Payments for Ecosystem Services—the Case of Forests

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Abstract Payments for ecosystem services (PES) is a trending topic in environmental resource management. The literature on PES has been growing almost exponentially, and practical applications of PES schemes are mushrooming all around the world. In this review article, I present the existing definitions of PES, the factors to consider during the design and implementation stages of PES programs, as well as discuss the recent theoretical debates related to PES in the literature—specifically those related to commodification and legitimacy of PES, its behavioral implications as well as the issues of power and equity. Despite a wealth of accumulated knowledge in the theoretical and experimental fields related to PES, there is still a considerable lack of empirical studies assessing the practical implementation of PES in the field. Only a few schemes are actually systematically assessed, and there is still a lack of a unified comprehensive framework for the thorough evaluation of existing practical experiences. I outline some of the future research challenges that need to be tackled in order to gain a better understanding of the opportunities that the PES mechanism offers to environmental policy makers and other interested stakeholders.

Keywords Payments for environmental services · Environmental governance · Economic incentives

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Introduction

Environmental degradation results from the general failure of conventional markets to account for numerous public goods and positive externalities that ecosystems provide to society [1], and the generalized inability of existing environmental policies to mitigate climate change and prevent the loss of biodiversity [2]. In recent years, increased attention has been drawn to alternative approaches to environmental conservation, among them financial incentives for the provision of ecosystem services (ES). The concept of payments for ecosystem services¹ (PES) —a promising tool for enhancing or safeguarding the provision of ecosystem services— has emerged over a decade ago from a general dissatisfaction with, on the one hand, the traditional government regulatory approaches to conservation, and on the other hand, the indirect approaches to conservation, such as integrated conservation and development projects and community-based natural resource management [3–5].

The core idea of PES is simple; landowners or managers are paid for the provision of certain ecosystem services, or for a particular forest management strategy generating the desired ES, by users or beneficiaries of these services [6•, 7•]. The combination of direct incentives with conditional contracts presumably leads to better environmental outcomes and more efficient allocation of conservation funds [3, 4, 8].

Implementation-wise, a multitude of different PES mechanisms exist around the globe—both in developed and developing countries [e.g., 9–13]. Costa Rica pioneered the use of

¹ The acronym PES is used in the literature to refer both to payments for “ecosystem services”—that is, emphasizing the enhancement of “nature” services, and for “environmental services”—that is, including amenities provided by the “built” or “actively managed” environment [136]. While there are compelling arguments to prefer one term over the other [25•, 41•], in this paper, I use these two terms interchangeably.

PES mechanisms in developing countries by launching in 1997 a country-wide program called *Pago por Servicios Ambientales* aimed at reversing deforestation [14]. Similar programs have been developed in Mexico and China [10], and in the early 2000, PES and PES-like mechanisms expanded through other Central and South American countries—the region with assumedly the highest number of PES mechanisms in the world [e.g., 15–19]. Examples of PES in developed countries are also abundant, e.g., different agri-environmental programs in the USA and the EU [e.g., 20–23], biodiversity offsets and banking in the USA, Australia [e.g., 24], water quality and carbon sequestration-related schemes [e.g. 12], etc. Existing PES schemes tend to focus primarily on three major ecosystem services: water, biodiversity, and carbon, although globally comparable statistics on PES to our knowledge do not exist. Likewise, there are no sound estimates of the share of forest-related PES schemes among the multitude of existing PES schemes; however, given forests' importance for the provision and safeguarding of the abovementioned ecosystem services, it is reasonable to assume that a considerable share of all PES schemes are in one way or another related to forests².

Practitioners aside, PES schemes are highly popular with donors, who see them as innovative instruments [8] and gladly embark on “the PES train” [25••]. Several multilateral organizations and NGOs such as the World Bank and the Global Environmental Facility, the International Union for Conservation of Nature and the World Wildlife Fund are viewed as the main driving forces behind the existing spread of PES initiatives around the world [26–28]. The popularity of PES is “sometimes beyond realistic expectations about under which preconditions PES can thrive” [25••], and it is frequently argued that the “uncritical promotion of the concept makes one suspect that its popularity is mainly based on ideological grounds, rather than on practical experiences” [28].

Since the seminal article of Wunder [6••] providing the first formal and the most cited definition of payments for ecosystem services, research on PES has skyrocketed and is growing at an unprecedented rate. The concept itself is still the topic of considerable academic debate and discussion and has been the subject of special issues in several leading journals, including *Ecological Economics*, *Ecosystem Services*, *Society and Natural Resources* and *Forest Policy and Economics*. Such interest can be explained by the diversity of theoretical framings and disciplinary perspectives underlying this concept [29•], which lies on the interface of natural and social sciences, and is of interest both to academics and practitioners.

