

PAYMENT FOR ENVIRONMENTAL SERVICES: A FURTHER ANALYSIS TO A COMPARATIVE STUDY OF THE BRAZILIAN AND ARGENTINE PERSPECTIVES

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Abstract: Payment for Environmental Services (PES) can be defined as a monetary/non-monetary compensation mechanism (provider-receiver principle) by the supply of environmental services. This work identified and analysed Brazilian and Argentine PES's case studies under a national perspective but also under an eventual and future River Plate watershed. Brazilian projects can be considered unique due their special conditions and the environmental goals of the various Federative Entities, mainly the case of Sao Paulo state. In Argentina, by contrast, and despite improvements in PES projects through county and federal government initiatives. Finally, it was suggested some aspects that could be utilized, such as “parameters”, to promote social, economic, and environmental standardization in conjunction with regional PES projects that require international cooperation.

Keywords: economic instrument, environmental policy, natural resources protection, River Plate watershed.

1 Introduction

Human activities influencing the development of civilizations and population growth are dependent on natural resources due to water, energy, and food demands. Nature provides ecosystem services such as carbon sequestration, vegetation for soil erosion control, wind for energy, water filtration, and biodiversity, but, while not renewable resources are extracted and depleted, ecosystem services can be delivered in perpetuity, depending on the condition of natural capital (KRONENBERG et HUBACEK, 2013).

Thus, environmental services can be considered “services promoted by ecosystems which help sustainability and environmental conservation”. One of the most important issues of our era is the search for an economic development model in which natural resources will not be exhausted with respect to future generations. This requires the promotion of ecosystem restoration and protection to maintain relevant environmental services sustainably. Environmental services is the performance of activities provided by

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natural ecosystems for the benefit of human society (SILVA *et al.*, 2017; JUNTTI, 2009; ARRIAGADA et PERRINGS, 2009).

Biodiversity provides a range of ecosystem services¹ that benefit people locally, national and internationally. The provision of these services stems directly from natural processes, although management interventions are often required to maintain, develop or protect them. Many are not priced or are undervalued by the markets which means that existing economic signals may not reflect the true value of natural capital (HARVEY, 2011).

This approach recognises that since many ES and the goods and benefits derived from them constitute so called public goods or at best, common pool resources, governance intervention is required to establish the kind of market signals that incentivise provision and sustainable use (JUNTTI, 2009; SETTI *et al.*, 2019; GAONZÁLEZ et RIASCOS, 2007).

The idea of payment, whether in a monetary or non-monetary sense, for environmental services derived from nature is rooted in the recognition of ecosystems as environmental service providers (CELESTE *et al.*, 2020). Ecosystems must be maintained, but if their monetary value is not recognized, they are not taken into account by decision-making processes (SILVA *et al.*, 2017). The concept of ecosystems services (ES) frames the relationship between society and nature in terms of the functions of ecological systems that directly or indirectly benefit humans (MEA, 2006; PORRAS *et al.*, 2013).

The recent growth of ES science can be attributed to the usefulness of ecosystem services as a concept that explicitly links ecosystems to human needs (BALVANERA *et al.*, 2012).

There have been several PES programs, both in Brazil and other countries - such as Argentine - which in most cases have been linked to water resources. In a global context, on another hand, water resources were considered in regard of the most important, within a priorities scale of 26 ecosystems services in Kafa Biosphere Reserve / Ethiopia. Anyway, other environmental/ecosystems services linked to water resources (hydric regulation, water purification and water cycling) were also identified in that natural reserve (MENGIET *et al.*, 2022). Thaden *et al.* (2021) studied water resources (program of hydrological services – PHS for groundwater recharge, water quality regulation, riparian corridors) under the environmental effectiveness perspective (deforestation, forest fragmentation, connectivity, biodiversity conservation, carbon sequestration, landscape-scale changes, etc.) in Veracruz, Mexico. The authors concluded that the key for the success of PES program is linked with high additionality of the projects and the PHS density within a landscape management approach. In the Brazilian case, PES programs are being studied in both urban and rural situations. Campos *et al.* (2021), for instance, discussed PES programs linked with flood control (analysis and economic viability). This kind of PES program is built, according to the authors, within a 6 steps process (project inception, planning, execution, monitoring and control, PES formulation and support tools).

The environmental service payment exists as an incentive to conserve the environment cost-effectively to land rural owner or small forest owners and farmers. Becoming an

alternative income for the suppliers of the environmental services provided (SILVA *et al.*, 2017).

It is also important to recognize that the Brazilian cases have special utility, because they assist with regulation of rural properties, the territorial mapping process, sanitation measures, and Forest Code implementation, as well the conservation of soil and water. In Argentina, improvements of payment for environmental services systems come predominantly from county and national governments. However, in a regional scale based on water resources, mainly, it must also discuss the case of two of the most important South American countries on the PES programs, even on a future regional sustainable integration: Brazil and Argentina, specially under a common sustainable natural perspective such as the river Plate watershed. Based on these Brazilian and Argentine examples, this study researched the hypothesis that it is possible to identify some parameters (social, economic and environmental) which could be used to promote PES project standardization and regional application in areas such as the River Plate watershed.

This study intends, within a regional environmental approach (Brazilian-Argentine region), to identify, systematize, compare, and analysed some PES case studies in Brazil – from a São Paulo state perspective – as well as in Argentina. Besides, this goal search to attend a very important and specific Brazilian constitutional dispositive, in other words, economic, political, social and cultural integration of the Latin America people (BRAZIL, 1988)³.

