The Payment for Hydrological Environmental Services. Examining the Experiences of Costa Rica, Mexico, Ecuador and Colombia*

Los pagos por servicios ambientales hidrológicos. Examen de las experiencias de Costa Rica, México, Ecuador y Colombia

Título en francés

Ángela María Rojas Sánchez**

Submitted: 2014-06-25 // Accepted: 2014-08-12// Available online: 2015-01-30
How to cite this article: Rojas Sanchez, Á. M. (2015). The Payment for Hydrological Environmental Services. Examining the Experiences of Costa Rica, Mexico, Ecuador and Colombia. *Ambiente y Desarrollo, 19*(36), xxx-xxx. http://dx.doi.org/10.11144/Javeriana.cvu8-15.phes
doi:10.11144/Javeriana.cvu8-15.phes

Abstract

There exists a global crisis in the management of water generating a necessity for the search of sustainable alternatives. These can be mechanisms such as Payments for Hydrological Environmental Services (PES), economic tools that promote the conservation of bodies of water from the change in the paradigm of use and conservation in societies. A documented review was conducted on the implementation of PES in four countries of Latin America —Colombia, Mexico, Costa Rica, and Ecuador— to identify tools in environmental management, with the objective of proposing guidelines that optimize the application of mechanisms in Colombia. This optimization is to be achieved through a recompilation of the experiences in the development and integral analysis of these mechanisms within the social, normative, economic, and institutional context.

Keywords: Payments for Environmental Services (PES), climate change, integrated management of water resources, environmental economics, and water quality.

---

* This article is based on the results obtained in the research project *Contribution to the mechanisms of type Payments for Hydrological Environmental Services in Colombia, to preserve the quality and quantity of drinking water* (PUJ, 2011-2014), developed by the author for the Master's degree in Environmental Management from the Pontificia Universidad Javeriana.

** Microbiologist and Master in Environmental Management Research Centre linked to BIOS 2015 Manizales, Colombia. Email: ang.roja@gmail.com

Resumen

Existe una crisis mundial en la gestión del agua, lo cual conlleva la necesidad de buscar alternativas sostenibles como lo son los mecanismos tipo pagos por servicios ambientales hidrológicos (PSAH), instrumentos económicos que promueven la conservación de los cuerpos de agua a partir del cambio en el paradigma de uso y conservación en las comunidades. Se realizó una revisión documental sobre la aplicación de los PSAH en cuatro países latinoamericanos —Colombia, México, Costa Rica y Ecuador— para identificar instrumentos de gestión ambiental, con el objetivo de proponer lineamientos que optimicen la aplicación del mecanismo en Colombia, a través de una recopilación de experiencias en su desarrollo y un análisis integral de los mecanismos dentro del contexto social, normativo, económico e institucional.

Palabras clave: pagos por servicios ambientales (PSA), cambio climático, gestión integral del recurso hídrico, economía ambiental, calidad de agua

Résumé

Résumé

Mots-clés: Mots-clés

Introduction

Ecosystems fulfil the function of supplying essential services for mankind, regardless of its use, demand, enjoyment, or value within a society. *The Millennium Ecosystem Assessment* (2005) defines them as direct and indirect benefits of provision, regulation, support, and culture. These are classified in two concepts: ecosystemic services, functions of the ecosystems that mankind uses for its wellbeing, generating an economic benefit; and environmental services, those related to an environmental problematic at the cost of the opportunity of generating positive externalities; from a risk or threat of the service with the demand and availability of a payment for its conservation, with the objective of accomplishing positive effects on the community (Maldonado *et al*, 2012). The Colombian biodiversity is perceived by the stakeholders as a public asset, which has led it to enter the dilemma of "The tragedy of the commons", as mentioned by Hardin (1968), where many stakeholders motivated by personal interest act independently, but rationally, destroying the shared, but limited resource, despite this exploitation not being beneficial. As a consequence, this has brought forth problems by environmental passives and the increase in a social vulnerability by the loss in ecosystemic services (PNGINSE, 2012)

Within the scenario of climatic change, the degradation by the means of exploitation of water resources in the last 50 years has caused a strong negative impact on the ecosystemic services of basins (Social-ecological services), directly affecting the wellbeing of mankind in terms of quality and availability of water. The use of different strategies of conservation, mitigation, and adaptation, has been raised to face this problematic of national and international importance.

Mechanisms such as Payment for Hydrological Environmental Services (PES) are an instrumental tool that encourages water uses to offer a service that benefits society as a whole. These are given by means of a voluntary agreement and negotiation (not in command and control), where the potential providers of the service must have real and clearly defined options of its use, under the scenario of at least one buyer (according monitors), and a seller (directly or through an intermediary) during the determined duration of a contract. The payments depend on the quality and quantity of the offered service, until the maximum amount offered is reached in cash or in kind (Wunder, 2005). The lack of knowledge of water resources in Colombia, as well as the feedback and interdisciplinary work between the parties involved (scientists, politicians, NGO's, communities, environmental institutions, among others) for decision making in the implementation, investigation, and/or regulation, leads to the questioning if indeed these mechanisms are effective in the conservation of water in Colombia.

