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ANALYSIS

Institutional dimensions of Payments for Ecosystem Services: An analysis of Mexico's carbon forestry programme

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ABSTRACT

This article proposes a multi-dimensional framework for understanding the development and effectiveness of Payments for Ecosystem Services (PES) schemes, framed around the notions of institutional design, performance and interplay. The framework is applied in the context of Mexico's Programme of Payments for Carbon, Biodiversity and Agro-forestry Services (PSA-CABSA), with an emphasis on its carbon component. The analysis shows that PSA-CABSA was promoted by civil society and its rules have been subject to continuous modifications over time. In the case of the carbon component, changes have been due to an original misunderstanding of how carbon projects should be designed, implemented, and carbon traded in actual markets. From a performance point of view, the paper shows that the programme has been well received by rural communities, and carbon payments have contributed to increase household income and to enhance forest management practices and organisational skills. The paper also highlights sources of institutional interplay with local institutions and international climate policy, and it reveals the importance of capacity and scale issues in securing an effective and fair implementation of PES. The conclusion provides some policy recommendations for the future development of PES initiatives in Mexico and elsewhere.

1. Introduction

The use of Payments for Ecosystem Services (PES) as a financial tool to support forest conservation has become popular across the developing world. PES attractiveness can be attributed to the interest of governments and civil organisations, in particular conservation NGOs, to find new ways of promoting forest conservation while supporting the economic development of rural populations. The interest in PES can also be related to the perceived belief, especially among environmental economists and increasingly among conservationists, that the protection and long-term sustainability of diverse ecosystems will only be viable if the full range of services provided by these ecosystems are economically accounted for. For some scholars, this perspective makes economic reasoning prevail over more traditional arguments for nature conservation based on existence and non-use values (Liverman, 2004; McCaulay, 2006). For others, the valuation of ecosystem services (ES) and their exchange should be a strategic approach in the creation of a new 'rural–urban compact', where cities reward rural populations more substantially for their provision of private and public goods (Gutman, 2007).

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In recent years, countries such as Mexico, Costa Rica and China have established PES programmes where governments pay rural communities and farmers for ES provision, such as climate regulation through enhanced carbon dioxide fixation by forests, water quality provision through the maintenance of forest cover in critical watersheds, or species and genetic pool conservation through the protection of standing forests in key biodiversity hotspots (Muñoz et al., 2006; Pagiola et al., 2005; Rojas and Aylward, 2003). In addition to these government initiatives, self-sustained PES initiatives involving private companies and NGOs as buyers and sellers of ecosystem services have also been put in place (Landell-Mills and Porras, 2002). In Central America, there are river basins where downstream water consumers transfer a regular payment to forest managers in the basin recharge area, and in exchange they are guaranteed sustainable forest management practices upstream so as to secure water quality (Corbera et al., 2007b; Rosa et al., 2003). Internationally, concerns for global climate change have led governments and companies in developed countries to finance tree plantations or forest conservation in developing countries to offset their greenhouse gas emissions. Investors have done so through voluntary carbon offsets (e.g., www.planvivo.org), and less so through the Kyoto Protocol's Clean Development Mechanism (CDM), with only one CDM forestry project registered up to May 2008 and located in China (Bayon et al., 2007; Corbera, 2005b; UNEP-Risoe, 2008).

In the context of global environmental change research, Tucker and Ostrom suggest that researchers are faced with the challenge of identifying the circumstances in which sustainable forest management can be achieved, and what types of institutional arrangements are most conducive for this goal (Tucker and Ostrom, 2005). This observation contributes to highlight the importance of understanding why and how PES emerge as new institutions for environmental governance, how they are integrated with other institutions, and how effective they are in practice in their goal of protecting ecosystems and their services. And despite the number of studies concerning the definition, quantification and valuation of ES have steadily increased over the last decade (*Ecological Economics* 64(2)), in-depth research on the institutional processes mediating ES provision through compensation mechanisms has only started to emerge. Studies have shown, for example, that payments for carbon forestry services have been mediated by land entitlements and local political conflicts, thus resulting in inequitable outcomes at local level, with poor landholders and women becoming marginalised from the schemes (Corbera et al., 2007a; Zbinden and Lee, 2005). In Mexico, willingness to participate in payments for biodiversity conservation projects has in some cases been influenced by existing rules and cultural values favouring conservation, which shows that PES can positively strengthen existing institutions for ecosystem conservation in addition to provide incentives for behavioural change (Kosoy et al., in press). More recently, a compilation of case studies in a special issue of this journal (*Ecological Economics*, 65) has contributed to highlight PES impacts on environmental conservation and human welfare. The comparative analyses of all contributions notes that PES institutional design greatly influences actor relationships, coordination and conflict with other policies and property rights, funding sustainability, and the nature of PES outcomes. PES are more successful when they are designed collaboratively between providers and identifiable ES users and result more ineffective when the government acts as an ES buyer on behalf of third parties or society in general (Wunder et al., 2008).

This emerging research contributes to visualise the importance that institutions in the broader sense (i.e., the rules of the game and their multiple interactions) play in the design and performance of PES. An institutional approach to PES contributes to reveal, for example, the tensions between PES design rules and resource managers' practices, any likely controversies over who owns and should benefit from payments, and it can emphasise the way in which PES schemes attribute a value to ES and plan to monitor their outcomes. It can also shed light onto PES positive and negative impacts on resource managers, including their effects on income, management skills and distributional aspects, such as who participates and remains excluded from PES. Finally, an institutional approach can also reveal the extent to which PES influence local ecosystem management practices and cultural values, strengthening or increasing beneficiaries' interest in ecosystem conservation, in addition to discuss any likely contradictions between PES and other existing policies for land-use management. Such examination, overall, can contribute to improve the design of PES schemes and address any of their negative outcomes.

The paper tests this analytical approach looking at Mexico's Programme of Payments for Biodiversity, Carbon and Agroforestry Services (PSA-CABSA, its acronym in Spanish), specifically examining its carbon component. More attention is devoted to the latter for its attempted linkages with international markets for carbon offsets, and the important lessons that can be derived for understanding the complexities of setting cross-scale institutions for ecosystem services and climate governance. A thorough examination of Mexico's PES is still premature – PES have only been implemented since 2003 – and lies beyond the scope of this paper. The following section presents the framework, which is based on concepts developed in the Institutional Dimensions of Global Environmental Change project (Young, 2002a; Young et al., 1999) and the work of other institutionalist scholars (Ostrom, 2005; Selin and VanDeveer, 2003), including institutional design, performance, interplay, capacity and scale. Section 3 presents Mexico as a case study and outlines the place-based, qualitative, research methods employed. Section 4 presents the results. We pay attention to PSA-CABSA design and its evolving procedural changes, and we analyse its performance to date examining statistics and the perceived benefits derived from carbon payments in four rural communities. We investigate sources of interplay at design and implementation levels, and we discuss the implications of the lack of organisational capacity for a more effective implementation of PES projects. Concerning the problem of scale, we show how establishing PES institutional arrangements at national level for carbon forestry services generates tensions and contradictions with existing forms of international governance over such services. Section 5 discusses these findings in the broad context of PES institutional governance and Section 6 concludes the paper with some policy recommendations for improving Mexico's national PES schemes and other similar initiatives.

2. Institutional framework for the study of PES

PES are founded on the assumption that ecosystem degradation is a result of the inability of conventional markets, which function well for private goods, to internalise ES economic value. In some circumstances, ES economic valuation may render ecosystem conservation more profitable than another land-use activity. However, leaving aside the methodological complexities characterising ES valuation (Kumar and Kumar, in press), the complexity of establishing an institutional setting which accounts for these ES is rooted in the fact that these are often, but not always, public goods, that is they are non-rival and non-excludable. This means that one person's consumption does not affect what is left for others and that no one can be prevented from enjoying the good. As a result, it is difficult to determine who should pay for ES provision and, in some cases, who is entitled to such reward (i.e., who owns ES). Moreover, as ES are supplied at different spatial scales, the beneficiaries also diverge according to the spatial range at which the benefits of ES accrue. ES can also be club goods, which means that they can be consumed by many individuals without affecting the consumption of the others, but whose consumption by non-members can be prevented (Engel et al., 2008). An example of an ES which is purely a public good is carbon sequestration, the beneficiaries of which are local and global, as climate regulation benefits everyone. Ecosystem managers which provide this service cannot exclude people to benefit from it. An ES which can be labelled as a club good are watershed services, which are provided by those who hold formal rights over land and water resources in the watershed, while beneficiaries may or may not be restricted to water users along the hydrological basin. In both cases, it may be difficult to delineate ownership over ecosystem services, as diverse resource users may have distinct attributions regarding the conservation and management of ecosystems, and the appropriation of the benefits derived from them (Humphreys, 2006; McKean, 2000). As we will show in this paper, such complexities cause problems of institutional design and become a source of institutional interplay in PES schemes.

We suggest using the lens of institutional analysis to investigate ES governance frameworks. Institutions are formal and informal rules which regulate what to do and not to do in a given situation. They are considered 'filters guiding human actions that affect biophysical systems and playing major roles in determining how humans react and adapt to actual or anticipated changes in biophysical systems' (Young, in press, pp. 2). In an environmental context, they regulate human interactions with natural resources and therefore affect environmental change processes (Dietz et al., 2003). PES have been conceptualised as new institutions designed to enhance or change natural resource managers' behaviour in relation to ecosystem management through the provision of economic incentives (Corbera and Brown, in press). In theory, PES should over time become a self-sustained market in which ecosystem service consumers channel financial resources to service providers. However, as we will show in this paper, this is not an easy task when service consumers are difficult to identify and they are not interested in ES conservation.

The framework we present below builds on a conceptual approach previously developed by Corbera and Brown (in press) and can help as a conceptual map to guide institutional research on PES. A framework constitutes 'a nested set of theoretical concepts — which range from the most general to the most detailed types of assumptions made by the analyst… [and] helps to identify the elements (and the relationships among these elements) that one needs to consider for institutional analysis' (Ostrom, 2005, pp. 27–28). In this case, the framework encompasses three analytical domains (design, performance and interplay), two cross-cutting dimensions (capacity and scale), and identifies a set of variables which we consider necessary to understand and evaluate PES (Table 1).

2.1. *Institutional design*

The first analytical domain addresses the process of institutional design. This implies understanding why PES is proposed as a policy tool in a particular context and which actors shape the rule-design process. The conceptual origins of a PES initiative may for example shed light on the driving causes of deforestation, the type of assumptions that its proponents make, and why they consider PES a good complement to existing policies. An analysis of PES rules can show whether rules are conducive to achieve their hypothetical goals or they seem prone to failure due to, for example, a deficient targeting of beneficiaries or a lack of integration with other policies. New institutions for environmental governance such as PES are an experiment, and they should be flexible enough to adapt to the dynamics of socio-ecological systems in order to adapt to new conditions. Neither should PES be considered the ultimate solution to ecosystems conservation, as in some circumstances, other strategies, including education and investment in sustainable technologies and practices, may be more appropriate (Engel et al., 2008).