The aim of this review article is to highlight the most important findings related to PES as mechanisms for sustaining

ecosystem service provision, as well as to shed light on the specific points of controversy in the academic debate over PES. First, I discuss the numerous definitions of PES and explore the necessary conditions under which PES emerge and function. Second, I discuss the factors that affect PES design and implementation. Third, I review some of the concerns that have been raised in the academic literature, and when possible contrast them with the experiences from the practical implementation of PES in the field. I end with a summary of concluding remarks and some suggestions for future research on PES.

What Is in the Name? Overview of PES Definitions

Original Conceptualization of PES

The concept of PES originates from the mainstream environmental economics understanding of market failures—namely externalities and public goods—being at the heart of environmental problems. In the simplistic view, the fact that ecosystem services are not priced in the conventional markets, means that providers of these services—land owners or managers—or resource users do not take them into consideration in land- or resource-use decisions, leading either to under provision or excessive use of crucial ecosystem services [e.g., 7••, 30, 31]. Environmental economics offers three possible solutions to this problem: quantity-based intervention—e.g., direct government provision of ecosystem services or a quota on the use of resources; price-based intervention—e.g., taxes or subsidies in the Pigouvian sense [32]; or fostering decentralized bargaining solutions in the Coasean sense [30, 33, 34]. The original definition of PES by Wunder [6••] conceptualized it specifically as a bargaining solution for reconciling the interests of different agents in the situations when ecosystem mismanagement is caused by the presence of externalities [7••].

According to the original definition, PES is “a voluntary transaction where a well-defined ecosystem service (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)” [6••]. The major feature of PES following Wunder's definition is, without doubt, its *conditionality*, meaning that payments are done conditional on the execution of certain agreed natural resource management practices. Conditionality is “what makes PES the frontrunner of a new paradigm of contractual conservation” [25••] and what differentiates it from other conservation approaches. Voluntariness of parties (either at individual or at collective level) ensures that both parties of the agreement have the power to terminate it

² According to a recent global survey of 55 schemes conforming to the original definition of PES, 47 % of identified schemes targeted forests, 40 % farmland, and 13 % semi-arid grasslands [82].

if certain performance criteria are not met, and it is a necessary condition for being able to implement conditionality.

In 2015, Wunder has refined his definition³ responding partially to the critiques that have been voiced during the last decade. The new definition stands as follows: “PES are voluntary transactions between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services” [25••]. In the revised PES definition, Wunder stresses the importance of the spatial divide between ES provision and use, by targeting PES specifically to offsite externalities (e.g., downstream flood protection), not to other ES which can be internalized otherwise, nor to the “provisioning services” (e.g., mushrooms, timber) in the MEA sense [35]. Moreover, he abandons the fiercely criticized notion of a “well-defined” ES as a performance indicator, replacing it by the “agreed rules of natural resource management,” which nevertheless keeps intact the spirit of the original definition [25••]. Another major change concerns the terms “buyers” and “sellers” that are replaced by “users” and “providers,” which do not have such a strong market connotation as their predecessors [25••].

This definition of PES rests on numerous ecological, institutional, and cultural preconditions which are crucial to ensure the operationalization of the concept in practice at all stages of implementation. These include, but are not limited to, the following:

- (a) tenure clarity and security among ES providers, and the authority to manage ecosystems [3, 7••, 8];
- (b) availability of real land-use choices for ES providers [3, 6••];
- (c) good understanding of the causal pathways and the linkages between land use practices and ES [6••, 7••, 36];
- (d) non-empty scope for bargaining, meaning that the perceived values of the ES to the users exceed the estimated costs of incremental ES provision to land-owners [6••, 7••];
- (e) understanding of the incentives for private provision of ES and social appropriateness of cash or in-kind payments [1, 6••, 8];
- (f) legal framework supporting the establishment of written or verbal agreements between the parties [3, 36];
- (g) governance structures for negotiating agreements, resolving disputes [36], and contract termination [7••]; and
- (h) institutions for monitoring the implementation of the schemes—in terms of control of undertaken activities, eventual impact on the provision of ecosystem services

(additionality criterion), and overall PES performance [6••, 7••, 8, 36].

Many of these preconditions rely on the existing institutions and logistics, while others may require external intermediaries or facilitators to create trust between ES users and providers, to overcome collective action problems (e.g., free riding), or to manage and distribute PES funds [6••, 7••, 8].