The objective of this project was the revision of the application of PES mechanisms in four countries of Latin America (Colombia, Ecuador, Costa Rica, and Mexico) identifying the instruments of environmental management relevant to the formulation of guidelines at a normative, economic, social, and institutional level, that contribute to the development of programs in water conservation and optimize the development of PES's in Colombia.

Methodology

The search for sources

A systematic revision was led in different databases concerning public and private academic publications: DialNet, Ebsco-host, ScienceDirect, Jstore, Springerlink, and Google Academic. 12 search criteria were used through the Boolean operators AND, and +.

With the purpose of filtering information from the experience in the first query, the search criteria were defined with the intention of filtering information in case studies and articles in Latin America. The operators used were Boolean: AND, and +, from 12 queries as follows: *Payment Environmental Services, water, Recurso Hídrico, Servicios Ecosistémicos, Servicios Ambientales, Pagos por servicios Ambientales,*

Pago por servicios Ecosistémicos, Pagos por Servicios Ambientales Hidrológicos, Gestión Integral del Recurso Hídrico, Calidad de agua, Abastecimiento, Cambio Climático.

Right away a search was conducted in reference to the four Latin American countries (Costa Rica, Mexico, Colombia, and Ecuador); countries that present the most study cases concerning the information on phase I.

Selection of sources and systemisation

Due to the ample information that evidences the extensive scientific output around the world in the search of sustainable solutions on the impact in natural resources through the use of environmental economy, a general chart was assembled that organizes the obtained results in the two phases of the search. This included: Search criteria, Country, Name of the Article, Author, Magazine, Year, and Pages.

Data Analysis

After completing the systemization process, a chart was made to facilitate the analysis of information. In this way, it allows a visualization of management tools on a normative, social, economic, and institutional level in the four countries selected: Costa Rica, Mexico, Colombia, and Ecuador.

Results

The comparative and analytical charts from this investigation among the four countries show that Costa Rica and Mexico present an ample experience in the study and application of PES mechanisms in Latin America, arisen from clear and defined normative, economic, institutional, and social instruments. On the other hand, Colombia and Ecuador still present a void in the formulation and development of these mechanisms, as a consequence of not having defined management instruments. Table 1 displays a matrix of analysis and comparison of the management instruments between these four countries.

The diversity and flexibility of PES mechanisms is evident in the formulation of management instruments, since they depend on variables such as a biophysical, social, political, economic, and the institutional aspect inherent to each country. Below we present the results for each country.

Costa Rica

Institutional Instrument

It counts with a public-private participation, in which an interaction with the related parties can be observed. The Costa Rican state applies the PES program through the Ministry of Finance, whose responsibility is to gather the resources and the Ministry of Environment and Energy (Minae), whose responsibility is to recognize the owners of woodlands and plantations for the services they provide through the National System of Conservation Areas (Sinac). This entity is in charge of the follow up and control of the PES programs (Fonafifo, 2007) and the National Forestry Financing Fund (Fonafifo), semiautonomous branch of the Ministry of Environment and Energy (Minae), in charge of planning and composed of three representatives from the public sector: one from the Ministry of Environment and Energy, one form the Ministry of Agriculture, one from the System of the National Bank, and two representatives from the private woodland sector, such as the directors of the National Forestry Office (Blackman *et al,* 2010; Redondo *et al,* 2006).

Another of the institutional tools, is the creation of concessions in water management, where the users and beneficiaries generate an economical agreement for the management of the resource, regulated by the Minae with the support of NGOs scientific and academic sectors, for the generation of information (Sotomayor, 2005).

Political Instrument

It presents a clear normative frame, recognizing the protection for the right to a clean and ecologically balanced environment, through the protection of environmental services, clearly defined in the national constitution of Costa Rica, sustaining schemes such as PES (Casas *et al*, 2008). The protection of water resources is under the responsibility of the State and the population, according to the Organic Environmental Law (Ley Orgánica del Ambiente) under the legislation of water resources in Costa Rica and the water law issued in Law 276/46. This law forces dealers of public waters to contribute in expenses towards the conservation of water basins, construction of defence works, and the payment of taxes that fixate the use of waters (Casas *et al*, 2008).

Additionally, the decree for the use of water (Decree No. 31176-Minae) establishes the bases for the institutional cooperation for the management of water on a national level (Sotomayor, 2005), and finally, there is law 7593 of the authority in charge of regulating public services, which provides the institutional frame linked to the development of this mechanism (Cordero, 2001; Rodriguez, 2002).

Table 1.
Management Instruments Applied to Payments for Hydrological Environmental Services Costa Rica, México, Ecuador, and Colombia