The diversity of socio-ecological systems makes impossible to identify a single institutional design which will work best in all circumstances. However, several scholars have tried to identify a set of design principles characterising successful and enduring institutions for natural resource management (Agrawal, 2002; Baland and Platteau, 1996; Ostrom, 1990). As summarised by Dolsak and Ostrom (2003), these principles include: 1) rules are devised and managed by resource users; 2) compliance with rules is easy to monitor; 3) rules are enforceable; 4) sanctions are graduated; 5) adjudication is available at low cost; 6) monitors and other officials are accountable to users; 7) institutions are devised at multiple levels; and 8) procedures exist for revising rules. PES scholars may like to investigate the relevance of these principles and identify criteria which make one type of PES institutional design in one location more successful and enduring than another. For such purpose, we require multiple PES studies to establish comparisons and provide valuable generalisations.

2.2. *Institutional performance*

A second analytical domain concerns institutional performance (Mitchell, 2008), that is an assessment of how PES achieve their stated objectives. This should include an analysis of whether payments contribute to change or enhance

Table 1 – PES analytical domains and key research questions

Analytical domain and dimensions	Guiding research questions	Analytical variables
Institutional design		
Are rules conducive to achieve goals?	Why is PES proposed as a policy tool? Which actors shape the rule-design process and how are their interests represented in the final rules? How and why design rules change over time?	Definition and evolution of PES rules over time Number and type of actors involved in PES design Actors' interests taken into account and excluded in the definition of PES Underlying reasons of procedural changes
Institutional performance		
Is an institution achieving its goals?	How do PES affect the beneficiaries of direct payments, the services they attempt to conserve, and the ecosystems providing such services? Why do beneficiaries decide to participate in PES? How do PES measure and monitor the provision of ES, and account for changes?	Monitoring of ES flows Number of participants and hectares under PES management Number of participants who failed to comply with PES rules Benefits and negative impacts of PES (environmental, economic, social and cultural dimensions)
Institutional interplay		
How do institutions affect each other	How do PES account for other institutions in their design and implementation? Which institutional synergies and conflicts exist as a result of institutional interactions?	Number and type of institutions (including policies and programmes) influencing or being affected by PES Types and effects of institutional interactions (including property rights' influence on design and performance)
Organisational capacity		
How does capacity affect performance?	Has PES design or implementation been hampered by a lack of organisational capacities across involved actors?	PES actors' level of organisational capacity
Scale		
(How does scale affect PES design and performance?)	Does an optimal scale of governance exist for the provision of each ES? Have there been any cross-scale institutions created to address problems of interplay? How do cross-scale institutions benefit PES design and performance?	Differences in PES design, performance and interplay due to governance scale Type of cross-scale institutional linkages to address interplay (e.g., stakeholder bodies, policy communities) and effects over the other analytical domains

ecosystem management practices and secure ES flows, an evaluation of how PES measure and monitor the provision of ecosystem services, the methods and proxies used for such purpose, and the mechanisms through which PES attempt to account for changes in ES provision over time, as a result of PES themselves or as a result of other external factors (e.g., forest fires, hurricanes, changes in ecosystem conditions or resource managers' behaviour). PES performance should also evaluate the collateral benefits and negative outcomes induced by PES at local level. This can include a reflection on why resource managers decide to participate in PES, which in turn may be intrinsically related to the nature of institutional design (e.g., the economic value attributed to ecosystem services, monitoring rules, and effects on existing forest rights), and an examination of which other aspects concerning human well-being have been enhanced (e.g., forest management skills, investment in household or community goods) or negatively affected (e.g., inequities in access to resources, ES stocks and flows or payments). Evaluating institutional performance necessitates the definition of a number of criteria against which the institution in question can be evaluated. Some institutions already define these criteria in their procedural rules and establish a monitoring scheme. Others remain vague in how to judge their performance and, in these cases, the researcher needs to define the criteria. The latter can relate to the direct objectives of the institution as defined in its constitutional rules, or they can also refer to other dimensions which may be indirectly affected by institutional development.

2.3. *Institutional interplay*

A third analytical domain which cuts across institutional design and performance is that of institutional interplay (Young, 2002a,b). Institutional interplay concerns how a set of institutions affect one another. The principal assumption behind this concept is that the interaction between two or more institutions can influence their respective outcomes. Institutional interplay characterises complex societies because the more human society develops, and social systems become integrated, more complex institutional structures are established and their outcomes become more dependent on existing and evolving institutional contexts. According to Young (2002a,b), there are two different manifestations of institutional interplay: symmetrical *versus* unidirectional and vertical *versus* horizontal. Symmetrical interactions refer to those cases in which two

institutions affect each other in a similar way. In contrast, unidirectional interactions refer to those cases in which one institution affects the other much more. Vertical interplay refers to the interaction between two institutions operating at distinct levels of social organisation (e.g., national forestry policies and customary practices governing forest resources), while horizontal interplay refers to the interaction between two institutions operating at the same level of social organisation (e.g., agriculture and forestry policies at the national level). In the case of vertical interplay, it is important to distinguish between vertical interactions involving adjacent institutions (e.g., between federal and state-level institutions) and interactions involving remote institutions (e.g., between environmental agreements and social practices at the community or household level).

One should then ask whether PES influence or are impacted by other institutions, and which type of synergies or conflicts across institutional arrangements exist. At this regard, for example, property rights influence considerably the design and performance of PES. Property rights have been generally defined as social relationships among people, which contain enforceable claims to rights in something (Fortmann, 2000). More specifically, property rights delineate rights of ownership in an asset, including the rights to use and consume the asset, to exclude others from the use of the asset, to change its form and substance, to obtain income from it, and to transfer these rights either in their entirety through sale or partially/temporarily, for instance through rental (Fuchs, 2003, pp. 44). Property rights define who has rights over ecosystems and their services and who can benefit from their sale, thus influencing who is legally recognised as an ES provider and the type of viable resource management practices. But local property rights can be characterised by complex layers of *de jure* and *de facto* rights over ecosystems and their products (e.g., trees, fodder, fruits), which makes difficult to define clearly who is legally entitled to benefit from ES, which in turn are a consequence of interacting and inseparable ecosystem functions. For this reason, it is argued that tailoring institutional arrangements to local property rights can be a determinant factor for an efficient and more equitable capture of the benefits derived from ecosystem services (Turner et al., 2003, pp. 508).

2.4. *Capacity and scale*

The analytical framework also takes into account two cross-cutting analytical domains such as organisational capacity and the scale of PES design and implementation, which impact upon the three analytical domains outlined above. We define the term "capacity" as the availability of social, institutional and material capital to design and implement PES programmes so as to achieve their stated objectives. Thus, one should differentiate between organisations that do not effectively implement PES arrangements and the effectiveness of such arrangements. It is important to understand the extent to which the effectiveness of an institution is jeopardised by lack of capacity across the actors involved in PES implementation.

The concept of scale is central in analyses of institutions for environmental governance. Across natural and social sciences, this concept has been coined in a variety of ways depending on the scholar's discipline and the research focus. Scale has been defined as 'the spatial, temporal, quantitative, or analytical dimensions used by scientists to measure and study objects and processes' (Gibson et al., 2000). For institutionalist scholars, the problem of scale concerns the extent to which institutional arrangements are similar and exhibit comparable processes across levels of social organisation ranging from the local to the global (Young et al., 1999). A more political take on scale argues that institutions for environmental change are framed differently according to the scale at which these are defined, which impacts upon problem definition, the nature of the arrangements, the actors involved, and the distribution of political power (Lebel et al., 2005). An institution can thus be related to a specific scale of governance and it often brings together distinct levels of socio-political organisation and different actors and interactions. Berkes (2002) argues that environmental management is in fact the product of various institutional arrangements designed and operationalised at different scales of socio-political organisation, which interact with each other in practice. In this sense, the author stresses the importance of cross-scale institutions designed specifically to address such interplay, such as co-management arrangements, multi-stakeholder bodies, co-management organisations, citizen groups, policy communities and social networks (Berkes, 2002, pp. 302).

It is important to understand how the scale of PES governance influences design, performance and interplay, as some ES may be better provided and managed when governed at a particular scale. Important questions at this respect include, for example, a) is there an appropriate socio-political and geographical scale to design and develop PES? b) What are the implications of such scale for the effectiveness and long-term viability of PES? And c) what are the existing governance linkages when PES are designed and implemented at different scales? Furthermore it is important to document whether PES initiatives incorporate cross-scale institutions to address sources of interplay and improve their performance.

3. PES in Mexico: case study and methods

Historically, Mexico has been relatively unsuccessful in promoting sustainable forest management and conservation. The country's deforestation rate for the period 1976–2000 has been estimated at an average of 86,718 hectares per year (ha/year) for temperate forests and 263,570 ha/year for tropical forests, and a total average annual loss of 545,000 ha/year for all ecosystem types, which situates the country amongst the most deforested in the world (Bray et al., 2005, pp. 6). Some argue that deforestation is caused by forest fires and the State's failure to regulate the activities of private and state-led logging companies, address rural communities' clandestine woodcutting (Klooster, 1999), and to tackle the underlying causes of dispossessed peasants migrating into areas of high biodiversity value (de Vos, 2002; O'Brien, 1998). But other scholars argue that deforestation is also caused by rural communities, who transform forests into pastures and agricultural lands, specifically when suitable geophysical characteristics are present and collective conservationist behaviour is weak (Alix-Garcia, 2004;

Alix-Garcia et al., 2005a). About 80% of Mexico's forests are legally titled to local communities who practice agriculture and forest management on family plots or common forests (Klooster and Masera, 2000; World Bank, 1995). As a result, any effort to halt deforestation successfully requires involving peasant communities. However, government policies supporting community forestry were not common until the early 1980s. Since then, 25% of communal forests is under a management plan (Klooster, 2003, pp. 117–118) and, specifically in highland areas, forest recovery is happening as a result of out-migration to urban centres and abroad (Rudel, 2008).

In this context, the Mexican government believed that new institutions such as PES could contribute positively to reinforce community-based forest conservation and sustainable forest management (Klooster, 1999; Klooster and Ambinakudige, 2005). In 2003, the Mexican government established a national programme of Payments for Hydrological Services (PSAH, for its Spanish acronym) (Alix-Garcia et al., 2005b; Muñoz et al., 2006) and in 2004 established a programme of Payments for Carbon, Biodiversity and Agro-forestry services (PSA-CABSA, for its Spanish acronym) (Corbera, 2005b). In 2006, these two programmes were merged into a single policy framework known as Programme of Payments for Environmental Services, with each component (hydrological, biodiversity, carbon and agro-forestry services) maintaining its own procedural rules. Prior to the creation of these programmes, Mexico hosted some PES initiatives, including one of the earliest carbon forestry projects in the world (Corbera, 2005a; Tipper, 2002), and a watershed scheme in the municipality of *Coatepec*, which was one of the first in Latin America to establish a trust fund through which water consumers rewarded forest managers for the maintenance of forest cover upstream of the local hydrological basin (Manson, 2004).

3.1. *PES legal, financial and operative framework*

The legal basis for the development of national PES programmes in Mexico can be found in the country's General Law for Sustainable Forest Development, passed in February 2003, and a modification of Article 223 in Mexico's Law of Rights. The former creates the Mexican Forestry Fund as a financial instrument to promote the establishment of incentive and market-based systems for the conservation of forest ecosystems. The modification of the Law of Rights also establishes that a small levy of national water tax payments should be channelled to the Forestry Fund in order to develop the PSAH. This translates into an annual funding of approximately Mx$ 300 million (Muñoz-Piña et al., 2008). Funding for PSA-CABSA, in contrast, has been annually negotiated in Congress since 2004. The National Forestry Commission (CONAFOR), a decentralised agency of the government's Natural Resources and Environment Secretariat (SEMARNAT), manages the Fund and administers all PES programmes.

