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Guest editorial special issue on payments for forest watershed services

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1. Introduction

Integrating complex forest-water interactions and trade-offs challenges the definition of sustainable forested watershed management practices, and the estimation of the broader economy-wide impacts of water and forest policies [20]. The ecosystem services provided through forestry programs are often associated to timber and biofuel production, carbon sequestration and biodiversity (e.g., Refs. [9,15,16]. Comparatively, forest watershed services have received less attention despite the prominent role that forest ecosystems can play in the quantity and timing of water flows as well as in water purification processes. There is growing evidence that forested catchments tend to have more stable water quality conditions, which can be translated into economic benefits through reducing water treatment and supply costs (e.g., Refs. [5,6,25]; and Lopes et al. [1]. in this issue). Forests are also associated with reducing both downstream water yield (e.g. Ref. [14]), and flood flows. Yet, both services remain disputed as they may depend on the scale, size and type of forests, their location, climate, soils and topography or intensity of rainstorms (e.g., Refs. [[10], [11],13,18,24].

The interventions required to improve local watershed services are likely to be context specific, as are the social and institutional factors that mediate human behaviour across watersheds and catchments. A wide range of approaches exist to promote sustainability in forest and water management. Economic incentives are one type of approach. Among these, payments for ecosystem services (PES) have been popularised over the last decades as a promising and innovative tool to shape natural resource use and management and achieve the sustainable development goals [17]. PES are positive economic incentives where ecosystem service (ES) providers can, in most cases voluntarily, apply for a payment that is conditional either on ES provision or on an activity clearly linked to ES provision [12]. Today, many if not most PES for watershed services involve forest conservation or forest enhancement through afforestation [7,19], and most of these payment schemes target areas with high potential to provide ecosystem services [26]. Despite payments for watershed services gaining popularity, the evidence on the environmental and cost-effectiveness of using PES as a tool for enhancing water benefits from forests is rather limited [23]. Managing forest-water interactions effectively requires, furthermore, the engagement of forest managers, forest and water users and other stakeholders across the catchment areas. The interaction among these stakeholders often gives rise to conflicts, particularly between upstream and downstream users [10,14b]. It has been suggested that PES schemes might be more efficient than traditional conservation instruments in addressing such conflicts [17,19,26].

The successful application of PES relies on some general preconditions being satisfied, such as well-defined and secure property rights, and sufficient administrative, monitoring, and enforcement capacities [12,26]. Moreover, the design and implementation of successful PES programs to deliver the targeted environmental benefits is a complex task that involves a considerable number of specific design decisions [12]. Which design features work best generally depends on the specific context, specifically socio-economic, institutional and resource-related factors [12]. Some design features, such as conditionality, targeting and differentiated payments, tend to make general sense from a cost-effectiveness perspective, but their implementation is still incomplete in existing PES schemes [26]. When forest and water are concerned, PES design is further challenged by our yet incomplete and fragmented understanding of the non-linearities and trade-offs involved between forest management, water use, water yield, forest products and the wide range of ecosystem services provided by forests [20]. Thus, more studies that consider the complexities of PES design in the specific context of forest-water interactions are needed.

This special issue contains four papers that address relevant socio-economic, institutional and environmental factors affecting the potential of PES as a tool to enhance the water benefits delivered by forests. The papers presented in this special issue give insight into the complex social, economic, institutional and environmental interactions affecting the creation and performance of PES schemes to promote sustainable forest and water resources management. They contribute to recent debates about forest-related water benefits, the separability of equity and efficiency in PES design, and the implications of a lack of conditionality and formal enforcement for PES performance. The results call for more integrated approaches in the design and implementation of PES schemes, as well as illustrate the usefulness of pre-testing alternative design options to allow for context-specific PES design.

It is widely recognised that spatial targeting of areas with a high ecosystem services density (delivery potential) and high risk (threat) of change can increase PES' environmental performance and cost-effectiveness [26]. The papers by Lopes and co-authors [1] and Ovando and co-authors [2] analyse the implications of spatial heterogeneity in land cover on water quality regulation and water provisioning services, respectively. Lopes and co-authors [1] contribute to the emerging literature that examines the effect of forest cover on the value of water purification service through the impact on water treatment costs. This study covers continental Portugal at municipality level, and analyses the effect of local and neighboring forest cover on water treatment costs, considering both surface and ground water sources. The results of this study confirm that a significant negative effect exists of local forest cover on water treatment costs in water treatment plants with groundwater abstraction points. While the effect of local forest cover on surface water treatment costs is not significant, the results exhibit spatial spillover effects, and a significant negative effect of neighboring forest coverage on treatment costs is also found. The results imply that ongoing forest land conversion to other land uses is likely to increase costs to society in the form of increased water supply costs. This is particularly relevant in developing areas that experience a growing dependence on groundwater resources to satisfy the demands of, in this case, the tourism sector in the Algarve in southern Portugal.