Instrument	*Countries*			
	Costa Rica	*Mexico*	*Ecuador*	*Colombia*
Institutional	State, Ministry of Finance. Ministry of Environment and Energy. National System of Conservation Areas. National Forestry Financing Fund. Ministry of Agriculture. National Forestry Office. System of National Bank.NGOs	Federal Government. Conafor. Mexican Forest Fund. Taxpayers Fund. Federal, State and Local Offices	Government. Municipalities. Cedarena. International Entities. Utilities. Fonag. NGOs.	Ministry of Environment and Sustainable Development. Regional Autonomous Corporations. Local Authorities.
Normative	Constitution of Costa Rica. Organic Environmental Law. Legislation on Water Resources. Water Act section 215: Public Utilities. Regulatory Authority Act 7593 utilities. Regulatory Authority for Public Services	General Law of Sustainable Forestry Development. Federal Law, Decree 94/07 and 233/08 - Transfer of Trust (3.5% investment- reforms and additional financial status code Mexico to capture the action for PES concept. General law of sustainable forest development. General law of ecological balance. Organic Law of Federal Public Administration. Act awards, incentives and rewards civilians.	Constitution of Ecuador. Act on conservation and sustainable use of biodiversity. Tax incentives aimed at environmental actions.	Political Constitution of Colombia. National Code of Renewable Natural Resources. National Policy on Integrated Water Resource Management. National Policy for the integrated management of biodiversity and ecosystem resources. Law 99 of 1990 - Economic Instruments. Law 1450 of 2011 Article 210 - Article 111 (Land Acquisition and use of 1% of the budget of local authorities). Decree 0953/14

Instrument	*Countries*			
	Costa Rica	*Mexico*	*Ecuador*	*Colombia*
Economic	National Forestry Financing Fund Fonafifo. Contribution Tax on Fuels. Tax Ecological-Consumption of all petroleum products. Project of Ecomercados. Local Forest Project. CDM project. REDD project. Certified Environmental Services - Credit contributions from the private sector. Water-Cannon of long-term funding for the integrated management of water resources and regulating water use and use in supply and development. International conventions and private institutions.	Mexican Forest Fund. Trust 3.5% of water charges to fund the programs. Federal, state and local resources or mixed. Resources from public sources. International funds administered by the federal government. Taxpayers Funds.	Programs of environmental protection and sustainable use. Economic incentives for productive activities focused on environmental protection. Fees for the right to water use. Specialized business cards intended for protection areas. Exemption from taxation of rural property. Fees or charges for the service water supply for consumption. Trust in government and non-government budget. Quote from private companies 10% investment watershed protection.	Public and private finance, mainly public. Post: Sina Territorial Authorities and regional autonomous corporations (Environmental Entity) invest part of their budget to fund conservation strategies. Collection through surcharges or environmental percentage of property taxes, effluent charges, fees for use of water, transfer the hydropower sector, fines and recovery resources for implementing environmental conservation projects. Tax incentives and environmental investment for the adoption of clean technologies, conservation of strategic ecosystems and innovation and development of new technologies exemptions. Using the 1% linked to environmental licenses on water resources, investment firms from the water and sewage to generate energy Fees for use of water, rate Remuneration, incentives and tax exemptions, PSAH
Social	Public participation and institutional interaction for decision-making in conservation of natural resources.	Perception of the environment for communities. Collective ownership. Community Participation. Social cohesion for decision-making. Spatial planning. Conservation activities through social safeguards.	Environmental communication. Community resource management. Creating basin management agencies. Institutional Support.	Institutions and development plans. Citizen participation. Administrative social groups.

Source: Own research performed for the purposes of this investigation

Economic Instrument

The PES is a financial recognition on behalf of the state through the National Forestry Financing Fund which, as a financial axis of the PES, defines these programs as a financial incentive from the State to the owners of woodlands and forest plantations for the environmental services they provide and that directly influence the protection and improvement of the environment. It guarantees the optimal functioning of the PES, coordinating the activities related with the guidelines, understood as decrees and manuals of procedures for the development of programs at a statistical and technical level,

processing payments to the beneficiaries of the contracts, and evaluating and assessing the programs. It also facilitates and promotes the inclusion of different participants with an interest in developments on forestry, thus allowing the adoption of a financial scheme that integrates different institutions, such as the National System of Conservation Areas (Sinac), the Fonafifo, the National Forestry Office (ONF), the forestry regents, the school of agronomical engineers, cooperatives, agricultural centres, NGOs, and other benefited parties (Fonafifo, 2007).

The funding of PES comes from the tax on fuels, in the project of eco-markets I and II, the 'Forestal Huetar Norte' project, MDL project, and the REDD project, within the frame of water management and different international agreements and private parties. The tax on fuels, called "ecological tax", is on the consumption of crude oil and all its derivatives. Environmental services certificates are issued to give credit to the voluntary contributions in the private sector, and the funds are used to finance the program of payments for environmental services; the buyers of the certificates designate the forestry zones in which the funds are to be allocated (Rodríguez, 2002).

Another model is when the Fonafifo agrees with hydropower companies payments towards funding the costs of protection on water resources. The water canon is an economic instrument for the long term funding in the management of water resources, for human provision and development. These two kinds of taxes are collected, conjointly in some cases with international agreements by the Fonafifo, for the payment of small forestry owners of strategically located conservation lots (Rodríguez, 2002).

Social Instrument

The PES schemes are proposed for the conservation of water sources, and consist of the adaptation of strategies based on the protection, valorisation, usage, and payment from practical learning and conjoint participation between the community, aqueducts, and Fonafifo in the issue of fees and public services (Cordero, *et al.*, 2001). These programs have the objective of managing environmental strategies for the sectorial, regional, and local development, with an impact on a social, political, and institutional level (Rosa *et al*, 2002).

Mexico

Institutional Instrument

It consists of public participation, in which an interaction with the involved parties can be observed. The State covers on an institutional level most of the necessities for the development and application of these mechanisms.