2 Theoretical Background

According to Pu *et al.* Apud Wang *et al.* (2017), payment for ecosystem services (PES) has come to be regarded as a promising market-based policy instrument to internalize environmental externalities. Payment for ecosystem services (PES) is championed as a promising approach for advancing environmental conservation (WANG et WONG, 2019). Ecosystem services, according with Millennium Ecosystem Assessment (MEA, 2005), are “people ecosystem benefits caused by ecosystems, on the following types: (a) Provision services – those that supply directly environmental goods and services used by human being for consumption or trade, with or without economic value; (b) Supporting services – “those that are necessary for the production of all other ecosystem services; they differ from provisioning, regulating, and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people (some services, as erosion regulation, can be categorized as both a supporting and a regulating service, depending on the time scale and immediacy of their impact on people.)”; (c) Regulating services – those that contribute to maintenance of ecosystem processes stability, such as carbon capture, air quality regulation, extreme climate phenomena moderation, maintenance of water cycle balance equilibrium, inundations and droughts minimizing and control of erosion and collapse on hillsides, and others that contribute to maintenance of ecosystem processes stability (at a local scale, for

3 Article 4o, single pagragraph, of Federative Republic of Brazil’s Constitution – 1988.

example, changes in land cover can affect both temperature and precipitation and, at the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gasses), and; (d) Cultural services –“these are the nonmaterial (immaterial) benefits people and human society obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences”.

The System of Payment for Environmental Services (SPES) is based on “user-payer” and “provider-recipient” principles, as in some cases users take into account environmental services value (positive externalities), and managers are paid as a reward for maintaining environmental services. Payments for environmental services (PES) have become an increasingly popular tool for environmental management, supplementing policy tools that were previously widely focused on command-and-control measures (EZZINE-De-BLAS *et al.*, 2016). Payments for environmental services (PES) have become an increasingly popular tool for environmental management, supplementing policy tools that were previously widely focused on command-and-control measures (EZZINE-De-BLAS *et al.*, 2016; KRONENBERG et HUBACEK, 2013). A system of payments for ecosystem (or environmental) services (PES) has a very simple logic: to increase the income of economic activities compatible with conservation, in order to encourage the sustainable use of natural resources, while at the same time penalizing predatory activities. In an ideal system, the polluter or user must pay so that the protector or provider receives. Thus, there is an incentive to conserve the goods and services freely provided by the natural environment that are of interest, direct or indirect, to human beings (YOUNG et BAKKER, 2014).

In PES, the service providers and buyers should have agreed on what possible trade-offs and benefits that each may get. Theoretically, implementing PES should consider high willingness to pay and low opportunity cost to service providers and should also consider fairness, efficiency and effectiveness and equity to both parties’s upland and lowland (CELESTE *et al.*, 20208).

Notably, private and public sector PES implementation models emerge, co-exist and cooperate worldwide. Private PES are usually negotiated and customized to local conditions, including so that ES buyers can directly sanction any non-compliance by ES providers (EZZINE-De-BLAS *et al.*, 2016).

A project can be classified as a PES if it meets the following criteria: (i) must originate in a voluntary deal; (ii) must have one well-defined environmental service, or a kind of land use that supports this kind of service; (iii) must have at least one environmental service “purchased” by one service consumer; (iv) must have at least one service provider, and; (v) must ensure that the provided service is guaranteed by a firm condition (WUNDER, 2005; ROBERTSON et WUNDER, 2005).

Since 2006, there has been an explosion of Payments for Environmental Services (PES) projects in Brazil, as well as efforts to pass PES laws at federal, state, and municipal levels. Even in this short period, an extraordinarily rich range of experiences has developed, with examples of the application of PES at a variety of scales, ranging from micro watersheds to entire states; in a variety of contexts, from remote forest frontier areas to the peri urban fringe of megacities like São Paulo; and using a variety of approaches, using direct payments

by users, sales to regulated and voluntary carbon markets, government funding, and mixes of these approaches (PAGIOLA *et al.*, 2013).

In most PES programs, the payment amount is in keeping with monetary assessments of natural resources and environmental services. This situation, in general, is quantified by the land opportunity cost (Land use that is not for forest plantations but rather for economic alternatives).

However, some economic, technical, institutional and legal lacks and difficulties for the PES program's implementation are possible such as negative reactions by not selected rural owners and/or properties according to both main PES goals and/or monetary or non-monetary payments (VAISSIERE *et al.*, 2020).

Some authors show that incoherent forestry policies cause negative impact to the sustainable environmental or ecosystem services provision. European Union (EU) forestry strategy for natural losses reduction and biodiversity restoration, under a climate change perspective, have been implemented in a disordered way (governance lack) by the EU countries (AGUILAR-GÓMEZ *et al.*, 2020). Another relevant problem on these kinds of natural programs is the meaning confusion between environmental compensation (EC) and PES although both concepts can be used in combination. Some authors also suggest that PES could shelter EC in its group (VAISSIERE *et al.*, 2020).

Some common characteristics were identified whatever the PES program: i) it is a important instrument for social, economic and environmental sustainability promotion, mainly in rural areas; ii) it have promoted social practice changes to more acceptable and desirable natural values, and iii) it is a incentive and not punitive instrument (AGUILAR-GÓMEZ *et al.*, 2020).

