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Review

A review of Payment for Ecosystem Services for the economic internalization of environmental externalities: A water perspective

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ABSTRACT

The allocation of economic value to environmental goods is intended to internalize the socio-economic and environmental costs of policies implemented and thus recognizes the value of the ecosystem and the consequences of environmental damage. This entails identifying the costs and benefits of management measures for conservation and of degraded ecosystems. The difficulties of this task are: (i) they are goods that have no market and (ii) there is a need for economic funding for conservation purposes. Payment for Ecosystem Services (PES) seeks to internalize the environmental externalities of human actions, ascribing monetary value to Ecosystem Services (ES) and helping decision-makers to recognize the real value of the loss of ES. Sustainable management is secured within a model of integrated resource management (a combination of economic, social, environmental, political and cultural spheres). PES breaks with the classical view of environmental protection (based on direct regulation to prevent, correct and punish harmful behaviour). This review focuses on concrete aspects of the sustainable management of ES related to water, examining the possibility of implementing PES for water ES, using mainly the Pigouvian approach. It considers the importance of developing PES schemes at the hydric level in response to the need for management of resources, while ensuring the supply for current uses and demand while being attentive to social and environmental dimensions.

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1. Introduction

The current state of technology has distorted people's relationship with the environment, as the standard argument is that if there is an environmental problem then the scientific community and technological solutions are able to fix it. However, management of ecosystem goods and services is feasible through a multidisciplinary approach (i.e., taking into account environmental, economic, social and political aspects). The use of Payment for Ecosystem Services (PES) is proposed to internalize environmental externalities generated daily. The starting point is viewed as the need to estimate the economic value of goods or services to be preserved and/or restored. For our purposes, the PES tools are associated with the hydric sphere to develop the theoretical foundations necessary to allow its implementation in the water management of

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river basins. Guidelines to be followed are framed with a view to achieving the internalization of environmental externalities. Through this literature review we focus on the general methodology and its relation to the hydric sphere (as a way of managing an increasingly scarce and problematic resource), to consider opening up a new way of managing resources by merging economic, social, political and environmental issues.

2. Ecosystem Services (ES) and internalization of environmental externalities

The Millennium Ecosystem Assessment (MEA, 2003) is defined as: "*the benefits people obtain from ecosystems. These include provisioning services such as food, water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits*" (2003: 3). Valuation of environmental goods through ES means valuing the natural capital (Lauf et al., 2014). However, market failure is responsible for creating environmental externalities as a result of inappropriate incentives for ES management; hence, the ability to modify ES quality is not considered within the decision-making process (Adhikari and Boag, 2013). Water is a public good and its degradation becomes an externality that is not taken into account because there is no market value imputed; governments and businesses are unable to internalize the value of such ES degradation (Schomers and Matzdorf, 2013). What are the ES provided by water resources? (i) water supply and aquifer recharge; (ii) regulation of water flows; (iii) regulation of nutrients; (iv) soil formation; (v) treatment capacity; (vi) biological control; and (vii) food production (Baker et al., 2013; Helfenstein and Kienast, 2014). As noted, these are vital for maintaining balance in the ecosystem; and therefore we reiterate the importance of knowledge based on the interrelationships between different ecosystems. According to Fregoso (2006), water ES "*appear in the hydrological cycle, as a result of the ecosystem's capacity to store water and thus keep water supply available for society benefit*" (2006: 30).