These quite restricting conditions indicate that PES are actually applicable to a very narrow set of problems and are by no means “intended as a silver bullet that can address any environmental problem” [7••], as their critics frequently argue.

Alternative Definitions of PES

Based on his definition of PES, Wunder [6••] differentiates between “true PES”—that is, PES that satisfy all the criteria of the original definition and “PES-like” schemes that do not. In reality, however, “true PES” are infrequent, and only a handful of all initiatives under the PES umbrella actually comply with all the definitional criteria [6••, 37]. Consequently, Wunder’s original definition has been criticized for being prescriptive and too narrow to accommodate all existing PES initiatives [e.g., 38, 39]. Vatn [40] considers the original definition a “theoretical reference point,” which emphasizes more “what PES should be according to a certain perspective, rather than what it really is or can be,” while Muradian et al. [41••] argue that “dividing PES into ‘genuine’ (good) and PES-like (less good) may cause a mismatch between theory and practice.”

A number of alternative broader definitions of PES have emerged in the literature [e.g., 38, 42], the most popular of which is that of Muradian et al. [41••]. They define PES as “a transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources” [41••].

This so-called broad definition of PES is greatly supported by the ecological economics scholars [37–39] and in turn is fiercely criticized by the environmental economists. The latter group argues that such a broad empiricist definition of PES comes to “nullify the logic that in the first place underpinned the emergence of PES” [25••] and fails to effectively differentiate PES from other economic incentives (positive and negative) oriented at natural resource management. More importantly, it fails to account for the key innovative feature of PES—its conditionality, vis-à-vis other more indirect nature conservation measures.

It remains to be seen whether the revised definition of PES by Wunder [25••] succeeds at bridging the definitional divide between the two academic school of thoughts. In practice, however, whether a certain initiative can be categorized as a “true PES” or as a “PES-like” initiative is of a lesser

³ A number of PES definitions in the spirit of Wunder [6••] have also been developed, see e.g., Porras et al. [18], Sommerville et al. [83], and Tacconi [137].

importance. Since real-life PES initiatives are seldom implemented as stand-alone policy tools [15, 40], it is far more important to consider how well they are integrated in and adapted to the existing institutional structures, as well as how well they are designed and implemented. After all, “‘PES-like’ is not per se an inferior classification to PES; customizations, policy mixes and combinations can represent perfect adaptations to complex realities” [25•].

PES Design and Implementation

The design and implementation of payments for environmental services is a complex process that requires the understanding of the whole array of socio-ecological components, apart from the general contextual settings, namely: (1) resource system and ecosystem services, (2) actors, and (3) governance system and mechanism design [29•, 42, 43]. I discuss each of these components in detail.

Resource System and Ecosystem Services

The biophysical nature of different ecosystems services as well as the characteristics of the resource system (e.g., forest) within which they are produced are of crucial importance for PES design. First of all, physical characteristics of ecosystem services determine their economic characteristics, such as rivalry and excludability [44] as well as their homogeneity, measurability, and observability [45]. These factors, in turn, directly influence how the payment mechanism should be designed and the level of associated transaction costs [1, 44]: e.g., whether the payment can be based on the quantity or quality of the provided ES (if it is measureable, observable, and verifiable), or on the activities promoting ES (if the latter one cannot be measured and/or observed). The former case is the case of outcome-based PES, whereas the latter is the action-based PES. In the majority of cases, payments are related to the specific resource management practices, which are believed to have positive impact on ES provision. This is especially true in forest-related PES schemes, where the time lags between activities and ES outcomes are significant.

The ES characteristics and their spatial distribution within a resource system (e.g., directionality of flow and geographical extent) also determine the feasibility of collective action and the distribution of costs and benefits of the ES [46–48]; therefore putting requirements on the actors who can be involved in the payment scheme. For example, omni-directional global public goods, such as carbon sequestration, require different mechanisms and actor constellations than uni-directional local public goods (e.g., water runoff) or in situ local public goods (e.g., landscape quality) [49]. Geographical proximity facilitates the identification of ecosystem good providers and beneficiaries and the establishment of links between them.

Technologies and infrastructures can also create exclusive intermediaries between service providers and beneficiaries (e.g., water utility infrastructures, hydro-electric dams etc.), facilitating the emergence of PES schemes even when the relationship between land use and ES remain poorly defined (e.g., water provisioning services) [18, 50]. Therefore, the adequate type of PES mechanism depends on the type of the ES and the scale of ES provision/use⁴. In addition, in case of public goods, individual producers do not have inherent incentive to ensure ES quality beyond the regulated level [51], and hence, regulatory backing (e.g., in a form of a cap or a quota) is key for successful operation of any economic instrument, including PES⁵ [52].