3 Material and methods

This exploratory research was basically based on both deductive and inductive approaches. Considering a wide analysis of the most important PES projects in Brazil and Argentina, we observed and emphasized, as a deductive approach, principal sustainable PES elements as our specific focus. It was also used an inductive approach to identify and systematize the most important aspects of Brazilian and Argentine PES projects that could be used as parameters for a general PES protocol in the River Plate watershed region of this study. Finally, it was used speculative, comparative, and logical approaches to compare the general characteristics of Brazilian and Argentine PES projects. Material and techniques entailed collecting, systematizing, and analyzing the most relevant news, data, and information linked to the PES projects. It was also relied upon professional and historical experiences, documental and literature reviews, and, finally, concept categorization.

In the Brazilian cases, within a particular Sao Paulo state perspective, it was consulted entities such as the National Water Agency (Agência Nacional das Águas - ANA), as well as scientific research institutes and universities (Escola Superior de Agricultura “Luiz de Queiroz” / Universidade de São Paulo (College of Agriculture “Luiz de Queiroz” / São Paulo University (ESALQ/USP), municipal and state environmental secretaries (Secretaria de Infraestrutura e Meio Ambiente do Estado de São Paulo (Secretary of Infrastructure and

Environment – São Paulo State (SIMA-SP) and Secretary of Environmental of Botucatu Municipality (Secretaria do Verde –Prefeitura Municipal de Botucatu), and the Federal Ministry of Environment (Ministerio do Meio Ambiente – Governo Federal MMA), among others. In order to assess the Argentine approach, we referenced documents from publishing entities such as Geographic Books Magazine, the Argentine Wildlife Foundation, the National University of Santiago del Estero, and the National Secretary of Environment and Sustainable Development.

4 Results

4.1 General rules of PES

PES are often described as market based on policy instruments where markets for scarce public goods are created to incentive their optimal provision. Most PES are not strictly speaking market based however, not least because the provision of these ES is not strictly conditional on the reimbursement, and the number of involved producers and consumers tends to be limited (JUNTTI, 2009).

Schomers et Matzdorf (2013) discussed the payments for ecosystem services economic approach relative to both developing and industrialized countries (Costa Rica, Mexico, European Union, USA, China, South Africa and Brazil). The authors, concerning Brazil, emphasized the Proambiente program (one of the first Brazilian initiatives within the PES perspective), predominantly. According to the USA, they argued about the beginning of the PES, through the Environmental Quality Incentives Program (EQISP), in 1930. They also commented that the environmental trend had been introduced in the Farm Bill, in 1996, and, with the expanding financing and creation of the Conservation Security Program (CSP), in 2002. In the American case, the programs can be considered, typically, a federal action to purchase environmental services from agriculture, according to Dobbs (2006) and Schomers et Matzdorf (2013).

UNEP (2010) developed a strong relationship among local policy, ecosystem services and climate change due to reference about several issues, such as “atmospheric carbon is sequestered through natural processes; plants and trees take up carbon through the action of photosynthesis whilst the oceans soak up carbon dioxide on a dissolved form, and ecosystems store an enormous amount of carbon”.

Reduction of Forest Degradation and Deforestation Emission (REDD), on a PES context is a mechanism created by international entities to pay landowners who keep the stand forests, without deforestation/cut. The REDD financial mechanism (Green Fund) doesn't take into account the private Carbon Market. This concept emerged at Bali way Letter, on the Bali Conference (COP-13) and established the positive incentives and policies in relation of environmental questions such as: i) emission decrease due to deforestation; ii) emission decrease due to forest degradation reducing in developing countries; iii) stand forest conservation; sustainable forest management, and: iv) carbon sock increase on developing countries forests (reforestation), according to Jalowitzki (2016). The author classifies the REDD concept on the following categories: i) REDD a Forest valuation element is the

emission reducing due to deforestation and forest degradation, on developing countries (COP - 16, Cancun); ii) REDD+ a REDD plus sustainable forest management plus carbon stock increase, on developing countries, and: iii) REDD ++ a REDD + plus agriculture (appropriated use of the lands), included the carbon stock increase on the developing countries forests (COP – 19, Varsovia).

However, during the 21a. session of the Parties Conference, on the United Nations Climate Board-Convention (COP-21), when it was signed the Paris Agreement, the REDD+ concept was firmly linked to the carbon emission reducing due to deforestation and forest degradation, with the sustainable forest management's paper, with the forest carbon stock increase, and, finally, with the payment possibility according the REDD's actions outcomes (Green Climate Fund). Nevertheless, in order to receive this kind of financial support wouldn't be possible others benefits (environmental services) not directly associated with carbon emission. Besides, the main Brazilian sources of the quantities of CO₂ emission relative contributions, considering 2000, were: (i) land use, land use change and forest (78%); (ii) energy (18,1%); (iii) industrial processes (3,9%). Naturally, the "land use, land use change and forest" element is crucial to the Brazilian participation on the environmental impact mitigation due the greenhouse gases emission. Considering this source, the CO₂ emission estimative of the Brazilian biomes, also in 2000, were: (i) Amazon (50,8%), Brazilian savannah (18,9%) and other biomes (8,3%), under a BME (2016) point of view.