Political Instrument

Since 2003 Mexico imposes the PES mechanism. The Federal Government regulates them, being this entity the primary promoter, buyer, and regulator of the market. However, state, federal, and local dependencies have the freedom of establishing PES mechanisms (General Law of Sustainable Forestry Development, 2013; Macip-Ríos, 2013). The federal law in article 223, points to a funding mechanism towards the income obtained by levying the exploitation and use of waters towards the development of PES programs under the Mexican Forestry Fund (Conafor, 2012).

In 2008 a public policy takes shape, a law for the operation of the program from decrees 94/07 and 233/08 for the transference of the trust fund, a 3.5% on the total cost of water. Additionally an amend is made and annexed to the financial code of the state of Mexico (Código Financiero del Estado de México), for the uptake of resources on the concept of payment for water services, to keep the trust fund. The program of sustainable forestry development (Programa de Desarrollo Forestal Sustentable) 2002-2025, aims to establish forest development by identifying priority areas for the PES and assess their potential (Probosque, 2013).

The Conafor, through the management of environmental forestry services, formulates the guidelines for a scheme of recurring funds with all kinds of environmental services, which aim to gather resources from Conafor and the users of environmental services for the payment to the owner of woodland lots that perform activities of sustainable management (Conafor, 2011). Among the laws relating to Schemes of Payments for Environmental Services is the general law of sustainable forest development. This law regulates and promotes the conservation, protection, restoration, production, management, cultivation and use of forest ecosystems of the country and its resources, and distribute the powers in forestry accrue to the Federation, the States, the Federal District, and Municipality. This is supported by the general law of ecological balance and environmental protection, the organic law of federal government, and the law of civilian awards, incentives, and rewards (General Law for Sustainable Development, 2003). The PES is seen as a breakthrough for the Mexican Environmental Policy since it pays off as a benefit to owning the land where environmental services are generated (Pérez-Marqueo *et al*, 2006).

Economic instrument

The use of the Mexican Forestry Fund as a basis for implementation of the Programmes of Payments for Environmental Services financial mechanism is given under the rules of operation, established to ensure the transparency and fairness of the agreements. Usually, this mechanism is established in relevant areas for the provision of environmental services. Payment is conditional based on the results after application of the mechanism, which are awarded if coverage remains (Conafor, 2010).

In the State of Mexico, the trust was created for the Payment for Hydrological Environmental Services; in it there is agreement to use 3.5% of what was received from water charges for program funding. The funds for the payment of environmental services are federal, statal, local, mixed, or from private companies. The resources used remain from public sources, international funds, managed by the federal government.

There is a National Program Payments for Environmental Services (ProArbol) developed by Conafor, where PES-type programs apply under promotion strategies at the local level, in order to enable the transfer of resources to users, such as drinking water. Meanwhile, there are local programs through taxpayer funds which seek to create a flow of funds between environmental service users and providers (Macip-Ríos *et al*, 2013; Frausto *et al*, 2011)

Social instrument

It takes into account the management of the territory, the perception of space, and the region with the surrounding communities, in order to transform collective ownership, community participation, and social cohesion, for making decisions on the conditions of conservation. One of the tools that support the operation of these mechanisms is the use of spatial planning, so that the PES is a promoter of the creation of instruments for land administration and as a stimulus to compliance derived from them (Hesselbach *et al*, 2009).

Programs typically include: training and technical assistance; development of management programs to ensure the implementation of conservation activities; the presence of social safeguards, ensuring the participation of vulnerable groups; and strengthening owners and possessors of land, which promote the strengthening of technical and organizational capacities (Conafor, 2010). The fact that state and municipal government departments, agencies involved in water management, civil and community organizations, private foundations, and watershed committees, take part in the PSE development mechanisms makes this a social instrument for the conservation of basins, where a relationship between the Government and the developers of programs is handled through an open communication channel (Bonfil, 2006; Frausto *et al*, 2011).

Ecuador

Institutional Instrument

It includes public participation. The implementers of payment schemes for environmental services in Ecuador are the municipalities, with the collaboration of Cedarena, control and monitoring programs, international cooperation and the government. The factors that are taken into account when formulating these mechanisms are: activities to be financed; the leading institution in the process; received technical support; water users; and beneficiaries. The leaders of the process are bottled water companies, municipalities, and other social groups (corporations, associations, and councils) to encourage conservation. Technical support is given to projects related to consulting firms, foundations, national, or international NGOs and international support (Cordero, 2008).

Political Instrument

Payments for Hydrological Environmental Services are supported by the Constitution of Ecuador, through its public interest in the conservation of biodiversity and maintenance of ecosystem services. At the legal level, recognition of PES is given in the Law on conservation and sustainable use of biodiversity. Tax incentives aimed at environmental actions are constitutional (Martínez, 2008). All experiences are based on bylaws and regulations for the operation of the collection and payment mechanisms for watershed conservation (Cordero, 2008).

Economic Instrument

The management tools are the programs related to environmental protection and sustainable use of natural resources, the establishment of economic incentives for productive activities focused on environmental protection, charging fees for the right to use water, revenues from sales of specialty cards designed for protected areas, and the exemption from tax of rural property (Martinez, 2008).

