

Payment for ecosystem services and its applications in India

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Ecosystem services are the processes of nature that directly or indirectly benefit human beings. These services need to be conserved through incentive-based market approaches for a sustainable future. Payment for ecosystem services (PES) is one approach that aims to manage natural resources and ecosystem stewardship, wherein the users recompense the conservators of the ecosystem services. While PES has numerous benefits in enhancing the awareness of linkages between human well-being (e.g. poverty alleviation) and ecosystem services, it is constrained by major challenges, especially in developing countries like India. This article reviews the significant issues and challenges of environmental marketing in India and suggests measures to promote PES.

Keywords: Environment, livelihood security, market, payment for ecosystem services, sustainable future.

THE world is experiencing a rapid decline in biological diversity. Almost a quarter of the total plant and animal species is on the verge of extinction. This in turn is undermining the productivity, resilience and adaptability of nature, thereby putting our economies, livelihoods and well-being at risk. Nevertheless, there is still immense potential in the global biodiversity. It is time to rebalance the demand for nature's goods and services with its capacity to supply them for a sustainable path of production and consumption¹. The Millennium Ecosystem Assessment (MEA) and The Economics of Ecosystems and Biodiversity (TEEB) suggest the use of market-based instruments for internalizing externalities associated with the use of nature's goods and services²⁻⁵. Payment for ecosystem services (PES) has thus gained attention to provide incentives for the improvement of ecological services, thereby promoting ecological sustainability and livelihood security⁶.

Since the publication of the Millennium Assessment Report-2005 (MA Report) by the United Nations, the concept of PES has been widely recognized as a remunerative tool for farmers and local people for the creation of positive externality through the conservation of nature and provi-

sion for a sustainable future. The debate on ecosystem services was kicked-off two decades ago with the two popular studies by Daily⁷ and Costanza *et al.*⁸ respectively. The concept of PES is useful for achieving overall sustainability. Even though PES has evolved over three decades, it is still nascent in many countries, particularly developing and underdeveloped nations. Here we conduct a systematic review on the evolution of PES and examine the status of implementation of PES programmes in India. We also put forth a few suggestions for the promotion of PES projects in developing countries.

History of ecosystem services

The concept of the environment benefitting human society can be traced to several millennia. The current concept of this interaction has emerged as environmental services⁹. The term 'nature's service' was first identified in a study by Westman¹⁰ in 1977. However, Ehrlich and Ehrlich¹¹ and later Ehrlich and Mooney¹² described the term 'ecosystem services' more elaborately. The concept gained momentum from 1997 onwards^{7,8,13,14}. This idea, originally used as a metaphor¹⁵, has now become the basis for an increasingly vast literature that seeks to assess, measure and value the dependence of humans and society on nature. It is considered to have triggered shifts in policy as well. Often policy-makers seek valuations and economic assessments as to how the loss in biodiversity has had a direct relationship with the loss in welfare (such as the TEEB study commissioned by the European Union¹⁶). Thus, 90 governments joined hands to establish an intergovernmental Platform on Biodiversity and Ecosystem Services¹⁷. Concurrently, a number of (PES) programmes have been launched, spanning watershed services, biodiversity conservation, carbon sequestration and other ecological services.

Concepts and definitions

Theoretical perspectives of PES

Environmental economics, ecological economics and the rejection of ecosystem services are the three main perspectives