An integrated vision of PES and the REDD+ measures and actions is considered something possible and extremely worthwhile. However, the relationship between them can be positive but not necessarily automatic. For this purpose, that is to say, a successful relationship between payment for environment services projects and REDD+, the following challenges around designing inclusive payment for environmental must be solved: (i) reaching the poor; (ii) elite capture⁴; (iii) (dis)economies of scale; (iv) limited marketing ability and financial sustainability (PORRAS et. BLACKMORE, 2014). The main aspects of PES have already been introduced above but it is still necessary to present the REDD, REDD+ and REDD++ concepts under The Climate Fund for Energy, Climate, and Social Actions point of view. Programs of Payments for Environmental Services (PES) have attracted considerable attention as a conservation tool in recent years and are likely to play an important role in many REDD strategies. PES is a market-based approach to conservation financing based on the twin principles that those who benefit from environmental services (such as users of clean water) should pay for them, and that those who contribute to generating these services (such as upstream land users) should be compensated for providing them (PAGIOLA *et al.*, 2019).

4 Projects not grounded in local realities can increase poverty, for example by exacerbating inequalities in access to resources, which can happen as a result of *elite capture*" (PORRAS et BLACKMORE, 2014).

4.2 Brazilian characteristics of PES

PES, in Brazilian case, has a strong relation with federal control and command instruments of environmental policy. In this sense, it was mentioned the federal environmental law (Brazilian Constitution-1998, Environmental National Law, Climate Change National Law, New Forestry Code, only to mention a few examples). So, with regard to federal financial funds supply for projects of PES, considering the national environmental law above mentioned, it is possible to mention the following main issues: National Assessed Contributions (Contribuições Nacionalmente Determinadas); Carbon Emission Reduction's Brazilian goal (37% until 2025), Low Carbon Agriculture Program (Programa de Agricultura de Baixo Carbono - ABC), and, mainly, The Water Producer Program (Programa Produtor de Agua), linked to National Water Agency (Agencia Nacional das Aguas, ANA), and the New Forestry Code (system of federal PES and forestry reserve quote), according to ANA (2008), BRAZIL (2012), PAGIOLA *et al.* (2013), SILVA *et al.* (2017), for example.

The Water Producer Program of Brazil's National Water Agency can be considered one of the most traditional federal PES projects among the Brazilian case studies. This PES is a voluntary program created to provide the incentive of financial compensation to agents who demonstrably enhance the protection and restoration of relevant rural environmental areas, with benefits to watersheds and human populations (ANA, 2008). This program has been applied in multiple strategic national watersheds. In Brazil in the city of extreme in Minas Gerais, through a municipal law the conservative water project aimed to preserve the fountains and springs in the municipality located on the watershed of the possessions. The watershed waters comprise one of the major water sources of the Cantareira system, which supplies the metropolitan region of São Paulo under a Sao Paulo state perspective to be discussed ahead (SILVA *et al.*, 2017).

It is important note that under a federal perspective, another PES programs and/or laws should be mentioned: i) The new Brazilian Forestry Code / Law n. 12.651, of 2012 (BRAZIL, 2012); this law has complemented (regulated) by Decree n. 10,828, of October, 01, 2021 (Green Product Banknote, relative to native forests and its biomes conservation and restoration activities) (BRAZIL, 2021, a); ii) Payment for Environmental Services National Policy / Law n. 14.119-2021 (BRAZIL, 2021, b) and, most recently; iii) "Plus Forest" Program (Amazon, Carbon, Entrepreneur and Bioeconomy modalities) (BRAZIL, 2022).

Water resources issues can be applied in all these Brazilian federal PES programs and/or laws because it can be also noted, directly or on an indirectly way, in all kind of environmental or ecosystem services. Try to be more objective, water resource can be deal as provision services (water for domestic or industrial uses, at Sao Paulo Metropolitan Region, for instance), life support (Brazilian mangroves), regulation services (hydrologic cycle equilibrium maintenance of Pantanal biome), and cultural services (River San Francisco, at Northeast region of Brazil). In fact, from now on, all these Brazilian federal PES programs and laws must be regulated, integrated and, mainly, implemented on an effective basis.

There also is the São Paulo state environmental law (considering that 26 states and the Brazilian capital form the country). Sao Paulo state is the most important Brazilian

state, with an expressive economic, industrial, social and environmental participation for the sustainable Brazilian development.

On this case is virtually repeated the same federal legislation approach above mentioned, just with the specific characteristic inclusion of this state (Sao Paulo state Constitution-1989, Environmental Sao Paulo State Law, Climate Change Sao Paulo State Law, among others). With respect to the state financial funds supply source for projects of PES it could be mentioned the following current alternatives/possibilities: i) Resolution SMA/FF n. 02 of August 28, 2018. Reorganization of Natural Heritage Private Reserves (NHPR) Guidelines, under the Forest Remaining Program (SIMA-SP, 2018, b); ii) Resolution SMA/FF n. 01 of April 20, 2018. Payment for Environmental Services due native vegetation conservation, ecological restoration and sustainable productive systems in the rural property's encouragement (SIMA-SP, 2018, a); iii) Resolution SMA n. 142 of 2017, Payment of environmental services Project by Riparian Forest (project of rural sustainable development) (SIMA-SP, 2017, b); iv) Resolution SMA n. 86 of August 25, 2017. Payment for Environmental Services Project due Native Vegetation Protection (Protection PSA), under the Climate and Biodiversity at the Atlantic Forest Project (SIMA-SP, 2017, a); v) Resolution SMA n. 60, of 2016. Payment for Environmental Services of Riparian Forest (SIMA-SP, 2016, b); vi) Resolution SMA n. 58, 05 of 2016, Payment for Environmental Services of Native Fauna Monitoring and Release Areas (SIMA-SP, 2016, a); vii) Resolution SMA n. 19 of April 19, 2015. Payment for Environmental Services for the Riparian Zone, under the Forest Remaining Program (SIMA-SP, 2015); viii) Resolution SMA n. 89 of 2013, Guideline for Payment for Environmental Services of Natural Heritage Private Reserves (NHPR) (SIMA-SP, 2013, b); ix) Resolution SMA n. 11 of February 6th, 2013. Project of Payment for Environmental Services on NHPR category, according to SIMA-SP (2013, a), and; x) Resolution SMA n. 37 of June 5th, 2012. Guidelines for NHPR PES Execution, under the Forest Remaining Program (SIMA-SP-2012).