Another critical issue is related to the interdependencies between different ecosystem services. Ecosystem services are typically jointly produced in the course of the resource management actions, resulting in trade-offs and synergies among different services. Although incorporating the full range of ES in a PES mechanism might not be desirable because the costs of including additional ES may far outweigh the benefits [53], failing to account for joint production in PES design may lead to undesirable impacts on other ES [1, 44, 51]. While there is scarce reported evidence that PES schemes actually result in unwanted impacts on unaccounted ES, the ecological research suggests that it might indeed present a problem [e.g., 54, 55], especially in case of outcome-based payments.

Bundling and layering⁶ of ES have been suggested as possible solutions to overcome the problems associated with joint production [56]. Bundling refers to merging multiple ES values from a delineated piece of land together for a sale on a single market (or to a single buyer), whereas layering allows different ES values from the same piece of land to be sold at different markets [57]. Some PES schemes combine both approaches, for instance, Costa Rica’s National Forestry Environmental Services Program, through the National Forestry Fund (FONAFIFO) channels government payments to private forest owners and protected areas for carbon sequestration, watershed protection, biodiversity conservation, and scenic beauty services from forests (bundling), and at the same time markets them to different local, national, and international buyers (layering) [9, 44]. In many instances, we also observe cases of “piggy backing” when one ES serves as an umbrella for the provision or conservation of other ES, which are, however, not paid for [57]. A good example of piggy backing is the Working for Water program in South Africa,

⁴ This resembles the “institutional fit” idea proposed by Young [138]; for critique of the concept see e.g., Bromley [139] and Van Hecken et al. [28].

⁵ For example, the famous case of New York City investing in the management of Catskills and Delaware watersheds was driven by the introduction of a stricter drinking water regulation [31].

⁶ For a good overview of the benefits of ES bundling and layering, see Deal et al. [140].

which successfully accommodates habitat maintenance and biodiversity conservation, among other ES, under the umbrella of watershed management payment scheme [58].

Other related PES design questions include the goals and objectives in relation to ES provision (e.g., is the aim to increase the provision of ES, or to maintain the existing provision?), with its implication for scheme additionality (the change in ES provision vis-à-vis business-as-usual scenario), and the need to identify the counterfactual baseline (e.g., without PES scenario) [6•, 7•].

Actors

Actors in PES schemes include ES beneficiaries or users, ES providers, as well as different intermediaries and donors [15, 39, 59]. These actors may be private individuals, as in case of individual forest landowners, communities, or representatives of different organizations (e.g., NGOs, companies, government, scientific bodies), and of civil society.

Ecosystem services are generated both on private, common, and public lands, and the owners, tenants, and/or managers of these lands can be considered as ES providers⁷. Although PES require well-defined property rights over land (in the sense of Ostrom and Schlager [60]), they also function in instances where property rights are less clear [6•, 40].

ES beneficiaries can either be direct users of ecosystem services, or indirect beneficiaries. In the first case, the ES users enter into PES agreements directly as the “ES buyer” party. Typically, this is the case for local ES, for which beneficiaries exist at local scales and can be easily and relatively cheaply identified. For example, one of the most famous cases of PES in Europe is that of a water bottling company Vittel that pays farmers for reconverting to extensive farming practices to maintain good water quality [61]. Comparable, albeit few, cases have also been documented in some developing countries related to watershed management [16, 62] and wildlife conservation [63]. PES schemes in which ES users directly interact with ES providers are typically called “user-financed” PES [7•, 15].

In the second case, collective action problems require the intervention of intermediaries—typically government or civil society organizations, to pull the demand on behalf of the actual beneficiaries. These types of schemes are typically called “government-financed” [15] or “third-party financed” [59]. This is where the majority of existing PES schemes fall into [e.g., 52, 64, 65]. They typically address ES which are pure public goods, and where beneficiaries cannot be

excluded at a reasonable cost [40]. Intermediaries can be the following:

- (a) companies - e.g., in Africa, tourism operators pay local residents not to develop the land (e.g., for cattle farming, charcoal burning, or agricultural cultivation—so as to promote wildlife conservation [66]),
- (b) municipalities - e.g., Pimampiro PES scheme in Ecuador that charges a compulsory water fee from downstream water users and channels the money to upstream landowners for watershed management [67, 68],
- (c) government bodies - e.g., government run PES programs in Costa Rica, Mexico, EU, the USA, China, and Australia⁸; and
- (d) non-governmental organizations or international bodies - e.g., The Regional Integrated Silvopastoral Ecosystem Management Project in Costa Rica, Nicaragua, and Colombia, which is funded by the Global Environmental Fund and implemented by the World Bank [11], or international carbon trading mechanisms such as the Clean Development Mechanism and Reduced Emissions from Deforestation and Degradation mechanism.