In developing this paper, PSA-CABSA origins, its procedural changes over time and current effectiveness were investigated through 16 interviews with policy makers, leading academics and NGOs involved in programme design and implementation. This was complemented with an analysis of bibliographic references, including project databases available through CONAFOR's website and two early evaluations of PSA-CABSA (Gómez Guerrero et al., 2006, 2005). Fig. 1 illustrates the implementation cycle of PES programmes in Mexico.

3.2. *Community selection*

We selected four out of seven rural communities receiving carbon payments from PSA-CABSA when this research started (January 2007) in order to discuss the dimensions of our analytical framework. The case studies were chosen according to geographical location (each one in a different Mexican state) and their ecological characteristics (with different types of forest ecosystems under management) (Fig. 2). As noted above, rural land property in Mexico is mostly in the hands of *ejidos* and indigenous communities. Their creation followed formal land petitions to the State by groups of rural families after the Mexican revolution, since the early 1930s and until the early 1990s. Families' household heads (which then became the original right-holders) were entitled to a parcel of land within *ejido* lands, which could only be bequeathed to one single descendant or spouse. Petitioners were also granted another area of communally owned forests and pastures (hereafter referred to as forest commons) over which a series of management regulations applied (Robles Berlanga, 1999). *Ejidos* and indigenous communities are governed through a collective assembly in which all original and new right-holders participate and have a right to vote. The assembly then establishes the rules governing resource use and land distribution, among other issues.

San Bartolomé Loxicha is an indigenous Zapotec community located in the state of Oaxaca. It has 2286 inhabitants and encompasses a total of 14,076 ha. People's main economic activity is coffee cultivation, followed by commercial logging. The carbon project was approved for implementation in 2004, and involved the plantation of 66,000 pines (*Pinus pseudostrobus*, *P. patula* and *P. oaxacana*) in 272 ha of the forest commons. The *ejido Orilla del Monte* is located inside the protected area of *El Volcán del Cofre de Perote* in the state of Veracruz. There are 4750 inhabitants and 2764 ha, of which 1000 have been reforested with native pines (*Pinus Cembroides*) through the carbon project. In 2003, the community established a forest management programme in order to promote forest conservation and, in the future, it aims to establish a company to commercialise pine nuts.

The *ejido Niños Heroes* is located in the *Tenosique* mountain range, in the state of Tabasco, which contains the last vegetation remnants of humid tropical rainforest. The rainforest has either disappeared or become increasingly degraded since the agrarian distribution of the 1960s and the consequent process of rainforest colonisation in the region (Durand and Lazos, 2004). The *ejido* has 167 people and 1800 ha, 200 of which are common forests and pastures. Within the latter, 100 ha have been reforested with *Tabebuia rosea*, and *ejido* members have carried out conservation, fire control and monitoring activities. Finally, the *ejido El Cajón* is located in the reserve of *Pico de Orizaba*, in the state of Puebla. It has a total of 669 inhabitants and 1200 ha, 900 of which are common forests and pastures. The carbon project started in 2005 with the reforestation of 280 ha with *P. pseudostrobus*, and the elaboration of a surveillance and forest fire control plan.

A focus group exercise was conducted in each community to document participants' perception of carbon payments. Each group included local authorities, farmers, and in some

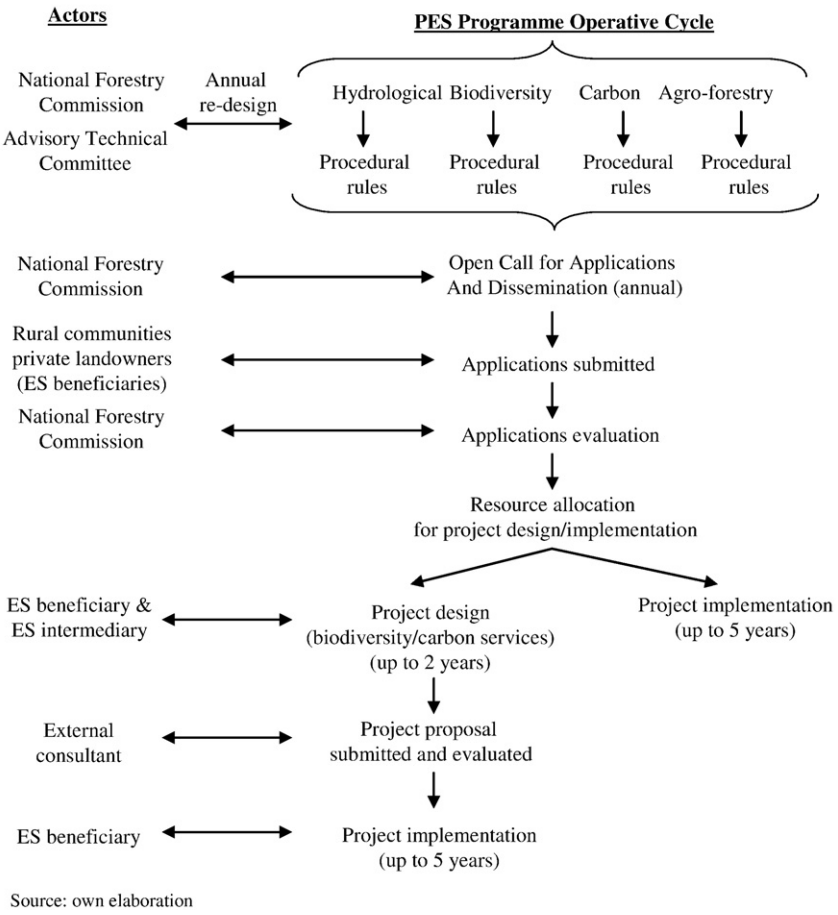


Fig. 1 – PES programmes operational cycle.

cases CONAFOR extension officers and service intermediaries. The biggest focus group involved 53 people and the smallest 18. Research objectives were explained and information on key concepts, including what is meant by ecosystem services, was provided. A series of graphic materials were used to elucidate farmers' views regarding: a) why they joined the project; b) which benefits they had derived from participation; c) how they got organised to implement the project; d) which activities they were currently developing; e) whether any conflicts had arisen as a result of project implementation and

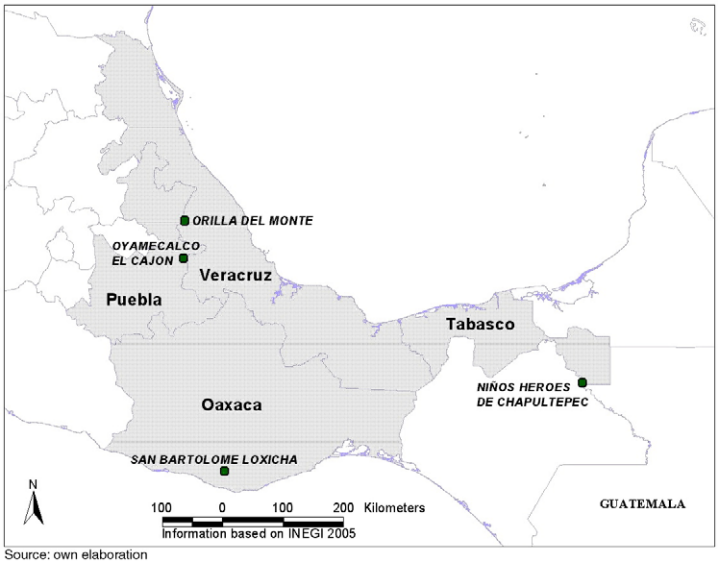


Fig. 2 – Location of carbon payments case studies.

f) which aspects of the project should be improved. In addition to these focus groups, 117 semi-structured interviews were conducted with CONAFOR officials, project intermediaries, local authorities and individuals involved in tree planting. These included formal right-holders, (77 men and 22 women), and informal right-holders, including one woman and four men.

4. Results

This section examines PSA-CABSA in the light of the analytical domains presented above. It is shown that PSA-CABSA procedural rules have changed over time to adapt to public funding constraints, to guarantee long-term beneficiaries' implementation commitment and, in the case of carbon, to meet international standards and reduce management costs. Rural communities' response to the programme and the benefits derived from it seem positive, albeit actual ES provision should be evaluated in a few years time. Sources of interplay include local property rights, which result in low transaction costs, and international guidelines for carbon forestry activities. Government evolving capacity explains ongoing learning and adjustment in procedural rules and it is critical to the future success of rural communities in securing funding for project implementation.

4.1. *Institutional design: actor perspectives and procedural changes*

In contrast with PSAH, which was jointly designed and promoted by CONAFOR and the National Institute of Ecology, PSA-CABSA resulted from lobbying by peasant and forest-based organisations, including the Mexican Council for Sustainable Agro-forestry (CCMSS), the Mexican Network of Forestry Organisations (Red MOCAF), the National Network of Coffee Producers Organisations (CNOC), and the National Union of Community Forestry Organisations (UNOFOC), among others. During 2002 and early 2003, these organisations negotiated with the government a National Rural Agreement (in Spanish, *Acuerdo Nacional para el Campo*), which outlined a development plan for the Mexican countryside. They lobbied to include a number of strategic sectors for policy development and funding priorities, such as 'a policy programme to implement Payments for Ecosystem Services: (i) on carbon fixation by forests to halt climate change; (ii) for rural communities who support biodiversity conservation; and (iii) for the development of agro-forestry systems, specifically for shade-grown coffee plantations' (Government of Mexico, 2003, pp. 37). These organisations believed that payments for these three activities would contribute to valuing forest conservation and sustainable management, and would lead to linking service buyers and providers through the creation of actual markets.

The politics of PSA-CABSA design were characterised by competing views over the likely operational feasibility of such programmes in the short term, mostly because sustainable funding mechanisms were not easily identifiable. Government officials considered that it was better to design such programmes once the PSAH would have been fully operational so as to learn lessons for the design of other schemes. In contrast, rural and forest organisations prioritised the establishment of multiple PES schemes, however loosely defined, so as to secure resources in the short term, and allowing for procedural changes as PES implementation proceeded. Such opposite perspectives become apparent in several workshops organised by CONAFOR in late 2003 and early 2004, which involved other government ministries, the previously mentioned organisations and other NGOs. These organisations manoeuvred to encourage CONAFOR to support their interests, catalysing a final agreement on PSA-CABSA rules (Kosoy et al., in press).

The programme's original rules had a common procedural framework with provisions for its three components (carbon, biodiversity, and establishment and enhancement of agro-forestry systems) and specific rules for project design and implementation under each component. General eligibility rules included that applicants could not be receiving support from any other PES programme and had to prove they owned the land where the project would develop. They also had to show proof of either the existence of a forest management plan, an environmental management unit, or the commitment to the project through a local assembly act, and they had to show that PES activities were additional (i.e., the development of land-use activities for ES provision could not have been possible without ES payments). The project area had to be located within eligibility areas as defined by CONAFOR. Applicants received up to 400,000 Mexican pesos (Mx$) [1€ = 16.39 Mx$, 24 May 2008] for project design, to be developed in collaboration with an external consultant or organisation, and implementation funding depended upon the project's scoring according to a set of pre-defined evaluation criteria. The original programme rules also established that CONAFOR had to communicate the contents and scope of PSA-CABSA to all potential beneficiaries through its regional state offices and it had to undertake an internal evaluation process, as well as commission periodical programme assessments.