Funding sources, in all cases, stem from fees or charges for the service of provisioning a water supply for human consumption. These are paid by local users, as permitted by the encoding to the Organic Law of Municipalities. The resources are invested in the maintenance and recovery of forest cover or moor (Cordero, 2008). This is the case of Fonag —Fund for Water Protection— a non-decreasing trust endowment that can receive money from the government, private organizations, and NGOs, such as Cedarena (National NGOs supporting plans through seed conservation projects). In this fund resources are managed by an independent financial organization that invests the funds as well as investment credits in watershed protection. It is further protected by the Securities Markets Act and a municipal ordinance that gives its sustenance.

This municipality determines the payment of a fee on the bill of drinking water to support Payments for Environmental Services programs. Fonag is ruled by a contract that establishes the terms of the fund, institutional structure, and purpose of the resource (Cordero, 2008; Echeverria, 2003). On the other side we can find the Municipal Public Telecommunications Company, Potable Water and Wastewater Basin Canton (Etapa), which promotes an integrated water resource management as a mechanism for water protection. The company defines a maximum of 10% of the drinking water tariff for basin conservation. Initially this budget was used to purchase the land (Cordero, 2008).

Social Instrument

According to the experience, these mechanisms are provided to enhance the quality of life of the families involved, since it is used to meet short-term needs. The Municipal Public Telecommunications Company, Potable Water and Wastewater Basin Canton (Etapa), is in charge of the environmental communication activities, community management of natural resources, and capacity management of the water bodies of the basin. It is also characterized by opportunities for citizen participation, participatory management plans that include conservation and productive activities performed in the middle basin, among others (Cordero, 2008).

Colombia

Institutional Instrument

It has a public-private partnership. The state is the main controller through the Regional Autonomous Corporations for monitoring such mechanisms in the affected regions, with assistance from the Ministry of Environment and Sustainable Development and nongovernmental organizations (NGOs); international cooperation; public and private research institutes on natural resources, biodiversity, and conservation; and other institutions involved.

Political Instrument

Despite not having a policy for the payment for environmental services, the development of PES-type mechanisms is legally considered as an instrument for the conservation of ecosystems and strategic territories. The Constitution of Colombia (Article 8), the National Code of Renewable Natural Resources and the Environment (Decree-Law 2811/74, Article 9), and the National Water Resources Policy (economic instruments for conservation) describe it as a management tool for the conservation of watersheds that supply water to nearby municipal water and/or as a tool that encourages the conservation of areas of ecological interest. Law 99 of 1993, referred in Title VII to the income of the Regional Autonomous Corporations (Articles 42 to 48), mentioning the use of economic incentives for conservation, which takes into account command and control mechanisms for contaminated areas, the fee for water use and conservation, the use of the premises (tax cost), and the transfer and use of income and assets of the Regional Environmental Corporations as an economic resource for the Conservation of Water Resources (Casas *et al*, 2008; Pérez *et al*, 2009).

The National Policy on Integrated Water Resource Management (2008) and the National Policy on Integrated Management of Biodiversity and its systemic Eco Resources (2012) refer to the need to implement environmental economics tools for natural resource management and, likewise, understand and analyse any territory as a social ecosystem.

The National Development Plan 2010-2014 (Chapter V-Sustainability Environmental and Risk prevention; Law 1450 of 2011) amends section 111 of the Act 99/93, Article 210, acquisition of areas of interest to municipal water, where they are declared areas of public interest as areas of strategic importance for the conservation of water resources that take water to municipal, district, and regional aqueducts. In addition, departments and municipalities must devote a percentage of no less than 1% of their current revenues for the acquisition and maintenance of these areas to finance schemes of Payment for Environmental Services. These schemes should be developed exclusively in the areas defined by the Environmental Authorities, according to the regulations of the Ministry of Environment and Sustainable Development, managed by the district or municipality, which must include these resources in the development plans and annual budgets (DNP, 2011).

Finally, Decree 0953 of 2013, stands as a normative instrument that redefines Article 210 of Law 1450 of 2011, and proposes the development and implementation of PES mechanisms as a temporary incentive for the acquisition and maintenance of strategic areas for the conservation of state-owned bodies of water through environmental and local authorities (Arango *et al*, 2013; Ruiz, 2011). The 0953 decree has two inconsistencies: firstly it is not clear in defining priority areas, as it only refers to areas at risk of deterioration, leaving aside those areas that are already degraded and with serious alterations to the placement of environmental services; and the purchase of land, which isolates the community around the areas, taking away the opportunity to strengthen cultural and environmental values.

Economic Instrument

In Colombia there are two sources of financing for the development of conservation programs of natural resources, be it private or public. Recently in accordance with Decree 0953, for Hydrological PES-type mechanisms, the main source of financing is through 1% of current revenue from environmental

authorities and local authorities. Within Local Payments for Environmental Services programs, contingent assessment is performed to determine the willingness to pay for environmental improvement through environmental funds volunteers, led by the directives of aqueducts and water user associations, under the advisement of the Regional Environmental corporations and the Ministry of Environment and Sustainable development (Quintero *et al*, 2005; Moreno *et al*, 2012). There are other sources of financing at the public level that the government uses today as administration instruments for the development of these programs, through revenues from environmental surcharges or property tax rates, effluent charges, fees for use of water transfers, hydropower sector, fines, and recovery resources for the implementation of environmental conservation projects, among others (PNGIRH, 2008).