Sao Paulo state approach is supported by a superior legal structure, that is to say, the Section VIII – Remaining Forests Program (Programa de Remanescentes Florestais), of the Climate Change State Policy's regulation instrument (ALESP, 2009). Remaining Forests Program, on Sao Paulo state's case, has recently modified by Decree n. 66.549 of March, 07th, 2022, also know like Payment for Environmental Services State Policy. So, this state has regulated the Payment for Environmental Services National Policy and one of the most interesting issues of it is the monetary and not monetary payment modalities (direct payment, supply of agriculture and forestry inputs, social improvements to rural and urban communities, technical, operational and financial support, environmental maintenance and inspection, etc.). The wide range of financial possibilities in the legislation is also interesting (private and public funds, environmental services users, legal obligations, donations of multilateral institutions, administrative fines conversion, among other options ALESP (2022).

There also are several PES programs, project and/or laws under State perspectives. The municipality of Botucatu, on the Sao Paulo state case, for instance is a expressive example, with its Law n. 1.153 of July, 7th, 2015 (MUNICIPAL LAWS, 2015). Botucatu municipality has developing a strong sustainable program base on local and specific natural

attributes such as: geomorphological landscape (“basaltic cuestras”); flora and fauna of Brazilian savanna and tropical forest remaining; panoramic views; sustainable tourism municipal policy; touristic region linked with water resources such as reservoirs and River Tiete, etc.

Some of the most important characteristics from these federal, state and municipal PES are reported in Table 1.

Table 1. Brazilian Federal PES (Water Producer Program, The new Forestry Code and Payment for Environmental Services National Policy), PES of Sao Paulo state National and Payment for Environmental Services project of Botucatu (municipality of Botucatu, São Paulo State, Brazil).

Program	Brazilian Federal PES (1)	PES of São Paulo State (2)	Botucatu PES Project (3)
Program context (voluntary)	Financial compensation to agents, small farmer Familiar Agriculture Water sources areas protection and restoration	Attendance to the Forest Remaining Program, under the Sao Paulo Policy of Climate Change Payment to rural farmers	Payment to rural farmers Harmonization of preservation and restoration of springs, native vegetation, water source areas, and income generation
Objectives	Financial incentives for select agents Level of diffuse rural pollution decrease Mitigation of sedimentation and eutrophication processes Strategic watersheds Water and soil integrated management diffusion Social, economic and environmental sustainability PES National Registry PES Contract types PES programs linked to Program of Environmental Preservation and Restoration Support and Incentive	NHPR implementation Natural attributes conservation, restoration and preservation in rural properties Sustainable Rural Productive rural systems Harmonization of income generation and environmental protection Water resources and riparian zones protection Fauna protection	Springs and water source areas protection Conservation of riparian and remaining forests Use of appropriate technical measures of soil conservation and ecological agriculture practices Prevention of erosion process and water pollution Promotion of scenic beauty

Program	Brazilian Federal PES (1)	PES of São Paulo State (2)	Botucatu PES Project (3)
Environmental services providers (Selection of criteria)	<p>Projects of rural producers with the following aspects:</p> <p>Present environmental situation</p> <p>Water and Soil conservation</p> <p>Actions for decreasing erosion</p> <p>Property documents</p> <p>Water allocation license (if water user)</p> <p>Certificate of water allocation charging (if water user)</p> <p>Familiar Agriculture</p> <p>Small Farmers</p> <p>Areas with native vegetation, degraded areas, natural conservation areas, Indian lands, panoramic views, areas for exclusion of fishing, priority biodiversity conservation areas</p>	<p>Rural producers in priority areas (preference: small-sized rural properties</p> <p>Rural private properties</p> <p>Sustainable use areas</p>	<p>Small-sized rural properties</p> <p>Priority to the small-sized rural properties located in relevant areas</p> <p>Existence of natural forest and soil restoration and conservation activities</p> <p>Use of ecological agriculture practices (or interest of Planting)</p> <p>Property documents</p>
Priority areas	<p>Identification and ranking of priority sub watersheds by their committees</p> <p>Rural properties submitted to Environmental Rural Registry and Program of Environmental Preservation and Restoration Support and Incentive</p>	<p>Selection of priority areas federal, state and municipal NHPR located in Sao Paulo state, for instance) according to specific legal guidelines</p>	<p>Native remaining forests conservation</p> <p>Refiling areas of Guarani Aquifer</p> <p>Basaltic “Cuestas” (a typical regional geological formation</p> <p>APA Botucatu (a protected nature area)</p> <p>River Pardo sub watershed</p> <p>Ecologic agriculture practices</p> <p>Environmental studies for priority areas determination</p>
Anthropic actions	<p>Soil conservation services, new forest planting, remaining forests preservation</p> <p>Carbon mitigation</p> <p>Panoramic views conservation</p> <p>Cultural appreciation</p> <p>Permanent Preservation Areas, Legal Reserve areas and Restricted Use areas protection</p>	<p>Measures and actions:</p> <p>Keep areas without environmental degradation factors</p> <p>Incentive of natural forest regeneration</p> <p>Plant seedlings of native trees (regional existence)</p> <p>Enhancement of Sustainable Use Areas and Riparian Zones and Flora and Fauna Protection</p>	<p>Preservation of remaining areas with vegetation</p> <p>Implementation of native vegetation in PPA’s</p> <p>Activities of soil maintenance</p> <p>Removal of degradation factors</p> <p>Implementation or improvement of ecological agriculture technical measures</p> <p>Environmental measures in terms of monetary or non-monetary values</p>