In carbon projects, project implementation funding oscillated between a guaranteed arbitrarily assigned price of 50 Mx$ to a maximum of 98 Mx$ per tonne of carbon dioxide equivalent (tCO_2eq) if the project was located in the buffer zone of a protected area, included species at risk of extinction, or applicants belonged to an ethnic group with high level of social marginalisation, among other factors regarding social and environmental issues. On top of this funding, PSA-CABSA applicants to any of the three components could be granted up to 150,000 Mx$ for annual verification of project activities, to be undertaken by an external consultant or community members; another 150,000 Mx$ for capacity-building activities, to be undertaken by an external party approved by CONAFOR; and up to 250,000 Mx$ for technical assistance and project follow-up, to be provided by community members or an external consultant, as decided by the applicants.

When PSAH and PSA-CABSA were integrated into a single framework of Payments for Environmental Services in 2006, which fell under a broader framework encompassing all forestry government programmes known as *The Pro-Árbol Programme,* eligibility rules did not change much except for contractual flexibility rules, which became stricter so as to oblige participants to return payments in case of no compliance. While in 2004 and 2005 failure to comply translated in payment cancellation, 2006 and 2007 rules established that participants

were entitled to a deferral in the application of sanctions if they showed that failure to comply was due to an uncontrollable reason. Resource users' rights to a fair monitoring process were secured but no sanctions have to date been imposed. In fact, the latest evaluation of the programme notes that there is not enough staff to cover the programme needs concerning outreach and monitoring (Gómez Guerrero et al., 2006). This implies that PES overall performance can be compromised in the future, as PES payments are not conditional to ES provision. As Wunder et al. (2008) note, this lack of conditionality is common in government-led programmes, which implicitly acknowledge the political difficulties involved in prosecuting poor landowners for non-compliance.

In 2006, specific rules for each PES component became substantially different. Carbon rules evolved to make projects comply with those rules established for small-scale afforestation and reforestation projects under the Kyoto Protocol's CDM. This meant that project areas had to encompass at least 500 ha (and a maximum of 3000 ha for the rules of 2007), they must had been absent of tree cover since 1990, and the annual sequestration rate had to fall below 8000 tCO_2eq. Applicants would now only receive funding for project design, and project developers would need to search for external investors interested in purchasing carbon from these projects. Such changes obeyed, on the one hand, to the government's realisation that long-term funding was not necessarily going to be available for carbon projects – recall that the budget for PSA-CABSA was annually negotiated in Congress – and, on the other hand, to the interest of the Mexican government to support projects which may potentially become sources of voluntary and CDM carbon offsets. This implied, in turn, eliminating the complex process by which carbon prices were established, thus further reducing CONAFOR's management costs but at the same time, as it will be shown later, reducing the number of applications under this component.

Alongside these procedural changes, CONAFOR set up a PES Technical Advisory Council (TAC). The TAC is organised around several working groups and is formed by ecosystem service intermediaries, academic institutions, civil organisations and government departments. A total of eight meetings have taken place since September 2007. The Council's role consists of advising CONAFOR on issues such as a) how to improve PES rules; b) which criteria for PES eligibility areas should be established; c) how to evaluate project developers' performance; d) the key lessons derived from PES external evaluation reports; e) the economic value of ecosystem services; f) forest policy integration and perverse incentives and g) how to expand PES programmes and establish real markets (Bezaury Creel, 2007).

4.2. *Institutional performance*

4.2.1. *National data analysis and project design concerns*

Since 2004 and up to July 2007, 671,000 ha have received support to develop and/or implement PSA-CABSA projects (Table 2). Reduction in the number of hectares receiving funding for design and implementation diminished substantially between 2004 and 2005, which is explained by the 50% reduction in the level of funding secured by Congress for PSA-CABSA. While in 2004 total funding was approximately of Mx$ 101 million, 2006 funding was just about Mx$ 10 million (Fig. 3). Therefore, the funds available were not sufficient to support the total number of successful applications and approximately between 5% and 10% of applications had to be put on hold until more funding became available in 2007 (Table 3). The ratio of investment per hectare over the period 2004–2006 (Fig. 3) has fallen steadily for project implementation (from 1616 Mx$/ha in 2004 to 726 Mx$/ha) and it has declined substantially for project design (from 2260 Mx$/ha to 81.37 Mx$/ha). Funding has recently increased with the negotiation of a Global Environment Facility and World Bank grant for US$ 15 and 45 million, respectively. CONAFOR will match the grant with another US$80 million over two years, with funds coming from PSAH's annual funding of Mx$ 300 million and another Mx$ 25 million provided by Congress. This funding framework has been designed to improve outreach and evaluation capacities in PES programmes, to increase the number of PES beneficiaries, and to promote a more effective and efficient ES commercialisation through the strengthening of monitoring systems and the establishment of well-functioning market-schemes (World Bank, 2006).

Table 3 also shows that most land area receiving support for project design was not under implementation in 2005 or 2006. The number of PSA-CABSA applications was substantial for all three years which indirectly shows that payments were sufficiently attractive for rural communities. However, rejection rates of programme applications and project design documents were also very high. Rejection of programme applications was due to several factors, including missing documentation, non-fulfilment of eligibility criteria, and lack of additionality in the case of carbon projects. From 83 and 69 proposals approved for biodiversity and carbon project design in 2004, only a very small fraction was granted with funds for implementation either in 2005 or 2006. High rejection rates of project design documents was explained by poor quality which, consequently, implies that funding fell into the hands of incompetent ES intermediaries.

An external evaluation of 32 out of 87 carbon project proposals submitted in 2005 and 2006 concluded that only four could be approved to proceed with implementation (Ruiz, 2007). Seventeen of these 32 projects were unable to establish an adequate baseline scenario and to account for the possibility of inducing land-use change somewhere else as a result of the project (i.e., negative leakage). In some cases, comprehensive carbon inventories were not accompanied by suitable project proposals. Other projects did not meet key eligibility criteria, such as the maximum annual sequestration rate of 8000 tCO_2eq for small-scale CDM projects or they confused terms like coal or charcoal with carbon dioxide. Finally, in at least two cases nothing but a full site description was written. Seemingly, an evaluation of 30 biodiversity project proposals submitted for external verification in 2007 rejected 12 of them and the rest had to be revised prior to receiving implementation funds (Gerez, 2007). Project proposals lacked clear project objectives and did not include baseline scenarios, monitoring methodologies, and sustainable funding mechanisms (e.g., ecotourism, hunting permits, sustainable extraction of non-timber forest products). Both evaluations demonstrate that substantial funding was lost in the preparation of unsuccessful project proposals, as developers lacked the necessary knowledge and capacity to design them. This was also related to the fact that CONAFOR officials faced important constraints in communicating the principles of PES projects to ES intermediaries and beneficiaries, as we illustrate in a case study below.

Table 2 – Number of hectares under PSA-CABSA 2004–2006

Year	In project design	In implementation	Total
2004	526,225	31,448	557,673
2005	20,520	29,477	49,997
2006	56,013	7281	63,294

Source: own elaboration from CONAFOR data.

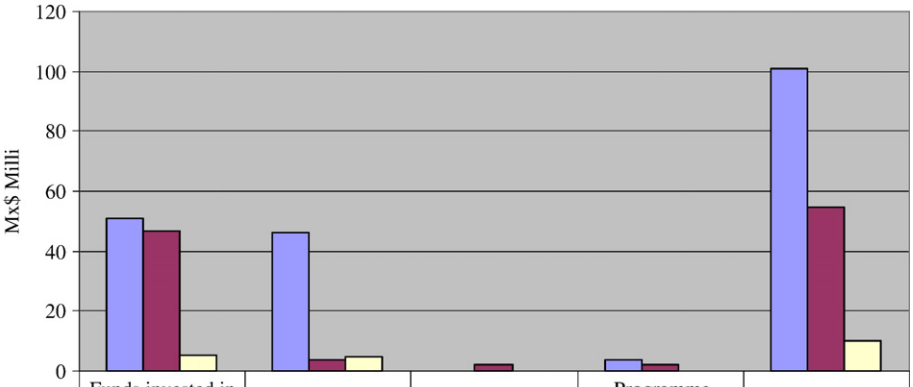
4.2.2. *Environmental and welfare implications at local level*

This section does not attempt to draw conclusive data on the economic, social and environmental outcomes of PSA-CABSA. One of the most recent external evaluations of the programme conducted surveys in 80% of the 51 *ejidos* receiving PSA-CABSA funding in 2005, but it only applied one single survey in each case, filled-in by local authorities or single landowners (Gómez Guerrero et al., 2006). Results indicate that 46.9% of the interviewees considered that PSA-CABSA income was important for their livelihoods while the rest did not. Those already involved in project implementation manifested that PES income was mostly used for rewarding those who participated in project activities. Furthermore, PES contributed to maintain and improve forests and agro-forestry systems which will derive further benefits in the future, such as an increase in the available non-timber forest products. Along these lines, Gómez Guerrero and colleagues highlight that 80% of the interviewees thought PSA-CABSA was reinforcing the idea that forest conservation provided both timber and other services which had not been valued before (Gómez Guerrero et al., 2006, pp. 87). However, they also mentioned that they were already preserving the forests before participating in PSA-CABSA.

Although this evaluation provides a general perspective on PSA-CABSA performance, case-study analyses help to illustrate in more depth how PES impact upon rural communities. Our research reveals differences in project finance, models of PES income distribution and expenditure, and show similar levels of ES provision and likely environmental benefits in the four cases analysed (Table 4). *San Bartolomé Loxicha* considered the carbon project an opportunity to complement ongoing reforestation and conservation activities in the forest commons. Total PSA-CABSA investment in the project sums up to Mx$2.71 million, of which over 70% has reached the community. The community assembly granted 20% of project revenues to the *Milenio Coffee Producers Organisation*, which brings together 100 farmers who are mostly involved in carbon project activities. The remaining 80% was distributed among farmers who participated in tree planting. The assembly created a Forest Committee to coordinate planting activities. Committee members also benefited from a CONAFOR forest management training course although they complained that the course was too short. Interviewees also felt that there was a need to receive more technical support from CONAFOR in order to apply for new funding opportunities and prepare complementary projects.

Orilla del Monte joined PSA-CABSA in order to reforest and promote the commercialisation of pine nuts, which are sold at high prices in regional markets. A group of 95 farmers established the Project Committee to coordinate project activities and facilitate information flows between CONAFOR, the *ejido* assembly and project developers. Ninety percent of carbon income for project implementation in 2006 was distributed among community members, and the remaining 10% was allocated to cover management and technical expenses incurred by project developers. These also received 68% of total income for project implementation in 2006, and the remaining 32% was paid to an external consultant for project verification. Taking into account the Mx$250,000 for project design, the *ejido*'s share of total carbon investment between 2005 and 2007 was 38.73%.