3. Managing the environment via Payment for Ecosystem Services (PES)

PES, according to Wunder (2005), is "*a voluntary transaction where a well-defined ES (or a land-use likely to secure that service) is being 'bought' by a (minimum one) ES buyer from a (minimum one) ES provider, if and only if the ES provider secures ES provision (conditionality)*" (2005: 3). PES aims to encourage a change in the management and use of ES and achieve effective conservation financing. As a result, PES can prevent overexploitation of ES and would avoid the need for the recovery of damaged ES. PES undertakes a preventive approach thanks to adapting ES use to population needs (Garbach et al., 2012). PES are designed for guarantee economic welfare through the internalization of environmental externalities; using pricing mechanism is better form for achieve it (Mombo et al., 2014). Economic instruments are important tools to achieve environmental targets thanks to their ability for changing provider behaviour. Under this approach, PES schemes become a complementary tool of command and control measures (Young and de Bakker, 2014). However, this is a highly complex process because the units in which the welfare of a society is expressed do not coincide with the units of measurement for natural parameters (Wallace, 2007). Hence, an ecosystem cannot be reduced to a single assessment process because it is not an isolated system (Fisher et al., 2009; Kallis et al., 2013). The main objectives of PES implementation are: (i) ES maintenance preventing its degradation, (ii) ES restoration (Robert and Stenger, 2013), and (iii) ensuring the continuous supply of the ES (Tacconi, 2012). For the attainment of these objectives, markets have to be created based on the Coase theorem or on the Pigouvian approach.

The Coase theorem establishes that government intervention is not needed for internalizing externalities; PES moves into a private sphere (Coase, 1960). PES schemes based on this principle have only been successfully implemented at the local level, where negotiations between stakeholders are relatively easy. The implementation focus is at the micro level so that stakeholders can agree within the framework of the PES. Furthermore, the price reflected in the agreement should not be considered as representative price of the real market value of the ES (Schomers and Matzdorf, 2013; Tacconi, 2012; Wunder et al., 2008). The Pigouvian approach is better because it emerges when the government is part of the PES design and the implementation is based on the premise that ES are public goods (Shapiro-Garza, 2013). It seeks to encourage a change of management activities to generate positive externalities through the creation of an ES market that establishes contact between target ES providers and beneficiaries; thus the prices arise from the environmental quality standards established by government (Van Hecken et al., 2015). Since government promotes the Pigouvian approach, PES has the greatest magnitude and it has higher transaction costs. For Rawlins and Westby (2013) this is the main PES approach, because ES, such as water are public goods, the only feasible approach in terms of biodiversity conservation and water quality (Wunder et al., 2008). To ensure the future feasibility of PES based on a Pigouvian approach, it is necessary to guarantee the availability of funds for self-maintenance, avoiding dependence on government budgets and turning PES into a more effective conservation tool and maximizing its positive ecological effects on ES. Through the fund, a sustainable source of long-term funding is attained, which *inter alia* covers the costs of monitoring and surveillance, the implementation of measures and payments in kind (Goldman-Benner et al., 2012; Van Hecken and Bastiaensen, 2010). Related to PES implementation for water ES, adoption of a Pigouvian-type approach is proposed. This would manage a resource characterized (in most cases) as a public good, while taking into account the interests of all stakeholders. The result would widen the scope for the development of measures to enable the promotion of communication between the political, social and environmental spheres and the sustainable management of resources within the framework of governance.

PES is subject to transaction costs as it seeks to link the political sphere to the economic, social and environmental spheres. The establishment of a PES scheme is expensive and complex, resulting in the need to identify correctly ES and to quantify, as realistically as possible, the *ex-ante* and *ex-post* costs. The weight of these costs on the PES programme is strong, so it has a direct impact on the field of decision making and also on the design of the measures to be implemented (Barnaud and Antona, 2014). If all the costs could be quantified, PES would be negotiated between the providers and beneficiaries to maximize the benefits gained from resources, assuming that transaction costs are insignificant. However, it is not possible to quantify all the costs. Thus, it might be necessary reduce PES costs to improve its efficiency. Nevertheless, if the costs are reduced, the consequences will be negative for PES operation and for achievement of the initial objectives. If, however, the approach is taken to the opposite extreme, a high value of transaction costs does not ensure the success of the PES programme as it will be difficult to maintain the level of exigency over time (Wunder et al., 2008). This is why institutional strengthening is crucial for determining, managing and distributing all costs appropriately and equitably (Lin and Nakamura, 2012), because an incorrect estimate will have a strong impact on the development and operation of the PES scheme (Wang, 2012).