv) the surface covered; and (v) other features, which include the ownership of the land, if there has

been any previous intervention in the area or the status quality of that area. The type of activity is the defining feature of the payments, and it is present in 74.8% of the transactions for which there is a differentiation. The type of forest or other land feature is present in 23.9% of the cases. The existence of a number of activities is the defining feature in 8.0% of the cases, while the surface covered is in 4.4% of the cases. Other features play a role in 8.8% of the observations.

The earliest program for which we have information started in Ecuador in 1984 (Porras and Neves, 2006). For 65.9% of the transactions, no information is reported regarding the duration of the contracts. For those cases for which there is information, contract duration ranges from 1 to 99 years, with average contract duration of 24.20 years (median of 5 years). 76.5% of the contracts have a fixed duration, while the rest have variable duration depending on issues such as the type of seller or the surface under contract. There are a 6.1% of perpetual contracts.

PES schemes in the field have evolved over time. This means that new differentiation features have been introduced, surface has been expanded or new buyers or sellers have been incorporated through time. We have accounted for those changes and have distinguished different 'stages' of the PES programs. In our database, 42.1% of the programs include several stages, meaning they have suffered changes along the time. Stages range from 2 (when one change occurred) to 8, with an average of 3.06 stages and a median of 2 stages per program[8]. This distinction of stages is crucial, since it generally affects the surface under contract (and/or the number of buyers or sellers involved). The duration of stages range from 1 to 5 years, with an average of 1.56 years and a median of 1 year (this is, on average PES schemes suffer some kind of changes every year and a half).

The large majority of contracts include periodical payments (73.5%), while there are 4.5% of cases based on one-off payments. Although it should be noted that for 22% of the transactions there is no information available.

A very interesting feature is the way decision on the payments was taken. The most relevant result is that in almost a third of the cases there is no information on how the process of establishing a PES was undertaken. Also very important is the fact that in more than half (55.6%) of those cases for which there is information, the decision process was top-down (e.g. from the government or responsible body), while in less than 20% of the cases, there was a direct negotiation between the stakeholders involved. Yet, in another 11% of the cases, the process was a combination of top-down and negotiation

[8] Regarding the stage duration, in some cases it is not clear in the paper whether a certain stage lasts the full period between two reported dates (e.g. there is information concerning year 2000 and information concerning year 2004, we assume that during those four years the contract details reported for year 2000 last fully until 2004).

among parties, i.e. therefore some kind of top-down intervention from government or government bodies is present in the vast majority of cases. This, together with the above mentioned lack of WTP studies can explain fundamentally some of the low rates of participation often reported on these kinds of schemes. In the remaining 10% of the cases, the amount of payment is voluntary from the side of the buyer.

Regarding the surface under contract, again it is very important to highlight that there is a great lack of information in the studies analyzed. In more than half of the observations (62.7%), there is no information on the surface under contract. For those cases where there is information, the surface under contract ranges from 13.3 hectares to 480,100 hectares, with a mean of 18,229 hectares and a median of 1,000 hectares.

The information regarding the payment differs depending on whether we look at it from the side of the buyers or the sellers. For the buyers, we have found three main payment types: cash (93.4%), in-kind payments (6.3%) and financial arrangements[9] (3.1%). A third part (32.4%) of the transactions where we have information use water fees (general water use fee or agricultural water fee) as the payment vehicle for service buyers. This can be in form of a fixed or not addition to the water fee, or the actual implementation of a water fee in those cases where there was previously none).

We have monetary information for buyers' payments in 205 of the observations. However, this monetary information is difficult to homogenize since it refers to different units (value/ha, value/ha/year, value/ha, value/year, value/month, value/m^3, among others). We are able to homogenize the information in USD2011/ha/year in 154 of the cases[10].

On the side of the service sellers, cash payments are also the most frequent (78.8% of the transactions for which there is information). However, in-kind payments to sellers are much more frequent than in the case of buyers (18.2% of the transactions for which there is information). A worth noticing example in this context is Los Negros in Bolivia, where landowners providing the service are paid in beehives, as a support to start alternative livelihoods (Asquith *et al*., 2008). Financial arrangements as ways of payments are present in 7.7% of the transactions. For more than 10% of the transactions there is no information on the payment type.