El Cajón used carbon funding to reward those who got involved in reforestation activities and forest patrolling. The *ejido* also bought communication equipment, including a radio and a computer, and project management was centralised in the community authority, who decides which activities should take place, when, and how much money should be spent. Taking into account the total funding received, including the funds for project design in 2005, the community received a



	Funds invested in project implementation	Funds invested in project design	Capacity-building funds	Programme management funds	Total funding
2004	50,836,679.00	46,389,993.00	0.00	3,889,066.88	101,115,738.88
2005	46,810,000.00	3,500,000.00	2,140,000.00	2,000,000.00	54,450,000.00
2006	5,288,098.88	4,557,946.08	0.00	211,523.96	10,057,568.92

Fig. 3 – PSA-CABSA funding 2004–2006.

Table 3 – Approval rates for PSA-CABSA applications 2004–2006

Year	Component	Approved for design (% over total)	Approved for implementation (% over total)	Approved but lack of public funding (% over total)	Rejected (% over total)	Total
2004	Agro-forestry	51 (12.7)	4 (1)	Not available	345 (86.3)	400
	Biodiversity	83 (38.4)	8 (3.7)	Not available	125 (57.9)	216
	Carbon	69 (31.4)	2 (0.9)	Not available	149 (67.7)	220
2005	Agro-forestry	4 (2.4)	13 (8)	Not available	146 (89.6)	163
	Biodiversity	16 (2.5)	7 (1.1)	Not available	621 (96.4)	644
	Carbon	6 (4)	5 (3.4)	Not available	138 (92.6)	149
2006	Agro-forestry	0 (0)	17 (12.1)	13 (9.3)	110 (78.6)	140
	Biodiversity	24 (3.9)	4 (0.6)	36 (5.9)	551 (89.6)	615
	Carbon	12 (8.5)	0 (0)	10 (7.1)	119 (84.4)	141

Source: own elaboration from CONAFOR data.

43.66% share of the total investment. The funding granted for implementation support was split between an intermediary (71%), who was responsible for providing technical assistance and training community patrols, and an external verifier (29%) who was responsible for project follow-up and verification.

Niños Heroes received funding directly for project implementation, which explains the *ejido*'s higher share of total carbon investment in contrast with previous cases (77.67%). The project intermediary and verifier was an academic institution which had prepared a feasibility study for a carbon project in the region in 2003 and 2004. This study was used to apply for PSA-CABSA implementation support. The *ejido* distributed carbon income among those who participated in planting and patrolling activities, which represented approximately Mx$7,000 per household/year. Some beneficiaries used the carbon income to fix a water pump which had been broken for some time. In 2005, most carbon income was used to hire an external consultant who helped establishing a greenhouse to produce seedlings for the project. They cultivated three types of native species but, as soon as they produced the necessary number of seedlings, they abandoned the greenhouse as they could not see any further use for it, at least in the short term. Some conflict resulted from the community's assembly decision to involve settlers in reforestation activities and to reward them with only half of the carbon income allocated to formal right-holders.

Finally, several interviewees across the four case studies argued that carbon payments value should increase. CONAFOR's financial support should also continue after the projects' 5-year implementation period, particularly if *ejidos* show proof of good organisation and tangible conservation results. Moreover, interviewees felt that *ejidos*' assemblies did not receive sufficient advice from government officers during the programme's outreach phase and, as a result, they were not aware of what developing a carbon project really meant in terms of design, implementation and interactions with CONAFOR and ES intermediaries. It was felt that CONAFOR and project developers would have had to explain PES characteristics much better and in plain language.

Carbon sequestration rates vary across the cases analysed. Estimates range between 29,076 tCO_2eq to 34,000 tCO_2eq for the first five years of project implementation. In *San Bartalomé Loxicha*, participants perceived that reforestation activities may increase the amount of water in their springs and that forest conservation is important to have access to 'clean air'. Their greater commitment to controlling forest fires, illegal tree-cutting and livestock roaming in communal areas were also considered positive. In *Orilla del Monte*, they had experience in government reforestation programmes since 1999, and community members thought these programmes had improved their attitude towards environmental conservation. In the other two case studies, people had divergent views regarding the project environmental benefits. In *Niños Héroes*, for instance, several farmers argued that the *ejido*'s involvement in the project was an impediment to increasing the amount of land dedicated to agriculture. However, they also recognised that payments were a good strategy to increase collective and household income. Farmers from *El Cajón* noted that the project had boosted people's interest in controlling livestock access to the commons, but the real benefits to the local commons had yet to be noticed.

As these four communities were funded for project design and/or implementation before the procedural rules establishing the need to comply with CDM rules were approved, it meant that reforestation activities mostly took place in already forested areas of the commons, thus contributing to enrich forest cover but failing to meet the CDM's requirement of establishing plantations in areas which had been denuded prior to 1990. Evidence above has made explicit that communities welcomed the recognition of their ongoing forest management and conservation practices through carbon payments. In the future, however, it will be interesting to examine whether the disappearance of carbon or other PES incentives as a result of government funding phasing out or communities and ES intermediaries failing to secure new investors undermines local commitment to forest conservation. In the same way that we know that the existence of single or combined incentives, such as financial benefits, social norms, rules' compliance and cultural values, determine commitment to ecosystem conservation, changes in the nature or the balance between different kind of incentives for local resource users can lead to behavioural changes, both collective and individual (White and Martin, 2002). Such changes, however, may also be driven by other variables, such as demographic pressures, changes in local leadership or migration trends.

4.3. *Institutional interplay*

The question of interplay concerns how institutions affect one another across governance levels. PSA-CABSA has

Table 4 – Economic, social and environmental benefits derived from carbon payments

Case study	Project finance and economic benefits	Social benefits	Cumulative carbon sequestration (tCO2eq)		
			5 years	10 years	14 years
San Bartolomé Loxicha	2004: 250,000 Mx$ for project design (100% allocated to project developers) 2005: 1,186,134 Mx$ for project implementation (54% distributed among community members and 46% for ES intermediaries and project verifiers) • 638,234 Mx$ for implementation • 150,000 Mx$ for project verification and evaluation • 147,000 Mx$ for capacity building • 250,000 Mx$ for technical assistance and project follow-up 2006: 638,234 Mx$ for implementation support (20% of project funds allocated to the Milenio Coffee Producers Organisation; 80% of project funds allocated to farmers who voluntarily participate in tree planting) 2007: 638,234 Mx$ for implementation support (20% of project funds allocated to the Milenio Coffee Producers Organisation; 80% of project funds allocated to farmers who voluntarily participate in tree planting) Share of total investment allocated to the community: 70.57%	Establishment of a Forest Committee Forest management training course	33,100	Not available	Not available
Orilla del Monte	2005: 250,000 Mx$ for project design (100% allocated to project developers) 2006a: 280,896 Mx$ for project implementation (90% distributed among community members) 2006b: 466,900 Mx$ for implementation support (68% allocated to project intermediary, and 32% allocated to external verification) • 246,000 Mx$ for technical assistance • 71,300 Mx$ for capacity building • 150,000 Mx$ for external verification and evaluation 2007: 280,000 Mx$ for project implementation (100% distributed among community members) Share of total investment allocated to the community: 38.73%	Establishment of the Project Partner Committee Expectations of deriving future income from pine-nut commercialisation	30,624	46,464	67,584
Niños Héroes	2005a: 573,966 Mx$ for project implementation (distributed among reforestation participants and investment in a local greenhouse) 2005b: 297,000 Mx$ for implementation support (100% allocated to project intermediary) • 131,400 Mx$ for technical assistance • 81,600 Mx$ for capacity building • 84,000 Mx$ for verification and evaluation 2006a: 573,966 Mx$ for project implementation (100% distributed among reforestation participants and patrol members) 2006b: 198,000 Mx$ for implementation support (100% allocated to project intermediary) • 87,600 Mx$ for technical assistance • 54,400 Mx$ for capacity builidng • 56,000 Mx$ for verification and evaluation 2007: 573,966 Mx$ for project implementation (100% distributed among reforestation participants and patrol members) Share of total investment allocated to the community: 77.67%	Water pump repair Greenhouse establishment	32,752	Not available	Not available
El Cajón	2005: 250,000 Mx$, for project design (100% allocated to project developers) 2006a: 295,000 Mx$, for project implementation (allocated to those who participate in reforestation activities and investment in collective goods) 2006b: 511,300 Mx$, for implementation support (71% allocated to project intermediary, and 29% allocated to external verification) • 250,000 Mx$, for technical assistance • 111,300 Mx$, for capacity building • 150,000 Mx$, for external verification and evaluation 2007: 295,000 Mx$, for project implementation (allocated to those who participate in forest patrolling and re-planting activities) Share of total investment allocated to the community: 43.66%	Purchase of a radio and a computer for community authorities	29,076	39,776	51,850

complemented, rather than conflicted with, other programmes in the forestry sector, particularly the National Network of Protected Areas and CONAFOR's reforestation programmes. One of the communities analysed received complementary economic support from CONAFOR through a reforestation programme and such additional funding was critical to finance the acquisition of plant seedlings from a state nursery, as it was impossible to establish a local nursery due to the local climatic conditions (lack of rainfall and water). Moreover, the federal PES programme has boosted regional and local interest in PES. The attempts in several Mexican states to support PES projects (e.g., in Veracruz, Coahuila, Colima, Mexico and Michoacán) suggests that the concepts and procedures underlying federal PES programmes reach lower levels of political organisation (state governments and municipalities). Mexico's PES programme, including PSA-CABSA, has thus had a multiplying effect, increasing the number of private–public–community arrangements designed to provide ES. However, there are still government policy programmes which contradict and can undermine PES efforts, such as the Agriculture Ministry's programmes of PROCAMPO and Alianza para el Campo. The former economically supports farmers for each hectare of maize cultivated while the latter promotes the expansion of new crops with a high market value (e.g., oil palm and avocado), thus inducing farmers to change their land-use practices.

PSA-CABSA has been purposely linked to procedural developments in carbon forestry at the international level, particularly the CDM, which has gone against the interests of Mexican civil organisations. Since projects must adhere to CDM rules, there has been a reduction in the number of project applications, and an increase in the rate of applications' rejections. This is a case of unidirectional vertical interplay in which the rules of an international institution affect the procedural framing of the other. In Mexico, such interplay undermines communities' ability to access carbon payments, at least until local capacities to design viable CDM forestry projects are in place. Even if these capacities emerge, it remains unclear whether PES carbon projects are attractive to investors in international carbon markets, which in turn may be dependent on the evolution of the negotiations for an international climate regime after the current phase of the Kyoto Protocol expires in 2012 (Boyd et al., 2007). Furthermore, Mexican rural communities' interest in enhancing the management of the forest commons – often with substantial forest cover – through PES and their interest in securing long-term funding from government are at odds with international procedures and the government's current approach.

Our analysis also shows the existence of symmetrical vertical interplay in the interaction between Mexico's PES programmes and local institutions for community organisation and forest management. *Ejidos*' assemblies and the availability of denuded or forested areas under common property have been critical to allow for low management costs in project development. CONAFOR officers deal only with community authorities, who in turn rely on collective assemblies to make decisions concerning their involvement in PSA-CABSA. Local institutions thus reduce the costs of PES outreach, management and monitoring, which would be very high if PES activities would have to be promoted across hundred of individual farmers and ES provision monitored accordingly. Gómez Guerrero et al. (2006, pp. 71) show a relationship of ES provision benefits *versus* costs for PSA-CABSA of 1.10 and an internal rate of return of approximately 17.60% (Gómez Guerrero et al., 2006, pp. 71). These data do not include the indirect benefits of biodiversity conservation, reduction in soil erosion rates and impacts on the climate, which would render the programme even more cost-effective.