The role of intermediaries varies depending on the context, but they may provide information, additional funding, act as brokers, help build trust between the PES parties [8], and reduce the overall costs of a PES initiative [40, 44].

Governance System and Mechanism Design

Successful PES implementation requires a thorough design and a well-functioning governance system. Mechanism design issues—such as what the payments are made for, how the funds are collected, how the funds are distributed, who are the targeted recipients of the funds, as well as the issues related to contract length, payment type, frequency, and timing are crucial for the success of the schemes. The governance system, in turn, is vital for establishing the rules for transactions, control and monitoring of activities, and contract enforcement. I briefly discuss some of these issues below.

Payment Objective

As discussed in “Resource system and ecosystem services” section, the payments can be linked either to the actual ecosystem service delivery (outcome-based payments), or to the management actions intended to lead to such service delivery (action-based payments) [6•, 69, 70]. In the former case, payments are tied to the measured quantities of generated ES, e.g., tons of carbon sequestered, or grams of water pollutants

⁷ The issue of whether public lands can be eligible for PES is a debatable question, as in many instances the state has the legal responsibility to ensure the provision of critical public goods and ES and should manage public land in accordance with this responsibility. For more information, see e.g., Tacconi [137].

⁸ See e.g., Schomers and Matzdorf [11] for a review.

reduced [15]. In the latter case, payments are granted per hectare of land, per unit of cost (e.g., per working hour), or as a percentage share of incurred costs [43].

Outcome-based PES schemes are preferable from the efficiency point of view, provided resulting ES provision can be verified at a reasonable cost based on reliable indicators, because they induce land managers to utilize their knowledge of the local situation to produce the outcome at the lowest cost or target the most appropriate land areas for the generation of desired ES on their property⁹ [69, 71]. At the same time, outcome-based schemes are riskier for landowners than action-based schemes, because the quantity and quality of generated ES is determined by a wide range of factors—e.g., changes in the natural environment, market price dynamics, political turmoils, etc.—not all of which are under control of the landowner/manager [71–74].

Often, however, monitoring complexity and the long-term nature of impacts, along with the ES characteristics discussed in “Resource system and ecosystem services” section, preclude the possibility of implementing outcome-based schemes, and in practice, action-based schemes are much more frequent. These, in turn, are considered to be less effective, as the link between management actions and ES delivery is often weak and not always based on sound scientific knowledge [6•]. The more straightforward is the relationship between management practices and ES outcomes (either in terms of quantity or quality)—e.g., afforestation schemes for carbon sequestration—the easier it is to sustain a functioning PES scheme. Yet, existing uncertainties over the exact scientific relationship between forestry activities and ES provision do not always constitute insurmountable obstacles for PES emergence, as examples of PES in watershed management and biodiversity conservation suggest [9].

In terms of remunerated activities, PES schemes are differentiated in activity-capping schemes and activity-enhancing schemes [6•]. In the former ones, landowners are paid to conserve the resource, and the payments are typically based on the opportunity costs of conservation plus occasionally costs of active protection. Examples of such schemes include e.g., mature forest reserves scheme in Catalonia [43], or METSO-scheme for biodiversity protection in Finland [75]. In the latter type of PES, payments target improved active resource management, which in turn would lead to enhanced ES provision. For example, afforestation schemes in Denmark follow this logic [76].

An aspect worth mentioning in this respect is the additionality of PES, that is, whether a payment initiative leads to outcomes that go beyond the business-as-usual baseline or not. Additionality assessment requires an establishment

of a counterfactual baseline—that is, an estimation of the expected ES provision in the absence of any PES mechanism. In practice, it is not an easy task, as predicting the evolution of ES provision on non-participating forestland is difficult, and past trajectories need not be indicative of the future ES provision in the absence of payments [77]. Additionality assessments typically entail an establishment of a control site and the use of statistical matching techniques [6•, 77]. In PES schemes involving reforestation or avoiding deforestation measures, for example, forest cover evolution in areas enrolled in PES schemes is compared to that in not enrolled areas [68, 78–81]. In practice, however, additionality of PES schemes is rarely assessed [82], and even in cases when such assessments have been done, they frequently demonstrate that little if any environmental and behavioral additionality have been achieved¹⁰ [e.g., 83, 84]. Moreover, notable differences exist in the bottom line additionality of schemes, attributable partially to the variability of assessment methods used [82].