[9] This is the case of Fuquene in Colombia, where an international NGO provides low rate loans to farmers (Greiber, 2009).
[10] Homogenization is done taking into account total surface under contract and/or total duration of the contract.

Regarding the sellers, we have monetary information in 206 of the cases, similarly to the buyers. However, this information is almost in all cases available in per hectare per year units (or convertible to).

It is worth-noting that the average value of payments for sellers is more than 60% higher than the average payment for buyers. This suggests that additional funding is financing the functioning of PES (via intermediaries, NGOs, etc.). It is also worth-noting the great variation of payments in both cases.

Regarding the frequency of payments to sellers, this is only reported in less than half of the cases (47.39%). For those transactions for which there is information, about half the payments occur annually (54.74%), and a quarter occurs with lower frequency (once every 2 or 5 years, for example). In 17.52% several payments are made to sellers in one year (monthly or every several months). Only in two of the examined transactions, sellers are paid in a sum lump.

4. Discussion

The analysis undertaken here provides evidence of how PES schemes for water related services have been applied in practice. We have seen specific features such as how deforestation is by far the mayor threat to water resources in the areas where PES is being implemented, although often several threats act together. Various drivers (promoters) and at least one intermediary seem to be required (national/local NGOs being the leading figure); while direct transactions between buyers and sellers are rare. Hydropower companies and domestic water users are the key buyers. Improving the extractive water supply is the targeted service in most of the transaction, although often several services, including not water related, are involved. Payments are based on input (actions) rather than outputs (service delivery). Transactions usually include several actions where forest conservation, forest management and reforestation are the key actions payments target. The majority of transactions involve periodical payments and include different level of payments, depending mostly on the actions involved and the type of forests. The very large majority of transactions involve cash payments from the buyers and the water fee is the most frequently used payment vehicle. Average payment for sellers are more than 60% of average payments made by buyers, which raise relevant questions such as: who is financing the difference in payment and transaction costs?

Three elements seem crucial for PES efficiency: (i) conditionality; (ii) the definition of the environmental service; and (iii) the level of payment in relation to the opportunity costs of the service providers and the buyer WTP. Our analysis shows that, based on the existing literature, there is still not sufficient knowledge on how the current PES deal with those three elements. Firstly, in relation to

conditionality, Engel *et al.* (2008) assert that it is critical to verify the existence of the ES and to establish a baseline against which additional units 'provided' can be measured. This is what links the action or input and the outputs in terms of ecosystem provisioning. The effectiveness of measures in terms of ES impact is one of the critical challenges of ecosystem services research, concerning not only PES, and requires a very good level of understanding of the baseline situation in terms of the provisioning of the ecosystem service and the link between the ecological functions and the provisioning of the service. So far, PES have been using forest land as a proxy for the provision of the ecosystem service, with benefits often simply attached to the number of hectares (Daniels *et al*., 2010). Our results show that the studies presenting existing PES hardly discuss this issue. It could be due to failure of reporting, but most likely relates to the fact that there is very little known prior to the implementation of the PES. As it has been shown here, only in very few cases a technical study was produced previously to the implementation of the program.

Secondly, in relation to the definition of ecosystem services, it has been shown that the studies present a very wide range of definition of ecosystem services involved in the PES schemes (from very clearly defined as hydropower productivity, to more ambiguous or undefined watershed protection). A systematic classification of services is required to be able to homogenize the PES schemes for comparison and further analysis. This links to the use of the MA classification and its related problems. The output based classification proposed by Ojea *et al.* (2012) and used here, was helpful and showed that improving water extractive supply of water is at the heart of the very great majority of current PES schemes.