Seemingly important is the fact that likely conflicts which can potentially result from the allocation and distribution of payments in PES schemes are minimised due to the communities' role in defining such allocation and distribution. This again reduces public transaction costs and ensures legitimate outcomes, at least in what concerns the ES providers' group. This, of course, is not always the case. Local institutions may not guarantee a fair distribution of project benefits, as shown in the conflict of *Niños Héroes*. More problematic, at least in the Mexican context, can be the provision of ES through individual landholdings, in particular if these ultimately belong to an *ejido* and have not been consolidated as pure private property. A carbon forestry project in southern Mexico providing voluntary offsets to international markets through reforestation activities in landholdings of individual farmers from several *ejidos* has enhanced inequalities in access to payments and created conflicts among farmers and between participants and the community assembly (Corbera et al., 2007a). Such contrasting evidence emphasises the fact that property rights underlying ES stocks and flows (e.g., common property, individual usufruct, or pure private property) influence the original design of PES schemes, including who gets involved and who holds the rights over ES and the correspondent payments, their transaction costs, and has welfare implications (Boyd et al., 2007).

Finally, Mexico's PES TAC constitutes a key element for interplay adjustment. It acts as a 'multi-stakeholder body' (Berkes, 2002, pp. 304) through which key stakeholders can provide policy recommendations to CONAFOR. It is a platform for the identification and discussion of sources of interplay, and it also provides specific insights for the improvement of PES rules. It also acts as a participatory body where stakeholders receive updated information from CONAFOR and where recommendations are generated collectively. During its latest meeting in September 2007, the TAC drew a series of recommendations to reform the rules governing all PES programmes. The extent to which these recommendations will be taken into consideration will be seen as soon as CONAFOR makes public the 2008 PES procedural rules, as the degree of influence of multi-stakeholder bodies in policy-making vary across institutional settings (Berkes, 2002). Table 5 summarises the research findings.

5. Discussion

Mexico's PSA-CABSA and PSAH have been instrumental in promoting a new vision of Mexico's forests as producers of intangible forest public goods, and they have helped to popularise the idea that ES can be compartmentalised, monitored and economically valued for the benefit of rural populations.

Table 5 – Institutional dimensions of PSA-CABSA

	Key characteristics	Future challenges
Institutional design	Originated from the lobbying activities of civil organisations	To address evolving institutional interactions with global (CDM)
	Procedural adaptation and flexibility: some procedural changes are sources of interplay and compromise performance	To consider the impacts of phasing out PES in local behaviour
	Multi-stakeholder body and continuous external evaluations which contribute to improve programme design	
Institutional performance	Positive response of potential ES providers	To improve capacities for project design and implementation
	High rejection of programme applications and project proposals	To improve communication between government, ES intermediaries and providers
	Lack of a stable funding flow	To secure long-term funding sources for local projects
	Lack of methodologies for ES flows evaluation (in particular for biodiversity and agro-forestry services)	To quantify environmental and welfare gains through the study of a large sample of funded projects
	Increased income and enhanced forest management practices[a]	
Institutional interplay	Synergies with other reforestation and forest management programmes	To address negative outcomes of interplay with other government policies and local institutions
	Interactions with global institutions which affect uptake, project design and performance	To delegate more decision-making power to multi-stakeholder body
	Indirect attribution of ES ownership to formal institutions at local level, often at the expense of excluding non right-holders from PES benefits	
	Interplay analysis through multi-stakeholder body	

[a] Based on case studies analysed.

From a design perspective, Mexico's PSA-CABSA conformed positively to most of the design principles outlined by Dolsak and Ostrom (2003), which may partially explain its relative success in terms of applicants' interest and civil society support. First, although programme rules have not been devised by resource users themselves, organisations representing users' interests have played a major role in framing the 'rules of the game'. Furthermore, the TAC ensures a continuous involvement of civil organisations and farmers' representatives in the ongoing reforms of PES schemes. Second, evaluating the compliance with rules for project design has been effectively undertaken by independent consultants, although compliance with project implementation on the ground will be subject to the amount of resources CONAFOR dedicates to this issue in the future, thus determining performance to a great extent. Third, in the light of the case studies analysed, implementation rules are enforceable and have contributed to enhance forest patrolling against illegal logging. Fourth, ES providers' rights to appeal were secured in the last procedural reform even if no sanctions have been applied yet. At this regard, it has been acknowledged that government-led PES programmes are relatively weak in guaranteeing payments' conditionality due to their focus on up-front financing and poverty reduction (Wunder et al., 2008).

Fifth, as concerns the accountability of other stakeholders to users, the capturing of funds by project intermediaries relates to lack of capacity and a deficient design. There is a need to ensure that the rights of local communities to prosecute any ES intermediaries who do not deliver well-designed project proposals or mismanage funds are guaranteed, for example through formal contracting supervised by CONAFOR or an independent legal entity. Government-led PES programmes would have to prioritise a few projects and regions in their early years and place the development of project proposals in the hands of experienced university research groups or NGOs, while creating a parallel funding stream for capacity building in project design, involving the rest of interested organisations, individual consultants and communities, thus scaling-up the programme as soon as capacities for effective project design and implementation exist.

The lack of a clear definition of how land-use activities are related to ES provision in PSA-CABSA rules, as well as the current shortage of guidelines and economic resources to monitor ES provision during and beyond contractual provisions, can also be attributed to design drawbacks which by no means are unique. Another 8 PES schemes in both developed and developing countries (Wunder et al., 2008) have also tied payments to the delivery of ES proxies (e.g., reforested area, rates of tree survival, areas under sustainable land-use management) rather than ES themselves, partly due to the biophysical complexity and the costs involved in measuring services like carbon sequestration or the relationship between improved land-use management and water quality. Seemingly, these schemes dedicate divergent efforts to monitor compliance over time, depending on priorities and economic resources available, and not all of them take into account the issue of additionality as PSA-CABSA does.

Unclear understanding of how to define and monitor ES also has to do with the fact that they are public goods, rendering them non-excludable, conceptually contested, and their flows difficult to quantify. Mexico's PSA-CABSA considered carbon fixation by forests, biodiversity conservation and agro-forestry systems under a single broad ES category, without further conceptual distinction or distinction between the types of land-use activities providing such services. However, we argue that they are essentially different. Broadly speaking, ES are the benefits people obtain from ecosystems, among which it is possible to distinguish between supporting, provisioning, regulating and cultural services (Millennium Ecosystem Assessment, 2005). Therefore, carbon fixation is the only of the three ES

which, per definition, can be considered an ES (i.e., a climate regulation service). In contrast, biodiversity conservation is a human intervention directed towards the protection of diverse or characteristic ecosystems, organisms or genetic pools, the existence and interactions of which may provide specific ES. In turn, agro-forestry systems are a product of an active management of human-designed and potentially biodiverse ecosystems, which can enhance critical ES. In effect then, PSA-CABSA took biodiversity conservation and agro-forestry systems as a proxy of ES, thus making their quantification and monitoring difficult and ill-defined. Confusion in what actually constitutes an ES is not uncommon (Gutman, 2007, pp. 385) and there exist distinct perspectives at this regard (Boyd and Banzhaf, 2007; Daily, 1997). Furthermore, conceptual ambiguity blurs the difference between ES types, ES flows and stocks of natural resources. The relationship between stocks and ES flows needs further scientific assessment in the light of changing management and physical conditions, such as rainfall variability or alterations of soil biota (Adams and Vira, 2008), as well as in the light of scientific literature challenging given relationships such as that forest cover contributes to increase water quantity or quality downstream (Grip et al., 2005). In Mexico's PSA-CABSA, what constitutes an ES has been influenced by the preferences of those actors involved in PES design, who in turn traded-off between conceptual complexity, monitoring costs and ES providers' knowledge and interests.

As noted in the Introduction, and taking into account the criteria outlined in Table 1, it is still early days to evaluate the overall performance of PSA-CABSA. Preliminary assessments and our local case studies show that it has been positively received by local communities, which have been encouraged to participate by attractive payments, have benefited from enhanced organisational skills around forest management, but have been surprised by the considerable amount of work and project management involved in implementation. ES providers' interest may also be related to long-term established collaborative partnerships between project intermediaries and local communities and the latter's long-term commitment to forest conservation. Nevertheless, PSA-CABSA performance has been partly jeopardised, on the one hand, by the inability of project intermediaries to prepare consistent project proposals and, on the other hand, by a variable level of government funding which has influenced funding flows for project design and implementation. The World Bank's grant is expected to address some of the above-mentioned design pitfalls while increasing the funds available for increasing monitoring efforts country wide.

This last issue relates to the importance of establishing long-term financial mechanisms and monitoring programmes for PES schemes, in order to support effective ecosystems conservation and ES provision (Martin et al., 2008). There is no reason to believe that sustainable land-use management will continue after payments are withdrawn, especially for government-led PES schemes where ES providers' prosecution in case of non-compliance is likely to be limited (Wunder et al., 2008). Existent programmes like Mexico's PSAH or Costa Rica's PSA have addressed the financial issue earmarking federal fees on water tariffs, fuel taxes or both, and the programmes coexist with local initiatives in which contracts between ES consumers and providers have been established (Muñoz-Piña et al., 2008; Pagiola, 2008). According to present rules, the future of Mexico's payments for carbon forestry services will depend upon international investors' willingness to support the communities who are currently designing these projects. For this to happen though, a strong marketing effort to link national carbon forestry projects with CDM and voluntary markets will be needed. This may imply some re-adjustments in project design and implementation according to the number of standards governing these markets (Peskett et al., 2007). Even so, this approach may not be sufficient as CDM investments in the forestry sector remain limited and voluntary offsetting markets are moving towards energy technologies (Corbera et al., 2008). Alternatively, and following the Costa Rican example, the government could tax fuel-based power stations, provide Mexican companies with incentives to invest in PES projects, or develop a national emissions trading scheme encompassing offsetting through reforestation and forest conservation activities. For biodiversity and agro-forestry or landscape services, however, funding remains relatively scarce, and future funding will be tied to government funding and the contributions of international organisations like the Global Environment Facility, the World Bank, and large conservation organisations. For these services, long-term committed buyers may be difficult to identify and the most suitable tax or incentive-based frameworks difficult to negotiate.