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concerning PES. Environmental economists consider PES as a voluntary transaction between the buyer and the seller of the ecosystem service based on the condition of conserving that particular service or land used. It derives from the Coase property rights (economic negotiations to settle disputes over property). On the other hand, ecological economists describe PES under three schematic components. The first component describes the importance of giving economic incentives in terms of the relative weight they carry in accordance with the non-economic incentives like social, moral, etc. The second component deals with the directness of environmental marketing between the buyer and the seller. It proposes that a direct programme will not have intermediaries in the marketing channel, and the functionaries would include only one buyer and one seller. Compared to the first and second components, the third component is relatively more important as it describes PES in terms of the degree of commodification. It addresses the question of to what extent the ecosystem service can be either assessed or measured, such as the number of tonnes of carbon sequestered. Nevertheless, the major challenge comes from those who reject the valuation of environmental service, arguing that conservation should be done for nature's very purpose and that it is next to impossible to quantify or commodify nature as its value tends to infinity; thus commodification of the natural capital may lead to underestimation of its true value. They consider that PES may decrease in utility because the wealth becomes concentrated in a way that the scarcity of the natural resources results in higher short-term value for unsustainable extraction of those resources, and also the long-term cost to cover replacement services is externalized onto the citizens.

Ecosystem services and human dependency

Since time immemorial, human societies have depended on nature and its resources for various benefits. Humans have also realized and understood this dependency since long time. For example, the Greek philosopher Plato recognized that deforestation was the major cause of soil erosion and reduced water flow in the Greek regions of Attica¹⁸. However, according to the MA Report¹⁹, the concept of ecosystem services threw light on human–nature interdependence and thus paved the way to understanding the global ecosystems and their ability to aid human well-being.

Ecosystem services cover diverse benefits that support and fulfil human lives^{7,19}. According to the MA Report¹⁹, ecosystem services are divided into four categories, viz. provisioning (food, water, wood), regulating (climate regulation), cultural (aesthetic, spiritual and recreational) and supporting (nutrient cycling and soil formation), services. The Report recognizes that human activities are depleting the natural capital and ecosystem services globally¹⁹. The extent of depletion is creating a potential strain on the Earth's ability to cater to the basic needs of the present

and future human generations. It was found that about 62% (15 out of 24) of the ecosystem services examined globally were used unsustainably between the period 1950 and 2000 (ref. 19). However, interestingly, it was found that provisioning services represented the major portion where enhancements in the services were realized over time, followed by the regulatory services. Since supporting services were not directly used by humans, they were not included in the analysis as opposed to provisioning, regulatory and cultural services. This trade-off between enhanced and degraded ecosystem services motivates an important societal challenge, i.e. human societies at both local and global levels are troubled with a dilemma between catering to immediate needs (like food, water, etc.) while also supporting the services for long-term sustainable needs (like regulating services)¹⁹. According to the MA Report¹⁹, addressing the above issue and reverting the damaged ecosystems back to normal is possible over the next 50 years, still it requires substantial policy support and the adoption of sustainable practices. Ecosystem service approaches are becoming pivotal in the conservation practices in different countries following the framework laid down by the MA Report¹⁹. With this novel approach also come new methods and practices that partially or fully provide alternatives to the ongoing conservation strategies. According to Goldman *et al.*²⁰, 'where traditional approaches focus on setting land aside by purchasing property rights, ecosystem service approaches aim to engage a much wider range of places, people, policies and financial resources in conservation'. Among the new strategies, the most prominent tool/technique is PES, which has been reviewed in this article.

Ecosystem services – concepts and definitions

The outputs, conditions, or processes of natural systems that directly or indirectly benefit humans or enhance social welfare are termed as 'ecosystem services'. They render several benefits to people either directly or as inputs into the production of other goods and services. According to Costanza *et al.*⁸, 'ecosystem services are the ecological characteristics, functions or processes that directly or indirectly contribute to the human well-being: that is, the benefits that people derive from the functioning of the ecosystems'. However, it is also important to note the concept of ecosystem dis-services. Ecosystem dis-services are the processes and functions of the environment that affect humans in a negative manner^{21,22}. The anthropocentric and utilitarian view argues that nature has its existence only to serve human beings^{23,24}. However, this view seems biased as nature and humans are interconnected and interdependent systems. Thus, ecosystem services provide a wholesome approach towards nature, human beings and other living organisms in the environment at large. They are broadly divided into four main categories, as mentioned earlier (Table 1; ref. 25).