Regarding the sources of financing from private entities or individuals, there are incentives and tax exemptions to environmental investment for the adoption of clean technologies, conservation of strategic ecosystems, and innovation and development of new technology. There are related resources to the 1% of the value of projects linked to environmental licenses for the use of water resources for the recovery, preservation and monitoring of the watershed (Article 43, Law 99 of 1993). Finally, it considers the investment from operators of water supply and sewerage systems for power generators, irrigation districts and all those sector investments that have a direct impact on water resources (PNGIRH, 2008).

Social instrument

The national institutions are the main instrument of management in the social sphere, through the National Development Plans (Provincial and Municipal), Environmental Management Plans (Regional), Triennial Action Plan, Land Use Plan, Departmental Plan for Water and Sanitation, and Management Plan and Watershed Management (Franco, 2009).

Hydrological PES programs are developed locally through voluntary economic agreements between a supplier and a beneficiary in a community with a common interest and a defined hydrological service (quality, water supply, water regulation, erosion control, and sedimentation). Internal and non-formal environmental authorities are created by communities for the management of water resources; among these we can find the Community Action Boards, Management Boards Water, Water Users Associations, Boards, and Rural Settlement Aqueducts (Moreno *et al*, 2012). One of the main problems this mechanism faces regarding citizen participation is the lack of an economic muscle to exert a stronger influence to meet the basic needs of the community, infrastructure, or water purification systems, in order to ensure their quality and comfort (Tehelen, 2006).

Discussion

The mechanisms for the payment of environmental services in Latin America are incentives that are developed through the state, recognizing the role of communities in the conservation of natural resources. This socio-ecological relationship is given by the continuous supply of ecosystem services at different scales, maintaining human wellbeing and conservation of biodiversity, as shown by the human consumption patterns of natural resources and ecosystem management. The interpretation of nature by men has been generating sustainable strategies to mitigate the problems of supply and demand for environmental services.

The use of economic mechanisms as a tool in the internalization of environmental markets makes Payments for Environmental Services an important decision as a conservation strategy.

The four management instruments analysed show that in this region we still need more research on the subject. Costa Rica and Mexico are a great example of success stories in terms of structuring a public-private and public institutional interaction. The objective and clear definition of institutional functions and ecosystem services make of PES an efficient tool for handling Environmental Services. Also, they have an Economic Fund charge of collecting financial resources, promoting safety among

water users and beneficiaries. Meanwhile, Ecuador and Colombia are still showing gaps at the structural, functional, and conceptual level, thus still having to fully comply with the guidelines or criteria that define these mechanisms, threatening the sustainability over time of the instrument (Blanco *et al*, 2007) Colombia is not efficient in the articulation of management mechanisms for the development of PES-type mechanisms.

According to the National Policy for Integrated Management of Biodiversity and Ecosystem Resources (PNGIBRE, 2012), the incorporation of variable residence, uncertainty, and the change in the management of ecosystem services at the national, regional, local, and trans-border levels lead to the promotion of changes in institutional operations, to promote their articulation with the aim to innovate and become more flexible in management mechanisms. The design and implementation of systems for monitoring and periodic evaluation, therefore, will promote institutional adaptive capacity within the social system.

Thus, it is proposed that the Payments-for-Environmental-Services-type mechanisms are understood and formulated from environmental principles at the Economic (Caution, Solidarity, Participation, Accountability), Regulatory (Trust, Responsibility), and Social levels (Reality, Solidarity, Responsibility, Participation, Sustainability, and Advertising), to guide their development and strengthening their institutions. One of the latest examples is the formulation of Decree 0953/13, which is aimed, in general terms, to be implemented locally. According to studies conducted by Natural Heritage, the current faults are at the structuring conceptual level. The selection of properties and the service definition are different in each PSE, therefore the perception of nature in the community will be the starting point for application.

Conclusions

The role of environmental economics seeks to encourage paradigm or usage behaviour shifts through sustainable strategies within the institutional and economic framework. Economic incentives for conservation function as tools to promote a consumption culture based on the sustainable use of natural resources.

Consumer behaviour in man is strongly influenced by cultural patterns developed from the perception of nature and its environment. Communities are who best know their environment and therefore, are the best candidates for conserving these ecosystems.

The experiences of countries like Mexico and Costa Rica show that through a well-structured teamwork of institutions it is possible to generate effective conservation of successful ecosystem programs. Their conceptual definition of the mechanism adapts it to the specific circumstances of each case, leading to citizen participation in an environment of safety when negotiating a defined environmental service for their own benefit. However, Ecuador, being a rich region for the development of these programs, fails to engage strongly on the issue in the wake of presenting a weak institutional, political, and indefinite vague conceptualization. These parameters analysed in Mexico and Costa Rica must be taken into account in formulating a policy for Payments for Environmental Services in Colombia.

Interpreting the comprehensive assessment of environmental services (or ecosystemic services, as proposed by the National Policy for Integrated Management of Biodiversity and Ecosystem Resources (PNGIBRE) of 2012 in Colombia) must be taken into account in decision making and the economic assessment, along with the use of other tools to achieve a better perception, appreciation, and understanding from society of biodiversity and its ecosystemic services for human well-being. The country, in the use of these tools, has not had relevant results for decision-making regarding the conservation of biodiversity.