Program	Brazilian Federal PES (1)	PES of São Paulo State (2)	Botucatu PES Project (3)
Payed Values (payment)	Payment according to existing forests [wide Permanent Preservation Areas (PPA) to restoration involve high values per hectare to pay for existing forests] Rural properties without PPA's Payment criterion is number of hectares of forests and according to forest conservation level Maintenance costs are total or partially covered, according to forest conservation level Diffuse pollution decrease Monetary funds of the Federal Program of PES Regulation pendency in the case of the forestry code	Payment related to natural conditions of the springs, according to the situation of vegetation maintenance (PPA) and also with its water resources use (consumption), water flow and localization Monetary resources of the Pollution Prevention and Control Fund	Payment according to the conditions of the areas and successional scale of the native remaining forests (ecological corridor, PPA, Legal Reserve area, etc.). Planting of new forest areas (fertilizers, seedlings, fence posts), and also according to the size of the area to be restored, as well as use and implementation of ecological agriculture technics Considering different values to each kind of activity
Remuneration criteria	Monetary values are established by watershed, according to its characteristics and payments are proportional to produced environmental benefits (each practice has its own calculus) Elected and Eligible areas vis-à-vis Formalised contracts (expectancy) Still not regulated (in the new forestry code case)	Annual Reference Value (VRA) = $C_v \times UFESP \times NHPR$ factor C_v = Valuation Coefficient UFESP = Fiscal Unity of Sao Paulo State $PSA = \sum (VRA \times AREA_i \times Cai)$ Cai = Area coefficient for each class of area i NHPR factor = variables linked with environmental threats and importance (In the NHPR case, for instance)	Values related to land opportunity cost and/ or the anthropic actions implementation -
Environmental Monitoring	Erosion decrease index: water flow at previously determined times, checking by contracting party Still not expected on the new forest code and PES national policy cases	Environmental monitoring system: Execution Reporting, Technical Visit, Environmental Regularity Maintenance of the rural property (NHPR case)	Short term environmental monitoring: quality and quantity (water flow) and long term: fauna and flora identification in the native forest areas

(1) New Brazilian Forestry Code (Law n. 12.651 of 2012); Payment for Environmental Services National Policy (Law n. 14.119, of 2021) and, more recently; Plus Forest Program (Amazon, Carbon, Entrepreneur and Bioeconomy modalities).

(2) Resolution SMA/FF n. 02/2018; Resolution SMA/FF n. 01/2018; Resolution SMA n. 142/2017; Resolution SMA n. 86/2017; Resolution SMA n. 60/2016; Resolution SMA n. 58/2016; Resolution SMA n. 19/2015; Resolution SMA n. 89/2013; Resolution SMA n. 11/2013 and; Resolution SMA n. 37/2012.

(3) Law n. 1.153/2015.

Nations Development Program (PROJECT UNDP ARG 99/011 – BIRF 4085 AR Loan), were executed by Faculty of Forest Sciences, National University of Santiago Del Estero.

Table 2. Main characteristics of Payment for Environmental Services projects (systems) in Argentina.

Program/Project/Year	Financing/author	Region
2006. Consulting of PES international experiences transference and also development of basis for case studies execution	• Secretary of Environment and Sustainable Development. Financing BIRF 4085-AR	Argentina. Provincias de Jujuy y Chubut
2009. Establishment of incentives for important global environmental services conservation	• Global Environment Facility (GEF Fund) United Nations Development Program (UNDP)	Jujuy, Chaco Formosa Entre Ríos
2010. Proposal of PES mechanism	• Denegri y Gaspari 2010	Sauce grande Buenos Aires
2011 Water resources PES Project in Misiones, concerning GEF project	• 2011. Global Environment Facility (GEF Fund) United Nations Development Program (UNDP/GEF Fund)	Misiones, Argentina
2012 Países Bajos y Ecosystems Grants Program. Coordinated by Nature Resources and Environment Foundation and Wildlife Argentine Foundation	• International Union for Conservation of Nature (IUCN)	Misiones

Several follow-up studies on PES programs have been carried out in Argentina, such as the “Los Pericos-Manantiales” Watershed PES (another example of watershed territory issues as one of the crucial elements of PES projects regionalization) in Jujuy, an Argentine county (SARMIENTO, 2011). In this study we identify crucial environmental services for the local PES project and also environmental service providers and consumers (SARMIENTO et RIOS, 2009).

We observed in these examples, studies of previous viability and local PES system viability. For this purpose, we carried out economic and financial analyses in regard to four alternative cash flow scenarios that could be created by the local PSA. We also analysed judicial and legal landmarks supporting PES systems, taking into consideration the possibilities of international, national, and local financial sources for specific PES project implementation. Additionally, a strong consulting services basis in the aforementioned Argentine cases enhance the development of previous viability studies for the implementation of PES projects in the River Futaleufquen watershed, in the Chubut region of Argentina (SARMIENTO et RIOS, 2009).