Ovando and co-authors [2] analyse the expected short- and long-term dynamics and spatial distribution of carbon sequestration and water services delivered by economically-driven forest management and abandonment decisions across Andalusia in southern Spain. The results indicate that preventing forest management abandonment has a significant positive effect on water provisioning services, whilst at the same time reducing carbon sequestration services in the short and medium term. The investment levels needed to prevent forest abandonment show a considerable degree of spatial heterogeneity as they depend upon forest species and management costs. Likewise, the effect of forest management on water provisioning services varies spatially, mainly according to forest attributes, such as forest structure, in terms of species and age classes distribution or the slope of the terrain, and local climate conditions. The study provides important input into the effective design of PES for forest water provisioning services, as mapping both the environmental effectiveness and investment costs of forest management enhances the cost-effectiveness of spatially targeted forest and water policies.

The third and fourth paper in this special issue deal with institutional and social factors influencing the environmental and equity impacts of PES in Mexico and Brazil. Equity considerations are of particular importance in many North-, Central- and South-American PES schemes, where these schemes often aim to reconcile multiple objectives [[8], [22]].

The first paper by Pfaff and co-authors is motivated by two observations: (i) involvement of ES users in PES design can lower implementation costs and increase PES effectiveness, and (ii) ecological, monitoring and transactions cost considerations may provide arguments for contracting with groups of ES providers rather than individuals [3]. In a framed economic field experiment conducted in Mexico, the authors simulate a setting where a group of ES users concludes PES contracts with a group of ES providers. The Mexican context is interesting because the Mexican National Forestry Commission (CONAFOR) is currently implementing a Matching Funds program to attract ES user funding into its existing national PES program for hydrological ES (PSAH). The experiment is conducted with water service users and providers within three watersheds participating in the new program. The study analyzes the impact on PES performance of relying on trust instead of external enforcement. This is highly relevant as a recent analysis of existing PES schemes found that schemes often lack monitoring and enforcement of conditionality [26]. This is puzzling to economists who have argued in favor of PES precisely on the grounds of its conditionality. Yet it could be that informal institutions based on trust are more effective than formal enforcement in some local contexts. The study by Pfaff et al. finds that site conditions matter: upstream-downstream trust is central to local PES creation and performance [3]. Moreover, social capital can be built through PES success, even if this success required sanctions. Thus, both prior trust and sanctions can act as assurance tools which align key expectations and promote successful cooperation. The results imply that stronger conditionality through the imposition and enforcement of sanctions can enhance the emergence and performance of PES and raise trust in settings where it is not pre-existent. Yet, the study also finds evidence of potential negative reactions to sanctions. This highlights the value of using economic experiments to pilot policy variation with relevant field populations before attempting to change and roll out program rules at larger scale.

The fourth and last paper, also led by Pfaff [4], examines a related issue: the enforcement of voluntary compensation promises made by downstream water users in so-called user-financed PES. It sheds further light on the role of trust versus formal enforcement, looking at both efficiency and equity impacts. The study is based on an economic experiment that extends standard Ultimatum and Trust games. Experimental sessions were conducted in Northeast Brazil, with populations at both ends of a large canal. The findings indicate that trust outperforms neoclassical predictions for efficiency (measured as total earnings), meaning that some degree of voluntary cooperation between ES users and ES providers can be expected even in the absence of formal contract enforcement. Yet, efficiency is limited by equity concerns. This result is in line with [21,22] arguing that equity and efficiency considerations are not separable when designing PES, and [7] showing that integrating multiple objectives into a single policy instrument results in trade-offs. The study by Pfaff and co-authors finds that formal enforcement (modelled as a binding compensation promise) improves both efficiency and equity of voluntary agreements between ES users and providers [4]. The results are highly relevant because there is often significant heterogeneity in power and wealth distributions between upstream and downstream populations in practice that may hinder the implementation of user-financed PES. The results also indicate that the state has an important role in enforcing voluntary payment offers by ES users. In fact, both studies by Pfaff and co-authors [[3], [4]] suggest a role for formal enforcement on both ends: making payments conditional on ES providers' behavior, and ensuring payments are made by ES users when conditionality is satisfied..

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