Thirdly, our analysis showed that top-down decisions determine the level of payment in the vast majority of existing programs and there is a dramatic lack of WTP and opportunity costs estimates to be compared with actual payments. This subscribes Ioris (2010) assertion that the payment for the environmental service is not the outcome of a free market bargaining[11]. Additionally, if the payment is not considered to compensate the opportunity costs of conservation, then market mechanisms can be achieving the opposite effect (Gómez-Baggethun *et al*., 2010). The voluntary nature of PES requires that both buyers and sellers see advantages over a business as usual scenario, and the lack of knowledge about willingness to participate (and their underpinning WTP and opportunity costs) comes across as a crucial limiting factor.

[11] It should be noted that Ioris (2010) asserts that instead, payments are "created by the regulatory demands and opportunistic behaviour of private firms".

Finally, some other remarkable information gaps found in current PES relate to the lack of reporting on the surface under contract. That information is crucial not only for understanding the extent of the programs, but also to be able to homogenize payments in comparable units (monetary units per hectare). Equally important is the fact that a very significant amount of studies fail to report the actual amount of payment (monetary information). This can also harm a monetary meta-analysis, to understand the factors determining the level of payment. Additionally, the actions involved in the PES schemes are generally poorly identified and there is a very important lack of information regarding contract details. For example, although contracts based on periodical payments seem to be more frequent, there are many studies that lack this information. Finally, and although top-down approaches for decision-making seem to be dominant, an important number of studies lack this information as well.

5. Concluding Remarks

In this exercise we have analyzed more than twenty years of experience on the implementation of water related PES in Latin America, on the basis of the most up to date collection of studies from the literature (peer reviewed and grey). The descriptive analysis presented here provides evidence of a number of issues, confirming some known facts (e.g. deforestation and forest management are at the heart of the majority of ongoing PES schemes), and revealing new ones (e.g. the average payment for sellers is 60% larger than the average amount that buyers pay for the service).

This article was not aimed at discussing whether PES are better instruments than other policy instruments, but whether the current existing (and accessible) information on existing PES programs with focus in water services and Latin America can help for improving PES implementation and efficacy. Very important information gaps have been identified, regarding conditionality, WTP and opportunity costs, or surface under contract. Improving our knowledge and understanding of PES is fundamental for better design and implementation of current and new schemes, and for improved ecological efficacy and social equity. In any case, we endorse the position which considers that PES is not a ´silver bullet´ that can address any environmental problem, but rather a tool that needs to be tailored for situations where ecosystems are mismanaged because benefits are externalities from the perspective of land managers. It is precisely for that tailoring process that a clear understanding of each of the components discussed in here is necessary.

Further development of this work will include a meta-analysis of the PES transactions for the identification of determinants of payments.

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References

Asquith NM, Vargas MT and Wunder S (2008). Selling two environmental services: in-kind payments for bird habitat and watershed protection in Los Negros, Bolivia. Ecological Economics 65, 676–685.

Barrantes G and Gomez L (2007). Capitulo 14. Programa de pago por servicio ambiental hídrico de la de la empresa de servicios Públicos de Heredia.

Brauman KA, Daily GC, Duarte TK and Mooney H (2007). The nature and value of ecosystem services: an overview highlighting hydrologic services. Annual Review of Environment and Resources 32, 67-98.

Camacho C (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.

Corbera E, Kosoy N and Martinez Tuna M (2007). Equity implications of marketing ecosystem services in protected areas and rural communities: Case studies from Meso-America. Global Environmental Change 17, 365-380.

Corporación Andina de Fomento, The Nature Conservancy (2008). Conservando los servicios ambientales para la gente y la naturaleza. Taller regional.

Daniels AE, Bagstad K, Esposito V, Moulaert A and Rodriguez CM (2010). Understanding the impacts of Costa Rica's PES: are we asking the right questions? Ecological Economics 69, 2116-2126.

Fisher B and Turner RK (2008). Ecosystem services: classification for valuation. Biological Conservation 141, 1167–1169.

Fu, B.J, Su, C.H., Wei, Y.P, Willet, I.R., Lu, Y.H., Liu, G.H. (20011). Double counting in ecosystem services valuation: causes and countermeasures. Ecological Research 26, 1–14.
Engel S, Pagiola S and Wunder S (2008). Designing payment for environmental services in theory and practice: an overview of the issues. Ecological Economics 65(4), 663-674.