From an interplay perspective, the paper has shown that both PSAH and PSA-CABSA have helped to promote and encourage the development of other PES schemes across the country, led by municipalities or specific ES users. For the carbon component, the rules set by global actors and institutions regarding what constitutes an eligible carbon forestry activity have prevailed over the interests of national institutions and local resource managers. Procedural changes in this direction have impacted upon the carbon component performance, as the number of project proposals became few in number when projects had to strictly conform to international project guidelines and when government financial support became limited to projects' design phase. To date, carbon forestry governance is hierarchical in nature, and PES programmes in developing countries rewarding resource managers for carbon management need to take into account policy developments at international level. In the future, the inclusion of avoided deforestation activities as a source of carbon credits under the climate change convention may also impact upon existing PES programmes in developing countries and lead towards the inclusion of new eligible activities and project implementation rules. Further analyses of interplay sources for different PES schemes implemented in different countries and at different scales need to be undertaken with urgency. Even if we consider that participation in PES is voluntary, therefore assuming that payments already cover ES providers' opportunity and management costs, contextual policy conditions in rural areas can change quickly, thus changing the potential monetary incentives available. Seemingly, it is necessary to draw a comparison across PES schemes regarding the cost and the challenges involved in negotiating contracts with ES providers, as well as their approach to defining who is entitled to sell and be rewarded for ES provision.

Finally, it is critical to mention that the scale of ES governance influences the three dimensions outlined so far, as well as the capacity issue. Wunder et al. (2008) highlight that government-led and user-led PES programmes differ considerably in their design and outcomes as a result of their different geographical implementation scale (national *versus* regional/local) and their key level of governance (central government *versus* local municipality or local users/civil organisation). The former are often characterised by lower transaction costs per unit of area under PES, uniform ES pricing, weak additionality, multiple objectives and unclear monitoring and long-term compliance unless stable funding sources are secured. The latter, in contrast, suffer from higher start-up and monitoring costs per unit of area but PES payments are better targeted and more closely negotiated with ES providers, ES monitoring takes place more effectively due to the users' vested interest and additional welfare impacts are not necessarily the objective of the scheme, which does not mean that such additional benefits do not accrue.

PSA-CABSA complies with most of the characteristics outlined above, except for the additionality requirement, and it has additionally ignored the complexities governing resource use at local level. The government has assumed that ES flows are owned by those who legally own the environmental resources providing such services. The patriarchal nature of local assemblies and the role of informal right-holders in the provision of ES have been ignored to avoid an interference with local customary practices. Governance from the top–down resulting in a deficient identification or participation of de jure and de facto ES providers was also a feature of Costa Rica's PSA programme, which was originally designed in such a way that excluded poor landowners who lacked of land title (Zbinden and Lee, 2005) — a problem which has been recently addressed, permitting the participation of landowners without land titles in the scheme (Pagiola, 2008). Government-led PES schemes can also suffer from lack of capacity at different governance levels. Government officers across the country may need a few years to become familiar with PES rules and provide the right information to ES providers. Additionally, government-led initiatives need to have available an important number of well-trained professionals across the country who can help communities develop their own projects. As we have shown, this has not been the case in Mexico, where it becomes urgent to establish procedures which make intermediaries accountable to ES providers.

6. Conclusions

Mexico's innovative experiment with PES provides important lessons for institutional scholars. Our analysis of PSA-CABSA between 2004 and 2006 highlights the importance of institutional design, performance, interplay and capacity issues in obtaining a holistic understanding of PES initiatives. In an increasingly complex social world, where multiple policies exist and overlap, and where there are diverse actors' interests across scales, flexibility in procedural design, ongoing learning and continuous institutional adaptation is critical to ensure the long-term effectiveness of new institutions for global environmental change (Biermann, 2007). Furthermore, we argue that the framework advanced in this paper is useful to organise future PES research, regardless of PES schemes' geographical and governance scale. The design component permits to draw critical insights on the politics of design, such as whose interests prevail in PES design, and to inform debates about ES definition, pricing, additionality, conditionality and transaction costs. The performance component, on the other hand, is central to understand whether PES can achieve their stated objectives of environmental conservation and ES provision and whether it is possible to create sustainable financing strategies for all ES. In turn, analyses of how behavioural changes induced through PES incentives (or the lack of) need to be systematised and should become central in the research agenda of the near future. Seemingly, it is necessary to provide more consistent and structured data on additional welfare benefits and to assess why these are achieved and what are the trade-offs in terms of overall payments and transaction costs.

Institutional interplay is, surely, the least researched area so far in the PES field, specifically because one needs to take a long-term research perspective, and focus on shifting policy dynamics and incentives in the communities, areas or regions benefiting from PES. In the context of government-led PES schemes, it is important to examine processes of institutional coordination so as to avoid contradictory policies and actions in rural development and land-use planning. In user-led PES, it is important to examine whether government policies or changes in international markets induce land-use change dynamics in the region or area subject to PES and what is the response of PES actors to such changes. Would ES providers stick to their PES contractual obligations? Would ES users prosecute those who fail to deliver the service? Would ES users cancel contracts if their economic conditions change or the funding framework becomes inadequate?

Capacity is an issue often overlooked in PES debates. However, this paper has shown that capacity is extremely important to design consistent schemes and projects and to generate the required trust among all stakeholders, which can ultimately determine the provision of ES in the long run. The emphasis of the analytical framework on scale has also proved relevant. Current PES analyses show that geographical and political scale does matter. Firstly, it defines which actors act as ES buyers and thus play a predominant role in rule-framing and, secondly, it seems evident that some ecosystem services are more efficiently targeted and monitored locally or regionally than at national or global scales. For watershed and biodiversity services, for example, a large share of funding may be secured from a locally designed institutional framework involving identifiable ES users, with the potential support of public expenditure (local government) and civil society (e.g., NGOs). In contrast, a service like carbon sequestration may necessitate of multiple actors across governance scales to meet international ES provision standards and secure funding from international or national investors.

In conclusion, we can draw a number of lessons learned from the analysis of Mexico's PSA-CABSA, and in particular from its carbon component, which can inform the future development of other government or user-led PES initiatives. From a design perspective, it has been shown that defining the nature of the service for which communities are rewarded and

establishing standard methodologies for the evaluation of ES provision is very important. Furthermore, all PES programmes should ensure that intermediaries are accountable, contracts define actors' rights and responsibilities, and power relationships are even. The inclusion of a multi-stakeholder body bringing together PES actors to analyse PES drawbacks as the scheme develops is certainly a good idea which, jointly with independent assessments, strengthen processes of ongoing learning and institutional adaptation. More important is to develop a sustainable financing framework where ES users flexibly compensate ES providers over a long period of time, and where continuous support for sustainable resource management is provided.

In addition, it is necessary to emphasise that PES programmes can decide to focus exclusively on the provision of ES and leave aside other welfare concerns. But even in this case, it is important to evaluate the extent to which PES directly or indirectly contribute to other aspects of economic and social development, beyond the provision of economic incentives. This is important to test the often assumed hypothesis that PES can be both a conservation and development instrument. Seemingly, it is critical to take into account that PES do not operate in a vacuum and thus they are influenced by other institutions such as property rights and land-use policies. PES outcomes result then from a combination of institutional factors, some of which are extrinsic to institutional design. Above all, however, PES schemes need to secure a minimum level of capacity and understanding across the actors involved so that they understand what PES is actually about and what should be delivered. Capacity considerably influences PES procedural design and early implementation stages, in turn affecting PES efficiency and actors' long-term trust.

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REFERENCES

Adams, B., Vira, B., 2008. Separating nature's stocks and flows in debates about ecosystem services. Manuscript presented at the NERC-ESRC Transdisciplinary Seminar Series: Ecosystem Services and Human Well-Being: Interrogating the Evidence.

Agrawal, A., 2002. Common Resources and Institutional Sustainability. In: Ostrom, E., Dietz, T., Dolsak, N., Stern, P.C., Stonich, S., Weber, E.U. (Eds.), The Drama of the Commons. National Academy Press, Washington D.C.

Alix-Garcia, J., 2004. Seeing the Forest and the Trees: A Spatial Analysis of Common Property Deforestation. Job Market Paper, University of California Berkeley, Berkeley.

Alix-Garcia, J., de Janvry, A., Sadoulet, E., 2005a. A tale of two communities: explaining deforestation in Mexico. World Development 33 (2), 219–235.

Alix-Garcia, J., de Janvry, A., Sadoulet, E., Torres Rojo, J.M., Braña Varela, J., Zorilla Ramos, M., 2005b. An Assessment of Mexico's Payment for Environmental Services Program. Comparative Studies Service Agricultural and Development Economics Division, United Nations Food and Agriculture Organization (FAO), Rome.

Baland, J., Platteau, J., 1996. Halting Degradation of Natural Resources: Is There a Role for Rural Communities? Clarendon Press, Oxford.

Bayon, R., Hawn, A., Hamilton, K., 2007. Voluntary Carbon Markets. An International Business Guide to What They Are and How They Work. Earthscan, London.

Berkes, F., 2002. Cross-scale Institutional Linkages: Perspectives from the Bottom–Up. In: Ostrom, E., Dietz, T., Dolsak, N., Stern, P.C., Stonich, S., Weber, E.U. (Eds.), The Drama of the Commons. National Academy Press, Washington D.C.

Bezaury Creel, J., 2007. El Consejo Técnico Consultivo (CTC) en el marco del Proyecto de Servicios Ambientales del Bosque. Presentation given at the Workshop "Payments for Ecosystem Services in Mexico: Current Status and Future Objectives", organised by the Tyndall Centre and the National Institute of Ecology. Mexico City, July 18–19, 2007.

Biermann, F., 2007. "Earth system governance" as a cross-cutting theme of global change research. Global Environmental Change 17, 326–337.

Boyd, J., Banzhaf, S., 2007. What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics 63, 616–626.

Boyd, E., May, P., Chang, M., Veiga, F.C., 2007. Exploring socioeconomic impacts of forest based mitigation projects: Lessons from Brazil and Bolivia. Environmental Science and Policy 10, 419–433.

Bray, D.B., Merino-Pérez, L., Barry, D., 2005. Community Managed in the Strong Sense of the Phrase: The Community Forest Enterprises of Mexico. In: Bray, D.B., Merino-Pérez, L., Barry, D. (Eds.), The Community Forests of Mexico. Managing for Sustainable Landscapes. University of Texas Press, Austin.

Corbera, E., 2005a. Bringing Development into Carbon Forestry Markets: Challenges and Outcomes of Small-scale Carbon forestry Activities in Mexico. In: Murdiyarso, D., Herawati, H. (Eds.), Carbon Forestry: Who will Benefit? Center for International Forestry Research, Bogor.

Corbera, E., 2005b. Interrogating Development in Carbon Forestry Activities: A Case Study from Mexico. Doctoral dissertation, School of Development Studies, University of East Anglia, Norwich.

Corbera, E., Brown, K., in press. Building Institutions to Trade Ecosystem Services: Marketing Forest Carbon in Mexico. doi:10.1016/j.worlddev.2007.09.010

Corbera, E., Brown, K., Adger, W.N., 2007a. The equity and legitimacy of markets for ecosystem services. Development and Change 38 (4), 587–613.

Corbera, E., Kosoy, N., Martínez-Tuna, M., 2007b. Equity implications of marketing ecosystem services in protected areas and rural communities: case studies from Meso-America. Global Environmental Change 17 (3–4), 365–380.

Corbera, E., Estrada, M., Brown, K., 2008. How do CDM and voluntary offsets compare? Working Paper 116. Tyndall Centre for Climate Change Research, Norwich.