A recent meta-study of 55 PES schemes worldwide found that additionality is positively influenced by three PES design features: spatial targeting, payment differentiation, and strong conditionality [82]. Tighter program eligibility rules, requirements to undertake a suite of practices rather than a single practice, and use of cost-benefit indices to rank applications for acceptance have also been suggested to improve additionality [77].

The concept of ecological additionality is closely linked to the issue of leakage, permanence, and perverse incentives, which are discussed in “Behavioral implications” section.

Payment Mechanism, Targeting, and Differentiation

Payment mechanism includes different aspects related to the source of funds for PES initiatives, payment modality and frequency, payment amount, and eligibility. In practice, different configurations of payment mechanisms can be found. First of all, funding for PES initiatives can come both from public and private sources, as well as from international donors. Private funding typically comes from NGOs, foundations, charities, private individuals, or as private investment by companies. Public funding typically comes either from general budget, or from earmarked taxes and charges. According to recent estimates, as much as 90 % of all PES schemes receive money from public sources, and this percentage rises to 99 % in case of PES schemes oriented at public goods [52].

Second, payments can be distributed either in cash or in-kind [85], and payments of both types are observed in reality [11, 43, 59]. The role of in-kind contributions, such as for

⁹ In the EU, for example, payment by result approach within the European agri-environmental schemes has been successfully tested and documented [e.g., 141, 142].

¹⁰ Additionality assessments of USA agricultural conservation programs indicate that additionality varies greatly depending on the contracted agricultural practices. Evidence shows that depending on the practice, from 19 to 93 % of farmers receiving payments would have not implemented contracted practices without the payment [77, 143].

example, technical assistance or infrastructure improvement can be especially beneficial in cases where monetary incentives are not well-perceived in the community.

Third, payments can be distributed up-front, on a periodic basis (e.g., monthly/annually), at the end of the period, or in any combination of these. Up-front payments are usually desirable when PES activities involve setup investments, whereas output-based payments are frequently paid after ES delivery [86]. In some government-financed schemes, up-front payments are the only possibility due to the annual budgetary allocations [43].

Fourth, payment amounts can be either uniform for all eligible participants, or can be differentiated (spatial differentiation, cost-benefit differentiation, see Schomers and Matzdorf [11]). Differentiated payments tend to be more efficient, but also are costlier to administer [40]. An important aspect in this respect is that of targeting—who are the potential providers that are eligible to receive PES funds. PES schemes can target specific types of providers, or specific areas—e.g., those with the highest potential to generate ES, with the lowest implementation costs, or with the highest threat to the ecosystem [59]. Targeting usually helps improve efficiency and effectiveness, but also results in higher transaction costs, as well as raises issues of perverse incentives [87], fairness, and equity [43].

Finally, the money raised needs to cover both the PES payments per se, but also the implementation and transaction costs [6•, 40]. In theory, PES payments need to cover at least the providers' additional costs associated with enhanced ES provision and should not exceed the ES beneficiaries' willingness to pay (WTP) for the enhanced ES [7•, 36]. In practice, however, payment amounts are either fixed (e.g., stipulated in government programs) or are negotiated bilaterally between ES beneficiaries and providers. Estimation of WTP and provision costs is, thus, not a necessary pre-condition for PES implementation [6•], although it is desirable especially when decisions about buying the ES are made not by direct beneficiaries (as in the case of e.g., biodiversity conservation) but by their representatives (e.g., NGOs, government authority), who might have a different WTP [88].

Contractual Specificities

PES contracts can be materialized both as formal and informal agreements, can involve individual beneficiaries or groups (e.g., communities or associations of land owners), and can be negotiated on a case-by-case basis, be based on market transactions or be a result of project-based negotiations. Contract duration is typically a key issue especially for landowners, given the long time frame and the uncertainties related to natural resource management [69]. Longer contracts might provide better security to involved agents and may lead to better environmental outcomes than shorter contracts

[89]—an observation supported also by empirical findings [59]; however, they may also be perceived as too restrictive [90] and may attract fewer landowners than shorter ones [89]. Having an option to cancel the contract has also been found to decrease farmers' required compensation level, while monitoring increased it [91].

In certain cases (e.g., biodiversity conservation), PES schemes may benefit from spatially coordinated incentives. In such cases, uniform payments for land-use changes are complemented with bonuses when neighboring landowners have similar land uses or have connections between patches which contain biodiversity-friendly habitat [69]. The Conservation Reserve Enhancement Program in the USA and subsidies with network bonuses in Switzerland are examples of such spatially coordinated incentives [69].