Farley J and Costanza R (2010). Payments for ecosystem services: from local to global. Ecological Economics 69, 2060-2068.

Gómez-Baggethun E, de Groot R, Lomas PL and Montes C (2010). The history of ecosystem services in economic theory and practice: from early notions to markets and payment schemes. Ecological Economics 69, 1209-1218.

Greiber T (2009). Payments for ecosystem services. Legal institutional frameworks. IUCN, Gland, Switzerland.

Heston A, Summers R and Aten B (2011). Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011.

Ioris A (2010). The political nexus between water and economics in Brazil: a critique of Recent policy reforms. Review of Radical Political Economics 42(2), 231-250.

Kosoy N, Martinez-Tuna M, Muradian R and Martinez-Alier J (2007). Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. Ecological Economics 61, 446-457.

Kosoy, N., Corbera, E. (2010). Payments for ecosystem services as commodity fetishism. Ecological Economics, 69, 1228–1236.

Landekk-Mills N and Porras I (2002). Silver bullets or fool's gold? A global review of markets for forest environmental S=services and their impacts on the poor. IIED, London.

Lloret P (2008). Fondo para la protección del agua (FONAG): un fideicomiso como herramienta financiera para la conservación y el cuidado del agua en Quito, Ecuador.

Locatelli, B., Vignola, R. (2009). Managing watershed services of tropical forests and plantations:Can meta-analyses help? Forest Ecology and Management 258, 1864–1870

MA (2005). Ecosystems and human well-being: current state and trends. Island Press, Washington, D.C.

Manson RH (2004). Los servicios hidrologicos y la conservacion de los bosques de Mexico. Madera y Bosques 10(1), 3-20.

Martinez Tuna M (2008). Mercados de servicios ambientales? Análisis de tres experiencias centroamericanas de pago por servicios ambientales. Dissertation.

Muñoz-Piña C, Guevara A, Torres JM and Braña J (2007). Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. Ecological Economics 65, 725-736.

Muradian R, Corbera E, Pascual U, Kosoy N and May PH (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. Ecological Economics 69, 1202-1208.

Ojea E, Martin-Ortega J and Chiabai A (2012). Classifying ecosystem services for economic valuation: the case of forest water services. Environmental Science & Policy 19-20: 1-15.

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

Pascual, U., Corbera, E., 2011. Pago por servicios ambientales: perspectivas y experiencias innovadoras para la conservación de la naturaleza y el desarrollo rural. Revista Española de Estudios Agrosociales y Pesqueros, 288: 11-29.

Porras I and Neves N (2006). Markets for watershed services - country profile.

Porras I, Grieg-Gran M and Neves N (2008). All that glitters: A review of payments for watershed services in developing countries. Natural Resource Issues 1.1. International Institute for Environment and Development. London, UK.

Robertson N and Wunder S (2005). Fresh tracks in the forest. Assessing incipient payments for environmental services initiatives in Bolivia. Bolivia Report/ taller regional.

Rojas M and Aylward B (2003). What are we learning from experiences with markets for environmental services in Costa Rica? A review and critic from literature. Environmental Economics Program.

Rosa H, Kand S and Dimas L (2003). Compensación por servicios ambientales y comunidades rurales, lecciones de las Américas y temas críticos para fortalecer estrategias comunitarias.

Sánchez-Azofeifa GA, Pfaff A, Robalino JA and Boomhower JP (2007). Costa Rica's payment for Environmental services program: intention, implementation and impact. Conservation Biology 21(5), 1165-1173.

Talavera P (2007). Inventario de las iniciativas de financiamiento en cuencas hidrográficas en Nicaragua.

Tognetti SS and Johnson N (2008). Ecosystem services from improved soil and water management: creating a return flow from their multiple benefits.

Van Hecken G and Bastianensen J (2010). Payments for ecosystem services: justified or not? A political view. Environmental Science and Policy 13, 785-792.

Veiga F (2007). Edificando el pago por los esquemas de servicios ambientales basados en servicios forestales de agua en los bosques del Atlántico, Brasil.

Wunder S (2005). Payments for environmental services: Some nuts and bolts. Center for International Forestry Research. Occasional paper.