The gap in the instruments in the governance, political, economic and social mechanisms for Payments for Environmental Services in Colombia is reflected in the few cases of success and the development of a Decree with conceptual problems. With a diagnosis of this type, it is difficult to

draw conclusions as to their efficiency as conservation mechanisms. The conservation of a basin should be a task for all its users by means of a social appropriation of resources in the context of shared responsibility, participation, and governance, thus strengthening relationships between parties.

The development of PES should go under the guidelines of IWRM and Gibse, to focus on the economic mechanism in a comprehensive context and thus making it more efficient. Finally, the use of Environmental Education Strategies must go along with the implementation of conservation incentives.

References

Arango, H. & Fandiño, O. (2013). *¿Es el Decreto 0953 de 2013 funcional para la implementación de esquemas de Pago por Servicios Ambientales en Colombia*? Bogotá: Fondo Patrimonio Natural, Serie Documentos de Trabajo: Elementos de Política, Proyecto Incentivos a la Conservación, Nº. 10.

Blackman, A. & Woodward, R. (2010). User Financing in a National Payments for Environmental Services Program: Costa Rican Hydropower. *Ecological Economics,* 69 (8), 1626-1663.

Blanco, J., Wunder, S., & Navarrete, F. (2007). *La experiencia colombiana en esquemas de pagos por servicios ambientales. Informe*. Bogotá: Coversa, Cifor.

Bonfil, H. & Madrid, L. (2006). Los Pagos por Servicios Ambientales en la cuenca de Amanalco-Valle del Bravo. *Gaceta Ecológica*, 80, 63-79.

Casas, A. & Martínez, R. (2008). *Marcos legales para el pago por servicios ambientales en América Latina y el Caribe: análisis de ocho países*. Washington: Organización de los Estados Americanos, Departamento de Desarrollo Sostenible.

Centro Agronómico Tropical de Investigación y Enseñanza (Catie) (Turrialba, Costa Rica). (2006). *Elementos principales de una propuesta de pago por servicios ambientales para el manejo de los recursos hídricos en la subcuenca del río Barbas, Quindío*, *Colombia.* Turrialba, Costa Rica: Catie.

Comisión Nacional Forestal (Conafor) (2010). Los Pagos por Servicios Ambientales como instrumento de Conservación. Congreso Internacional "Los Pagos por Servicios Ambientales-Mecanismos para la gobernanza de los Recursos Naturales". Retrieved from http://qacontent.edomex.gob.mx/congresopsa/documentos/conferencias_magistrales/groups/public/documents/edomex_archivo/congresopsa_pdf_nacionalpsa.pdf.

Comisión Nacional Forestal (Conafor) (2011). Programa de Mecanismos Locales de Pagos por Servicios Ambientales a través de Fondos concurrentes. Retrieved from http://www.conafor.gob.mx/portal/index.php/tramites-y-servicios/apoyos/mecanismos-locales-de-pago-por-servicios-ambientales-a-traves-de-fondos-concurrentes.

Comisión Nacional Forestal (Conafor) (2012). Pueblos Indígenas e incentivos para la conservación. Retrieved from http://www.amazonia-andina.org/amazonia-activa/noticias/pueblos-indigenas-e-incentivos-para-conservacion.

Colombia (1993). *Constitución Política de Colombia*.

Cordero, D. & Castro, E. (2001). Pago por servicio ambiental hídrico: El caso de la Empresa de Servicios Públicos de Heredia (ESPH). *Revista Forestal Centroamericana,* 36, 41-45.

Cordero Camacho, D. (2008). Esquemas de pagos por servicios ambientales para la conservación de cuencas hidrográficas en el Ecuador. *Informe*, 17 (1), 54-66. Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA).

Echavarría, M. (2003,). *Algunas lecciones sobre la aplicación de pagos por la protección del agua con base en experiencias en Colombia y Ecuador*. In III Congreso Latinoamericano de Manejo de Cuencas Hidrográficas (Arequipa, Perú, 9 al 13 de junio de 2003).

Franco Barrera, J. (2009). *Estrategia de gestión ambiental a partir de la formulación de un esquema de pago servicios ambientales (PSA) para la regulación del recurso hídrico en la quebrada "La Colorada" del municipio de Arcabuco (Boyacá)*. Bogotá: Universidad Javeriana.

Frausto, J. M. & Landa, R. (2011). *Avances y perspectivas de la Política de Pagos por Servicios Ambientales en México*. In Seminario Internacional Sobre Evaluación de Políticas Públicas Forestales, México.

Fondo Nacional de Financiamiento Forestal (Fonafifo) (2007). *Estructura organizacional del Fondo Nacional de Financiamiento Forestal*. Costa Rica: Fonafifo.

Hesselbach, H., Galindo, L. M., Caballero, K., de la Maza, R., Sánchez, L. F. & Guevara, Y. (2009). *Estrategia de pago de servicios ambientales por desempeño hidrológico en Quintana Roo*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Instituto de Hidrología, Meteorología y Estudios Ambientales (Ideam) (2010). *Estudio Nacional del agua.* Bogotá: Ideam.

Instituto Iberamericano de Cooperación para la agricultura (IICA) (2010). *Un nodo de cooperación técnica sobre los Pagos por Servicios Ambientales en Costa Rica.* Costa Rica: IICA.