Ongoing Debates and Research Agenda

The academic literature on PES has been evolving rapidly in the past decade, and the research focus has been shifting from the operationalization of the original concept, broad theoretical assessments of its implementation [e.g., 7•, 40, 85, 92], biophysical compatibility between ecosystem services and PES mechanisms [44, 50, 93], towards issues related to the overall legitimacy of the approach, behavioral implications, and power structures underlying PES implementation. In this section, I pinpoint some of the major debates that have been attracting attention over the past years.

Commodification, Legitimacy, and Market-Based Instruments

In his original definition, Wunder [6•] conceptualized PES as a possible solution to the externality problem based on a bargaining approach between two parties. Proponents of this approach view “true PES” as a means to put Coase theorem into practice [7•] and emphasize the advantages of PES over traditional command and control mechanism—such as cost effectiveness, flexibility, and greater respect for freedom [e.g., 30, 94, 95]. The extensive use of market rhetoric among the scholars, who talk about buying and selling ecosystem services [6•, 7•, 96], led to the general misconception that PES are inherently market-based instruments (MBI), and as such rely on the competitive market forces for their functionality [97, 98].

The consideration of PES as a market-based instrument led to two noteworthy developments: an intense academic debate on whether or not PES actually fall into the category of market-based instruments, and the emergence of a critical body of literature rejecting the whole concept of PES based on the market rhetoric. The former debate has culminated in the paper of Muradian et al. [99], co-authored by 33 prominent

scientists, who raised a word of caution against the overreliance on PES as a mechanism for environmental governance, stating that “not all payments are markets” and questioning the alleged win-win outcomes (pro-environment, pro-poor), frequently attributed to market-based mechanisms and PES schemes. If one analyses, however, the original definition of PES, and the earlier examples of schemes that the proponents consider “true PES” or PES-like schemes (e.g., Costa Rica PES scheme, Vittel case, New York City case), one would hardly find any real market forces at play or any hint at targeting win-win outcomes. User-financed schemes tend to function based on bilateral bargaining between the ES beneficiaries and ES providers (e.g., such as in Vittel and New York City cases), whereas government-financed schemes can hardly be claimed to allocate public funds using market-based mechanisms¹¹ [8]. The alleged win-win focus does not hold either conceptualized as a direct approach to conservation, PES primarily targets environmental outcomes, and any poverty alleviation concerns are viewed mainly as beneficial side effects [8, 100]. Therefore, the consideration of PES as market-based instruments is merely a misconception, which neither the proponents nor the critics of PES actually support.

Another prominent trend in the academic literature on PES is to depart from the market-based rhetoric attributed to the original PES definition and totally reject the concept and its applicability to solve environmental problems [101]. These scholars view PES as instruments of “neoliberal conservation” or “green neoliberalism” [102–105] and reject the whole idea of commodification of nature [39]. The main arguments of the proponents of this critical approach to PES can be summarized in three points: (a) markets are not legitimate tools to solve environmental problems that are caused by the failures of these very markets [e.g., 106]; (b) the utilitarian conceptualization of ecosystem services disguises the true ecosystem complexity, ignores the existence value of nature [e.g., 39, 107], and erodes the intrinsic motivation to conserve nature [e.g., 108]; and (c) PES mechanisms conceal underlying power inequalities and may lead to unequal social consequences [e.g., 39, 40, 105, 109], for example, by resulting in unequal access to land and resources by privileging those with ability to pay [16].

While the legitimacy issue is outside the scope of this paper, I will briefly dive into the latter two issues in the following sections.

Behavioral Implications

Concerns about the behavioral implications of PES have been voiced for as long as the concept existed. In fact, many of these concerns can be extended to a whole variety of

instruments relying on economic incentives, among which we encounter both MBIs and PES mechanisms [40, 99, 110]. According to economic theory, an increase in the economic incentives provided for an activity will enhance performance [7••]. However, economic incentives are only one of a variety of motivational factors driving environmental conservation behavior [41••]. Findings from behavioral and experimental literature demonstrate that the interaction between economic incentives and intrinsic motivation is complex, and both crowding out and crowding in outcomes may occur in practice [111, 112], depending on the extent a society relies on economic incentives [11, 108], and other situation-dependent variables [108].

Payments for ecosystem services—as a positive incentive—are expected to work especially for activities for which there is little or no pre-existing motivation or ethical obligation [113], but there is also evidence that explicit economic incentives can have limited or counterproductive effects [108]. Evidence shows that in some cases merely the presence of incentives may have unintended consequences [114, 115]; in some other cases, it is their extent or type (cash vs. in-kind) that triggers the unwanted reaction [111]. On the other hand, PES can strengthen social cohesion and improve collective action [43, 59], therefore resulting in crowding in effects. The empirical evidence of the impact of PES on intrinsic motivation, however, is still rather limited and inconclusive [8], which represents a prominent avenue for future research.