Wunder S, Engel S and Pagiola, S (2008). Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecological Economics 65, 834-852.

Wunder S and Montserrat A (2008). Decentralized payments for environmental services: The case of Pimampiro and PROFAFOR in Ecuador. Ecological Economics 65, 85-698

Annex

Table I: Detail of the water PES studies analyzed

Reference*	Study year	Country	Site	Scale	Targeted service	Action	Sellers	Buyers
Robertson and Wunder (2005); Asquith *et al*. (2008)	2005 2007	Bolivia	Los Negros	Local	Extractive quantity	Forest protection	Landowners	External donor, local NGO, municipality
Robertson and Wunder (2005)	2004	Bolivia	La Aguada	Local	Extractive quality and quantity	Forest regeneration, land use change	Landowners, farmers	Water cooperative, local NGO
Greiber (2009)	2009	Bolivia	Comarapa	Local	Extractive, quality and quantity	Various activities and projects	Landowners	Domestic water users, local NGO
Greiber (2009)	2009	Bolivia	Mairana	Local	Extractive, quality and quantity	Various activities and projects	Landowners	Domestic water users, local NGO
Veiga (2007); Greiber (2009)	2008 2009	Brazil	Extrema, Minas Gerais	Local	Extractive, quality and quantity, carbon storage	Forest protection, reforestation, other	Farmers	Municipality
Veiga (2007)	2007	Brazil	Paraiba do sul	Local	Extractive, quality and quantity	Forest conservation, forest restoration	Landowners	
Porras and Neves (2006); Porras *et al*. (2008)	2006 2008	Brazil	PCJ	Local	Extractive, quality, damage mitigation	other	Landowners	Water utility
Greiber (2009)	2009	Brazil	Greater Sao Paulo	Local	Extractive, quality and quantity	Forest protection	Landowners	International NGO
Tognetti and Johnson (2008); Greiber (2009)	2009	Colombia	Fuquene	Local	Extractive, damage mitigation	Agricultural practices change	Farmers	International NGO
Porras *et al*. (2008)	2008	Colombia	Plan Verde	National	In-stream	Reforestation, restoration, management	Landowners	Farmers, hydropower producer, government
Corporación Andina de Fomento (2008)	2007	Colombia	Procuenca	Local	Extractive, quality and quantity	Forest conservation, Reforestation	Landowners	Water users, government, external donor
Corporación Andina de Fomento	2007 2009	Colombia	Valle de Cauca	Local	Extractive, quality and	Various activities and projects	Landowners	Water users

(2008); Greiber (2009)					quantity			
Rojas and Aylward (2003); Pagiola (2008); Blackman and Woodward (2010)	2003 2007 2010	Costa Rica	Volcán, Don Pedro/San Fernando	Local-national	In-stream, damage mitigation	Forest conservation, restoration	Landowners	Hydropower producer
Rojas and Aylward (2003); Pagiola (2008)	2003 2007	Costa Rica	Platanar	Local-national	In-stream, damage mitigation	Forest conservation	Landowners	Hydropower producer
Rojas and Aylward (2003); Pagiola (2008)	2003 2007	Costa Rica	Platanar (independent)	Local	In-stream, damage mitigation	Forest conservation	Landowners	Hydropower producer
Rojas and Aylward (2003);	2003	Costa Rica	Monteverde	Local	In-stream, damage mitigation	Forest protection, conservation, management, other	Local NGO	Hydropower producer
Kosoy *et al.* (2007); Barrantes and Gómez (2007)	2007	Costa Rica	Heredia	Local	Extractive quality	Forest conservation, reforestation, regeneration	Landowners	Domestic water users
Kosoy *et al.* (2007) Barrantes and Gómez (2007)	2007	Costa Rica	Rio Segundo	Local-national	Extractive	Forest protection, regeneration	Farmers	Domestic and other commercial water users
Rojas and Aylward (2003); Porras and Neves (2006); Pagiola (2008)	2003 2006 2007	Costa Rica	Rio Aranjuez	Local-national	All services, instream quality and quantity	Forest conservation, management, reforestation	Landowners	Hydropower producer
Rojas and Aylward (2003); Porras and Neves (2006); Pagiola (2008)	2003 2006 2007	Costa Rica	Rio Balsa	Local-national	All services, instream quality and quantity	Forest conservation, management, reforestation	Landowners	Hydropower producer
Rojas and Aylward (2003); Porras and Neves (2006); Pagiola	2003 2006 2007	Costa Rica	Rio Laguna Coste	Local-national	All services, in-stream quality and quantity	Forest conservation, management, reforestation	Landowners	Hydropower producer