Macip-Ríos, R. & Macip R. F. (2013). Pago por servicios ambientales (ecosistémicos) en México ¿una alternativa para la conservación de la biodiversidad y el desarrollo? . *Revista BIOCYT*, 6 (20), 375-387.

Martínez, R. (2008). *Guía conceptual y metodológica para el diseño de esquemas de pagos por servicios ambientales en Latinoamérica y el Caribe.* Departamento de Desarrollo Sostenible-DDS-Informe. Washington D.C: Organización de Estados Americanos (OEA).

Martínez de Anguita, P., Rivera, S., Beneitez, J. M., & Cruz, F. (2006). Establecimiento de un mecanismo de pago por servicios ambientales sobre un soporte GIS en la cuenca del río Calan, Honduras. *Revista GeoFocus*, 7, 152-181.

Mexico, Camara General de Diputados del H. Congreso de la Unión (2013). *Ley General de Desarrollo Forestal Sustentable*. Retrieved from http://www.normateca.gob.mx/Archivos/66_D_3162_05-06-2012.pdf.

Millennium Ecosystem Assessment (MEA) (2005). *Evaluación de los ecosistemas del milenio. Informe s*íntesis. Washington: MEA.

Ministerio de Ambiente y Desarrollo Sostenible (MADS) (Colombia) (2012). *Política Nacional para la Gestión Integral de la Biodiversidad y sus Servicios Ecosistémicos*. Bogotá: MADS.

Ministerio de Ambiente y Desarrollo Sostenible (MADS) (Colombia) (2013). *Decreto 0953.*

Ministerio de Ambiente, Vivienda y Desarrollo Sostenible (Colombia) (MAVDS). (2007). *Estrategia Nacional para el Pago por Servicios Ambientales. Informe.* Bogotá: MAVDS.

Ministerio de Ambiente, Vivienda y Desarrollo Territorial (Colombia) (MAVDT). (2004). *Memorias del cálculo de la tarifa mínima de la tasa por utilización de agua.* Bogotá: MAVDS, Grupo de Análisis Económico e Investigación del Ministerio [en prensa].

Ministerio de Desarrollo Económico, Dirección de Agua Potable y Saneamiento Básico (Colombia). (2000) *Ministerio de Ambiente y Desarrollo Sostenible*. Bogotá.

Moreno Sánchez, R., Maldonado, J. H., & Borda-Almanza, C. (2012). Heterogeneous User and Willingness to Pay in an Ongoing Payment for Watershed Protection Initiative in the Colombian Andes. *Ecological Economics,* 1-9.

Pérez Cárdenas, O. E. & Chaves Mejía, A. A. (2009). *Análisis y diseño de un sistema de pagos por servicios ambientales por la protección del agua en la microcuenca La Colorada, municipio de Arcabuco, departamento de Boyacá.* Bogotá: Universidad de La Sallé.

Pérez-Maqueo, O., Delfín-Alfonso, C. A., Fregoso, A., Avalos, H. C., & Zamora, M. E. (2006). Modelos de simulación para la elaboración y evaluación de los programas de servicios ambientales hídricos. *Gaceta Ecológica*, (78), 47-66.

Protectora de Bosques (Probosque) (2013). Programa para el Pago por Servicios Ambientales Hidrológicos. Retrieved from http://portal2.edomex.gob.mx/probosque/desarrolloforestal/estudiosdemanejo/serviciosambientales/index.htm.

Quintero, M. (2010). *Servicios ambientales hidrológicos en la Región Andina: estado del conocimiento, la acción y la política para asegurar su provisión mediante esquemas de pagos por servicios ambientales*. Lima: Consorcio para el Desarrollo Sostenible de la Ecorregión Andina (Condesan) e Instituto de Estudios Peruanos (IEP).

Rodríguez Becerra, M. & Espinoza, G. (2002). *Gestión ambiental en América Latina y el Caribe: evolución, tendencias y principales prácticas*. Banco Interamericano de Desarrollo (BID).

Rodríguez, J. M. & Sáenz, A. (2002). Pago por servicios ambientales en Costa Rica. *Revista Forestal Centroamericana*, (37), 68-71.

Rosa, H., Kandel, S., Dimas, L. (2003). *Compensación por servicios ambientales y comunidades rurales: lecciones de las Américas y temas críticos para fortalecer estrategias comunitarias.* Costa Rica: Programa Salvadoreño de Investigación sobre Desarrollo y Medio Ambiente

Ruiz Agudelo & Augusto, C. (2011). Metodologías para mecanismos de conservación en comunidades rurales de Colombia, a través de esquemas de pago por servicios ambientales. *Revista Facultad de Ciencias Básicas*, 7, 136-155.

Sánchez, J. A. & Madriñán, S. (Eds.) (2012). *Biodiversidad, conservación y desarrollo*. Bogotá: Uniandes.

Sotomayor, R. T. (2005). Análisis de los beneficios ambientales y sociales derivados de la protección de cuencas usando el mecanismo de PSA. Costa Rica: Fondo Nacional de Financiamiento Forestal.

Wunder, S. (2005). *Payments for Environmental Services: Some Nuts and Volts*. Indonesia: Center for International Forestry Research (Cifor) Occasional Paper Nº. 42.