Closely related behavioral issues include the impacts of PES schemes on leakage of undesirable activities to other areas [1, 7••], permanence of activities after the program financing ends, as well as the possibility of perverse incentives [43]. For example, a carbon PES scheme that finances reforestation in a certain area might increase deforestation pressure in an adjacent area (leakage) and might not guarantee that the trees would not be cut after the program is over (permanence) [6••]. Landholders may also intentionally damage ES in order to qualify for PES schemes (perverse incentives) [9]. However, researchers suggest that these difficulties can be overcome with an appropriate scheme design, external insurance, and third-party certification [9].

Power, Social Capital, and Social Implications of PES

One of the biggest debates in PES literature concerns the equity-efficiency tradeoff. The proponents of PES advocate that PES should primarily target efficiency in resource allocation, rather than poverty alleviation [7••, 36]. For example, targeting payments to specific groups of ES providers may improve efficiency but is not necessarily equitable. The critics of PES, however, consider that equity-efficiency interdependence is “a key feature of PES schemes” [116] and argue that the equity-efficiency relationship within PES schemes is determined by the institutional setup [116]. Current research

¹¹ With a few notable exception of procurement auctions examples in Australia and in the USA.

within this domain focuses on disentangling the role of socio-institutional context for equity-efficiency considerations by considering power relationships among PES actors [e.g., 116–122]. PES schemes, as any other social interactions, emerge within a wider context of social and political dynamics [123], and therefore, “the shape of policies on the ground can differ significantly from the shape they should take based on theoretical considerations” [124]. Asymmetric power relationships among PES actors can explain why poor people accept lower payments [109], or why they may be forced to sign contracts that wealthier people could avoid [52]. PES programs can reinforce existing conflicts over access and control of forest resources [16], especially when holding little land precludes or limits PES participation [40]. On the other hand, some of these problems can be overcome by building trust among PES actors and improving participation requirements [16].

In other cases, PES can create scope for negotiating existing practices resulting from the established power relations [26, 125–127] and can induce changes in landowners’ perceptions, norms, and values about “good,” “accepted,” and “desirable” practices to nature conservation [28]. The fact that interactions among agents, including the levels of trust and community organization influence the outcomes of the schemes [43], recently spurred research on the role of social capital in PES [43, 128–133]. However, more research is still needed on the ways in which socio-institutional dynamics influences PES design and implementation.

Conclusions and Avenues for Further Research

As the review of literature indicates, PES is in fact a complex and frequently misused term. The theoretical definition of PES is different from what is observed on the ground. Only a handful of PES experiences in practice conform to the “true PES” definition of Wunder [6•], and most existing initiatives at best can be qualified as PES-like schemes. Alternative and more encompassing definitions have been proposed, but the debate is still there on whether or not the definition of PES should be idealistic or empiricist. The fact that some real-life examples of PES mechanisms are labeled PES as a way to improve the access to funding and attract attention of donors, practitioners, and policymakers [25•] does not help in the definitional debate either.

However, far more important than the issue of what can or cannot be termed PES is the actual design of schemes in practice. Since PES are implemented within existing institutions of natural resource management, it is imperative to explore how the diverse configurations of institutional interplay and actor interactions shape the design and performance of PES mechanisms. Ostrom’s socio-ecological systems framework [134, 135], recently adapted and elaborated for PES [29•] and PES

assessments [43], can serve as a comprehensive framework for a thorough evaluation of practical examples of PES and PES-like mechanisms. There is a rich avenue for future research in this direction, especially considering the institutional issues, such as local adaptation, power structures, trust, and social capital.

Another prominent avenue for future research concerns environmental effectiveness and economic efficiency assessment of existing PES schemes. Only a handful of schemes are thoroughly analyzed, and issues such as additionality (requiring the establishment of counterfactual baselines and measuring ES provision), leakage, and behavioral impacts (e.g., permanence, crowding out/in, perverse incentives) are very seldom considered in PES assessments. The lack of empirical studies undermines the possible advances of PES implementation in practice, as many of the theoretical concerns remain in the realm of untested hypothesis. Understanding how PES mechanisms work in theory and in practice, and knowing their limitations, is crucial for exploiting their full potential as a policy tool for solving complex environmental problems we are confronted with.

Compliance With Ethical Standards

Conflict of Interest Dr Prokofieva has no conflicts of interests to declare.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by the author.

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