Table 1. Categorization and functions of various ecosystem services

Provisioning services	Regulatory services	Cultural services	Supporting services
Food production (crops, vegetables, fruits, fish, etc.)	Regulation of climate and gases	Recreation (eco-tourism, sport, fishing, and other outdoor recreational activities)	Formation of soil
Raw materials (lumber, fuel and fodder)	Ecosystem disturbances regulation, pollination and biological control	Cultural/eco-tourism (aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems)	Nutrient cycling
	Water regulation and supply		Refugia
	Control of soil erosion and sediment retention		Genetic resources
	Waste treatment		

Source: Dhruva Bijaya *et al.*²⁵ and authors' compilation.

Payment for ecosystem services

PES is a market-based conservation tool in which the beneficiaries compensate the providers who protect, enhance or restore the ecosystem services^{26,27}. PES has been one of the most promising innovations in the conservation strategy of biodiversity since the Rio Meet in 1992. It has evolved to be one of the potential approaches to address economic externalities of commodity production and optimum resource extraction, improving socially, ecologically and economically desirable outcomes. The basic idea behind PES is to pay landowners to protect their land to ensure the provision of some 'services' provided by nature, such as water, habitat, climate regulation or carbon storage²⁸. The important and attractive aspect of PES is that it not only promotes investment in the conservation of the environment but also rewards people for the same. This indicates that PES has the potential to alleviate poverty and reduce conflicts between conservationists and local communities. It derives its roots from conservation programmes in the past, like the integrated conservation and development programmes (ICDPs). The definition of PES is market-based, one that describes that the beneficiaries (directly or indirectly) pay the providers of the services. PES schemes require the involvement of the beneficiaries and providers of the service (buyers and sellers) and the intermediaries acting as a link between both. However, the scale and implementation of the programmes depend mainly on the location, political and administrative will of the governments and financing agencies.

PES is basically a market-based approach for achieving environmental outcomes by internalizing the economic externalities²⁹. Carbon sequestration, water-related services, forest and biodiversity are some areas where PES schemes are primarily being used around the globe³⁰. Over 280 PES-type schemes were found to be under development (or operational) in the early 2000s (ref. 31), and a good number of advancements have been made thereafter as well. The ecosystem marketplace is an internet-based information portal for PES that compiles all the information on PES programmes worldwide. It identifies the market values for ES that indicate the scale of markets for the services partially.

For biodiversity, 39 existing programmes and 25 programmes in various stages of development were analysed (with a prime focus on North America), all amounting to a minimum annual market size of US\$ 1.8–2.9 billion³². In case of carbon markets, a minimum of US\$ 149.2 million has been transacted to date for forest carbon credits³³. For watersheds, out of 216 identified PES programmes, only 113 were functional with active transactions with a market value of US\$ 9.2 billion³⁴. In 2008, about 289 million hectares (Mha) area was protected by PES programmes (270 Mha in China, 16.4 Mha in USA, 2.3 Mha in Latin America and less than 0.2 Mha in Asia, Africa and Europe)³⁴. It is expected that in future, substantial growth will be seen across carbon, water and biodiversity PES programmes. From the pioneering national programme in Costa Rica in 1997, PES has been tested at different locations globally, including the water funds across Latin America³⁴, steep-slope land conversion in China³⁵ and watershed health in USA³⁴. However, with the growing importance of PES, debates about the potential benefits and challenges of such market-based approaches for sustainable development have come to the forefront and need to be assessed.

Benefits of PES

PES projects have extended multiple benefits for ecosystem stewardship and communities. PES has the potential to impact the landowners' perceptions towards the protection of the environment and enhance awareness about the interlinkages between ecosystem services and the well-being of humans thereof. Ecosystem services are often considered as externalities by the landowners that give them little incentives to produce or conserve these services^{20,36}. As a result, assessing the monetary value of such services can demonstrate the value of conserving them to the participants^{26,36}. PES schemes that provide incentives for implementing better extraction and land-use patterns along with improving the ecosystem services may serve as suitable livelihood-generating projects for those who depend on subsistence farming for their livelihood³⁷. Key on-site benefits of PES schemes like water saving, enhanced soil fertility,