(2008)								
Pagiola (2008)	2007	Costa Rica	National	National	All services	Forest conservation, protection, reforestation, management	Landowners	Several hydropower producers, domestic and other commercial water users, farmers, recreation
Camacho (2008); Corporación Andina de Fomento (2008)	2007	Ecuador	Celica	Local	Extractive	Forest restoration, other	Landowners	Domestic water users
Camacho (2008); Corporación Andina de Fomento (2008)	2007	Ecuador	El Chaco	Local	Extractive	Forest conservation and restoration	Landowners	Domestic water users
Porras and Neves (2006) Porras et. Al (2008)	2006 2007	Ecuador	Cuenca	Local	Extractive, quality and quantity, in-stream, damage mitigation	Forest protection, conservation, management, other	Farmers, park administration	Hydropower producer, domestic water users
Porras and Neves (2006) Lloret (2008) Camacho (2008)	2006 2008 2007	Ecuador	Quito	Local	In-stream and extractive, quality and quantity, cultural	Forest protection, management	Farmers	Hydropower producer, water utility, farmers, recreation, other commercial water users
Wunder and Montserrat (2008); Camacho (2008)	2007	Ecuador	Pimampiro	Local	Extractive, quality and quantity	Forest protection and regeneration	Landowners	Domestic water users
Porras and Neves (2006)	2006	Ecuador	Pedro Moncayo	Local	Extractive quantity, damage mitigation	Reforestation, management	Public, private and cooperative landowners	Water utility, farmers
Porras and Neves (2006) Rosa *et al*. (2003)	2006 2003	El Salvador	El imposible	Local	Extractive, quality and quantity	Forest protection, conservation, other	Park administration	Domestic water users
Porras and Neves (2006)	2006	El Salvador	Lake Coatepeque	National	Extractive quality, in-stream quality, damage mitigation, cultural	Agricultural practices change, other	Public, private and cooperative landowners	Domestic water users, recreation, fisher
Corbera et. al (2007)	2006	Guatemala	Las Escobas (Cerro San Gil)	Local	Extractive, in-stream,	Agricultural practices	National NGO	Domestic water users,

					damage mitigation	change, management, other		hydropower producer
Kosoy et. Al. (2007)	2004	Honduras	Jesús de Otoro	Local	Extractive, quality	Forest conservation, better environmental practices	Farmers	Domestic water users
Muños-Piña *et al*. (2007)	2007	Mexico	National	National		Reforestation and forest conservation	Public, private and cooperative landowners	Government
Porras and Neves (2006); Manson (2004)	2006 2004	Mexico	Coatepec	Local-national	Extractive	Reforestation and forest conservation	Farmers	Domestic and other commercial water users, government
Porras and Neves (2006); Manson (2004)	2006	Mexico	Coatepec (FIDECOAGUA)	Local	Extractive	Reforestation and forest conservation	Farmers	Domestic and other commercial water users
Porras and Neves (2006); Porras *et al.* (2008)	2006 2008	Mexico	Zapalinamé	Local	Extractive, quantity	Improved management practices, conservation of existing ecosystem	Landowners	Water users
Talavera (2007)	2007	Nicaragua	El Regadio:	Local	Extractive			
Kosoy *et al*. (2007); Martinez-Tuna (2008)	2004 2008	Nicaragua	San Pedro del Norte	Local	Extractive, quality and quantity	Agricultural practices improvement, soil conservation practices	Landowners	Domestic water users

* When several studies are cited for the same PES scheme, more than one source has been employed for that PES.

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