Daily, G.C., 1997. Introduction: What are Ecosystem Services? In: Daily, G.C. (Ed.), Nature's Services. Societal Dependence on Natural Ecosystems. Island Press, Washington D.C.

de Vos, J., 2002. Una tierra para sembrar sueños. Historia reciente de la Selva Lacandona 1950–2000. Centro de Investigaciones y Estudios Superiores en Antropología Social y Fondo de Cultura Económica, Mexico City.
Dietz, T., Ostrom, E., Stern, P.C., 2003. The struggle to govern the commons. Science 302 (5652), 1907–1912.
Dolsak, N., Ostrom, E., 2003. The Challenges of the Commons. In: Dolsak, N., Ostrom, E. (Eds.), The Commons in the New Millenium. Challenges and Adaptations. The MIT Press, Cambridge.
Durand, L., Lazos, E., 2004. Colonization and tropical deforestation in the Sierra Santa Marta, Southern Mexico. Environmental Conservation 31 (1), 11–21.
Engel, S., Pagiola, S., Wunder, S., 2008. Designing payments for environmental services in theory and practice: an overview of the issues. Ecological Economics 65, 663–674.
Fortmann, L., 2000. Property in non-timber forest products. European Tropical Forest Research Network Bulletin 32, 72–73.
Fuchs, D.A., 2003. An Institutional Basis for Environmental Stewardship. The Structure and Quality of Property Rights. Kluwer Academic Publishers, Dordrecht.
Gerez, P., 2007. ¿Qué están proponiendo los proyectos CABSA-Biodiversidad? Análisis sobre 30 proyectos evaluados. Presentation given at the Workshop "Payments for Ecosystem Services in Mexico: Current Status and Future Objectives", organised by the Tyndall Centre and the National Institute of Ecology. Mexico City, July 18–19, 2007.
Gibson, C.C., Ostrom, E., Ahn, T.K., 2000. The concept of scale and the human dimensions of global change: a survey. Ecological Economics 32 (2), 217–239.
Gómez Guerrero, A., Aldrete, A., Hernández Rivera, G., Chávez Aguilar, G., de los Santos Posadas, H., Valdez Hernández, J.I., Valdez Lazalde, J.R., González Guillén, M.J., Romero Sánchez, M.E., Hernández de la Rosa, P., Rivera Vázquez, R., Fernández Cazares, S., 2005. Evaluación del Programa de Pago de Servicios Ambientales por Captura de Carbono, y los derivados de la Biodiversidad y para Fomentar el Establecimiento y Mejoramiento de Sistemas Agroforestales (PSA-CABSA). Ejercicio Fiscal 2004. Comisión Nacional Forestal, Mexico City.
Gómez Guerrero, A., Aldrete, A., Fierros González, A.M., Hernández Rivera, G., Ángeles Perez, G., Valdez Hernández, J.I., Valdez Lazalde, J.R., González Guillén, M.J., López López, M.A., Hernández de la Rosa, P., Rivera Vázquez, R., Fernández Cazares, S., 2006. Evaluación del Programa de Pago de Servicios Ambientales por Captura de Carbono, y los derivados de la Biodiversidad y para Fomentar el Establecimiento y Mejoramiento de Sistemas Agroforestales (PSA-CABSA). Ejercicio Fiscal 2005. Comisión Nacional Forestal, Mexico City.
Government of Mexico, 2003. Acuerdo Nacional para el Campo. Government of Mexico, Mexico City.
Grip, H., Fritsch, J.M., Bruijnzeel, L., 2005. Soil and Water Impacts during Forest Conversion and Stabilization to New Land Use. In: Bonell, M., Bruijnzeel, J. (Eds.), Forests, Water and People in the Humid Tropics. Cambridge University Press, Cambridge.
Gutman, P., 2007. Ecosystem services: foundations for a new rural-urban compact. Ecological Economics 62, 383–387.
Humphreys, D., 2006. Logjam: Deforestation and the Crisis of Global Governance. Earthscan, London.
Klooster, D., 1999. Community-based forestry in Mexico: can it reverse processes of degradation? Land Degradation and Development 10, 365–381.
Klooster, D., 2003. Campesinos and Mexican forest policy during the twentieth century. Latin America Research Review 38 (2), 94–126.
Klooster, D., Masera, O., 2000. Community forest management in Mexico: carbon mitigation and biodiversity conservation through rural development. Global Environmental Change-Human and Policy Dimensions 10 (4), 259–272.
Klooster, D., Ambinakudige, S., 2005. The Global Significance of Mexican Community Forestry. In: Bray, D.B., Merino-Pérez, L., Barry, D. (Eds.), The Community Forests of Mexico. Managing for Sustainable Landscapes. University of Texas Press, Austin.
Kosoy, N., Corbera, E., Brown, K., in press. Participation in payments for ecosystem services: case studies from the Lacandon Rainforest, Mexico. Geoforum.
Kumar, M., Kumar, P., 2008. Valuation of the ecosystem services: a psycho-cultural perspective. Ecological Economics 64 (4), 808–819.
Landell-Mills, N., Porras, I., 2002. Silver Bullet or Fools' Gold? A Global Review of Markets for Forest Environmental Services and Their Impacts on the Poor. International Institute for Environment and Development, London.
Lebel, L., Garden, P., Imamura, M., 2005. The politics of scale, position, and place in the governance of water resources in the Mekong Region. Ecology and Society 10 (2), 18.
Liverman, D., 2004. Who governs, at what scale and at what price? Geography, environmental governance, and the commodification of nature. Annals of the Association of American Geographers 94 (4), 734–738.
Manson, R.H., 2004. Los servicios hidrológicos y la conservación de los bosques de México. Madera y Bosques 10 (1), 3–20.
Martin, A., Blowers, A., Boersema, J., 2008. Paying for environmental services: can we afford to lose a cultural basis for conservation? Environmental Sciences: Journal of Integrative Environmental Research 5 (1), 1–5.
McCaulay, D., 2006. Selling out on nature. Nature 443, 27–28.
McKean, M.A., 2000. Common Property: What is It, What is It Good for, and What Makes It Work? In: Gibson, C.C., McKean, M.A., Ostrom, E. (Eds.), People and Forests. Communities, Institutions and Governance. MIT Press, London.
Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, D.C.
Mitchell, R.B., 2008. Evaluating the Performance of Environmental Institutions: What to Evaluate and How to Evaluate It? In: Young, O.R., King, L.A., Schroeder, H. (Eds.), Institutions and Environmental Change: Principal Findings, Applications, and Research Frontiers. The MIT Press, Cambridge.
Muñoz, C., Guevara, A., Bulas, J.M., Torres, J.M., Braña, J., 2006. Pagar por los Servicios Hidrológicos del Bosque en México. In: Pagiola, S., Bishop, J., Landell-Mills, N. (Eds.), La venta de servicios ambientales forestales. Instituto Nacional de Ecología, Mexico City.
Muñoz-Piña, C., Guevara, A., Torres, J.M., Braña, J., 2008. Paying for the hydrological services of Mexico´s forests: analysis, negotiations and results. Ecological Economics 65, 725–736.
O'Brien, K.L., 1998. Sacrificing the Forest. Environmental and Social Struggles in Chiapas. Westview Press, Boulder, Colorado.
Ostrom, E., 1990. Governing the Commons. The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge.
Ostrom, E., 2005. Understanding Institutional Diversity. Princeton University Press, Princeton & Woodstock.
Pagiola, S., 2008. Payments for environmental services in Costa Rica. Ecological Economics 65, 712–724.
Pagiola, S., Arcenas, A., Platais, G., 2005. Can Payments for Environmental Services help reduce poverty? An exploration of the issues and evidence to date from Latin America. World Development 33 (2), 237–253.
Peskett, L., Luttrell, C., Iwata, M., 2007. Can Standards for Voluntary Offsets Ensure Development Benefits? Forestry Briefing 13. Overseas Development Institute, London.
Robles Berlanga, H., 1999. Tendencias del campo mexicano. Estudios Agrarios 13, 31–60.
Rojas, M., Aylward, B., 2003. What are We Learning from Experiences with Markets for Environmental Services in Costa

Rica? A Review and Critique of the Literature. Environmental Economics Programme, International Institute for Environment and Development, London.
Rosa, H., Kandel, S., Dimas, L., 2003. Compensation for Environmental Services and Rural Communities in the Americas: Lessons from the Americas and Key Issues for Strengthening Community Strategies. Programa Salvadoreño de Investigación sobre Desarrollo y Medio Ambiente, San Salvador.
Rudel, T.K., 2008. Meta-analyses of case studies: a method for studying regional and global environmental change. Global Environmental Change 18, 18–25.
Ruiz, F., 2007. Experiencias en la formulación de proyectos forestales de captura de carbono. Presentation given at the Workshop "Payments for Ecosystem Services in Mexico: Current Status and Future Objectives", organised by the Tyndall Centre and the National Institute of Ecology. Mexico City, July 18–19, 2007.
Selin, H., VanDeveer, S.D., 2003. Mapping institutional linkages in European air pollution politics. Global Environmental Politics 3 (3), 14–46.
Tipper, R., 2002. Helping Indigenous Farmers to Participate in the International Market for Carbon Services: The Case of Scolel Te. In: Pagiola, S., Bishop, J., Landell-Mills, N. (Eds.), Selling Forest Environmental Services. Market-based Mechanisms for Conservation and Development. Earthscan, London.
Tucker, C., Ostrom, E., 2005. Multidisciplinary Research Relating Institutions and Forest Transformations. In: Moran, E.F., Ostrom, E. (Eds.), Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems. The MIT Press, Cambridge.
Turner, R.K., Paavola, J., Coopera, P., Farber, S., Jessamya, V., Georgiou, S., 2003. Valuing nature: lessons learned and future research directions. Ecological Economics 46 (3), 493–510.
UNEP-Risoe, 2008. CDM Pipeline Overview May 2008. www.cdmpipeline.org.
White, A., Martin, A., 2002. Who Owns the World's Forests? Forest Tenure and Public Forests in Transition. Forest Trends and Center for International Environmental Law, Washington D.C.
World Bank, 1995. Mexico Resource Conservation and Forest Sector Review. Resources and Rural Poverty Operations Division, Latin America and the Caribbean Regional Office, Washington, D.C.
World Bank, 2006. Environmental Services Project. Project Information Document. Appraisal Stage. Report No.: 35419. The World Bank, Washington, D.C.
Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecological Economics 65, 834–852.
Young, O.R., 2002a. The Institutional Dimensions of Environmental Change. Fit, Interplay and Scale. MIT Press, London.
Young, O.R., 2002b. Institutional Interplay: The Environmental Consequences of Cross-scale Interactions. In: Ostrom, E., Dietz, T., Dolsak, N., Stern, P.C., Stonich, S., Weber, E.U. (Eds.), The Drama of the Commons. National Academy Press, Washington D.C.
Young, O.R., in press. Building Regimes for Socio-ecological Systems: The Diagnostic Method. In: Young, O.R., King, L.A., Schroeder, H. (Eds.), Institutions and Environmental Change: Principal Findings, Applications, and Research Frontiers, MIT Press.
Young, O.R., Agrawal, A., King, L.A., Sand, P.H., Underdal, A., Wasson, M., 1999. Institutional Dimensions of Global Environmental Change. Report No. 9. International Human Dimensions Programme on Global Environmental Change, Bonn.
Zbinden, S., Lee, D.R., 2005. Paying for environmental services: an analysis of participation in Costa Rica's PSA program. World Development 33 (2), 255–272.