Another Argentine case referenced, also from 2009, was the study “Establishment of incentives for the conservation of ecosystem services of global significance”. This study was supported by the Global Environment Facility (GEF) fund, under the purview of the

United Nations Development Program, and was executed by the National Secretary of Environment and Sustainable Development (SAyDS) as well.

In 2011, Argentine provinces implemented the following PES projects: (i) Jujuy (water control and scenic beauty); (ii) Chaco and Formosa (carbon capture and biodiversity maintenance), and; (iii) Entre-Rios (biodiversity maintenance).

Denegri & Gaspari (2010), considering the relationship between PES and water resources within the Argentine example, demonstrated the principles of PES project formulation in the River Sauce Grande watershed in Buenos Aires County.

Additionally, a PES project on private lands located in Misiones County has been operating since 2010. This project, called “Países Bajos y Ecosystems Grants Program”, is coordinated by Fundación Ambiente y Recursos Naturales and Fundación Vida Silvestre Argentina, with the support of the International Union for Conservation of Nature (IUCN). After these projects, an Argentine study was carried out in June 2010, in response to projects in Costa Rica, concerning different PES project models that could be executed in Misiones County (GOBBI, 2011).

Nevertheless, there are elements in the Argentine examples—such as previous viability, local PES system viability, and economic-financial analysis regarding alternative cash flow scenarios—that could be used in order to enhance future discussions about standardized and regionalized PES projects (WUNDER, 2006).

4.4 Discussion

Brazilian PES project aspects commented on in this paper are summarized in Table 1, while Understanding of Argentine PES project elements commented on here are enhanced by Table 2. Several effective Brazilian PES components, such as the kind of environmental measures to be implemented—including small-sized rural properties, best agriculture practices, and ecological agriculture principles—are crucial and peculiar elements that are not yet present in the Argentine PSA projects analysed in this study.

PES initiatives have a great potential as an alternative strategy for conservation activities in Brazil but, among other requirements, they require the definition of adequate methodologies to evaluate how much landowners should receive as compensation (YOUNG et BAKKER, 2014). PES can help make the value of ecosystem services more explicit and thus modify and potentially reverse incentives for resource users to over-exploit or convert them (HARVEY, 2011). Argentine PES examples, in contrast with the Brazilian cases, have been supported by a strong technical guideline (previous viability, local PES system viability, in conjunction with economic and financial analysis), mainly a consulting services basis. The Brazilian cases, on the other hand, have been supported by strong judicial and legal precedent, as can be seen in our study. Another example of watershed territory issues as one of the crucial elements of PES projects regionalization. Previous viability studies are quite important to the Argentine examples but they aren't strongly consolidated on Brazilian cases yet.

Authors such as Wunder (2013) and Kronenberg et Hubacek (2013) respond that in many poor countries economic development or innovation do not frequently occur and

indeed PES may be a unique opportunity offered to such communities. Wunder suggests that PES do not necessarily mean capping development because people in poor communities are involved in diversified activities, only some of which might conflict with providing a given ecosystem service.

The systemization of Brazilian payment for environmental services (PES) projects at federal, state, and municipal scales can be effectively achieved in the context of the following characteristics: (i) voluntary participation; (ii) purposes; (iii) environmental service provider selection criteria; (iv) priority areas; (v) anthropic intervention types; (vi) payment values; and (vii) environmental monitoring proposals. Considering an analysis of the Brazilian cases in this study, aspects such as rural producers within a specific watershed, pecuniary remuneration, water resource issues, community structures, and different methods and remuneration values, can be the main axes for the development of the standardization process for regional PES project construction. It is necessary to advance in other ecosystem services for PES schemes because most are focused on water resources (YOUNG et BAKKER, 2016).

It was observed, on another hand, thinking about PES possibilities in the River Plate watershed, that the 10 modalities of Sao Paulo State PES have reached only a 6 years period (2011-2018) and it have got 4 years (2018-2022) without any new PES resolution in this State.

In regarding of these PSE resolutions, 4 have related with NHPR (Natural Heritage Private Reserve Reserve), 2 with riparian (forest, vegetation and/or area) zone, 2 with native fauna and, finally, 2 with a more current and incisive rural-environmental context (ecological corridors, Southeast region of the state, tropical forest biome, biodiversity, sustainable rural system and Climate change).

It was verified, under a chronological perspective, that several São Paulo State PES resolutions deal with NHPR (Resolution n. 37/2012, 11/2013 and 89/2013; 02/2018) and have related with REDD+, biodiversity, water production, State environmental credits, guideline for selection of priority areas.

Resolution n. 19/2015 and 60/2016 have deal with riparian zones and it have strongly linked with the new Brazilian forestry code / federal law (environmental rural registry, familiar Agriculture, consolidated rural area on situations before July, 22 of 2008).

Resolution n. 58/2016 and 86/2017 have linked with native flora and fauna protection (animal release and monitoring) as well as and riparian zones protection under a tropical forest in southeast corridor (Climate and Biodiversity project).

Finally, Resolution n. 142/2017 and 01/2018 are PES, under a sustainable rural development perspective, have relationship with the following issues: i) native flora conservation; ii) ecological restoration; iii) sustainable rural system adoption by small farmers in the southeast corridor; iv) Climate and biodiversity questions.

All these resolutions have also a strong relationship with the new Brazilian forestry code (PES discussed below under a federal PES perspective).

Federal and State PES Federal laws have been implemented under a directly or indirectly water production/conservation approach. In fact, federal and State PES have built a “conversation” around several aspects such as Climate change, for instance.

PES program from Botucatu municipality, in contrast, has presented characteristics both federal and state PES programs. It can be also verified that this local PES has got important environmental attributes to be possibly used on River Plate watershed case, such as, native remaining forests conservation, refilling areas of Guarani Aquifer, typical regional geological formation, protected nature area, river sub watershed, ecologic agriculture practices and environmental studies for priority areas determination).

Finally, some decisive questions must be here appointed: what are the effective sustainable outcomes in front of this huge set of PES in Brazil, Sao Paulo State and Botucatu municipality? Is it necessary this quantity of PES programs and laws? Considering the peculiar characteristics of São Paulo State and Botucatu municipality, is it necessary produce River Plate watershed PES State PES or it would be possible work with the Argentine, Brazilian, state and local PES?

It would be necessary to discuss these and another PES questions in a proper place, in a proper moment and on a proper way, mainly under River Plate watershed approach.

In Argentina, improvements of environmental services are also initiated by national government and provincial efforts. However, in contrast with Brazil, Argentine PES projects are focused on expressive elements such as previous viability analysis, economic-financial viability, and environmental market viability based on environmental service providers and consumers’ voluntary construction processes. Some processes have only reached the feasibility or pre-feasibility stage and no PSE schemes have been implemented.

Nevertheless, there also are elements of the Argentine examples, such as previous viability, local PES system viability, and economic-financial analysis regarding alternative cash flow scenarios that could be used to support future discussions about standardized and regionalized PES projects, mainly in the context of the River Plate watershed environmental management.

There are several Brazilian and Argentine issues which could be used to guide the process of standardizing regional PES project construction, especially from a watershed management perspective, not only within the Brazilian and Argentine geographic limits, but also in other River Plate Watershed countries, such as Paraguay and Uruguay.

On the Argentine perspective, and a also thinking in a River Plate watershed context, PES is fundamentally different from conventional environmental policy instruments in operating through incentives rather than disincentives like legal regulations, sanction mechanisms, or taxes. This inherent incentive feature is both its virtue and its major challenge. If well-designed, payments can be a least-cost Pareto efficient solution to correct market failures. However, poor design could lead to wasted financial resources and potentially adverse environmental or social outcomes, for example, through unintended effects on human behaviour. In many aspects, PES is thus a demanding policy tool that can synergistically complement environmental policy mixes if carefully designed and implemented in appropriate contexts more over yet between countries.

Besides, it is necessary to find out the causes of the scarce participation of the actors in the PSE schemes. One of them may be the lack of definition of WTP and WTA to participate. To find out more about the factors that would affect the participation of farmers in the PES program, it would be necessary to apply a study to investigate whether they are willing to accept changes in land use in exchange for incentives for it (PORRAS et BLACKMORE, 2014).

Moreover, as is also true for the Brazilian cases, Argentine national PES projects, considered within a River Plate watershed point of view, have not yet developed a method to take into account specific social, economic, and environmental issues, especially from the environmental service providers and consumers' points of view. Consequently, a kind of remuneration systems for sustainable issues as a specific target has yet to be built. It is possible to say, in comparative analysis with the Brazilian cases, that the Argentine PES projects do not yet have any consolidation of social, economic, and environmental issues which could be used as parameters for a standardized and regionally applicable PES project model.

5 Conclusion

There is still no clear structure in Argentine PES projects regarding social, economic and environmental aspects, as seen in Brazilian PES projects, mainly considering the case of Sao Paulo state perspective, which could be used to create a standardized and regional model of PES projects.

In addition, no national PES project protocols have yet been developed in Brazil or Argentina that take into account these types of specific social, economic and environmental issues, mainly from the point of view of environmental service providers and consumers. The most likely solution is to build a targeted compensation system. In both countries, we urgently need new policy frameworks that reward the provision of ecosystem services and promote the greening of supply chains. There are only Argentine or Brazilian PES projects, but not regionalized and standardized PES projects between the two countries.

As Celeste *et al.* (2020) proposes, in other regions, a joint PES program between Brazil and Argentina may hold promise as environmental protection for forest and agricultural land users, generating alternative sources of income.

Joint actions between both countries are necessary to improve the effectiveness of payment systems for environmental services. Likewise, the legal frameworks that allow the joint implementation of PES schemes must be made compatible.

On the one hand, Brazil has a wide spectrum of environmental laws oriented to environmental services and PES schemes, while Argentina lacks appropriate legal frameworks to implement PES schemes.

There is a great need to generate policies and instruments of state economic incentives to stimulate the development of PSE in Argentina.

Help local producers in both countries prepare for new market opportunities between Argentina and Brazil as consumers and public policies stimulate demand for products and

services that respect biodiversity and the environment. There is a lack of development of instruments and an adequate and reliable legal framework to promote private-private PSE schemes.

Promote PES demonstration activities and capacity building in private actors and public agencies to develop the knowledge base, reduce transaction costs and scale up successful initiatives. Support an international agreement within the framework of the Common Market of the South (MERCOSUR) on a REDD+ mechanism as part of the global climate regime, while ensuring that other ecosystem services are taken into account in addition to climate mitigation. Finally, all these aspects involving Argentine and Brazilian PES must be considered if it be thinking about issues to build a regional PES strategy under a River Plate watershed perspective.

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