shade and reduction in chemicals may often be initially missed by the beneficiaries but can be quickly realized once the programme is implemented³⁸. Studies provide evidence that PES projects can both protect as well as restore ecosystem services when compared to other human-made technological approaches^{39–41}, thereby resulting in equal or greater net benefits because of the opportunity of PES to protect the environmental services (co-benefits)^{20,42,43}. They are also seen to have facilitated better communication among the stakeholders by alleviating upstream and downstream stakeholder tensions, thereby acting as a conflict resolution tool along with law enforcement, increased awareness of landowners and community self-policing resulting in greater community self-empowerment^{36,44}. Knowledge about environmental awareness is key to ensuring the success and long-term sustainability of PES programmes. Therefore, empowering the local farmers and rural masses with education and monetary incentives helps refine and enhance their practices in favour of the environment, leading to sustainable investment in the community to achieve self-sufficiency.

Challenges in addressing PES

PES schemes have numerous benefits to society. Nevertheless, the challenges associated with PES need to be addressed so that it can continue as an effective conservation and policy tool. The examination of existing programmes points towards potential inefficiencies, such as lack of additionality, leakage and incorrect payments^{26,41}. Lack of additionality is paying those beneficiaries who are already conserving the ecosystem services for other reasons like financial, legal, etc.^{26,41,45}. Spillover or leakage occurs when ecosystems are damaged due to activities outside the PES-targeted regions for reasons like market pressure or increased land demand^{26,41,46}. However, leakages may also offset positive outcomes from the environment that have been achieved within the area of the PES project. Incorrect payments may occur in two ways – first, insufficient payment to the landowners that may make them continue the old and poor land-use practices, and secondly, high payments that can result in inflated payment prices for the existing services²⁶. Engel *et al.*²⁶ also raised an additional concern about the lack of permanence of the PES projects. That is, the benefits of PES projects will be realized for a particular period of time that varies from project to project (but commonly ranges for about 10–20 years, 50–100 years, etc.). External factors such as market or agricultural demands that influence the land-use or land-management practices by the farmers might also affect the permanence by creating negative externalities on the ecosystem services. Lack of long-term and secure funding sources for a PES programme can also threaten its permanence. Sometimes the landowners may incur an initial income loss while altering their production practices to meet the goals of the PES pro-

jects^{36,47}. This situation may arise due to the high cost of changes in vegetation or planting new trees, or the need for crop diversification. This is an important concern for the poor as they face potential financial challenges in covering upfront costs to participate in and benefit from a PES programme.

An Ecosystem Marketplace report in 2009 pointed out that the majority of the PES schemes though similar, do not fulfill the actual definition of PES in reality. Failure to generate buyers and avoiding the PES provision of conditionality are the two major areas where projects like PES fail to follow through⁴⁸. Funding has also been a debatable topic for PES schemes as many have failed to look beyond external donors and often do not locate the potential long-term funding for beneficiaries of the ecosystem services. Even though there are a multitude of lessons to be learnt from the existing theoretical and practical applications of PES schemes, it is important to note that project design and implementation with appropriate research and proper engagement of stakeholders could enhance the potential to deliver environmental and social benefits, and minimize the problems therein.

Implementation of PES around the globe

The first PES programme implemented on a national scale was in 1997 in Costa Rica named ‘Pagos por servicios ambientales’ (PSA), funded by the World Bank and Global Environment Facility (GEF). It was named as ‘ecomarkets’. In 2003, a programme was started by a local NGO in Los Negros, Bolivia, for combined payment for watershed and biodiversity. The farmers in Jamestown, Rhode Island, USA, had the practice of harvesting hay in their fields twice annually, which destroyed the habitats of many local birds. To save the birds, economists at the University of Rhode Island and EcoAssets Market Inc raised money from the residents worth USD 5–200 per person. Similarly, Salt Lake City, USA, managed majority of its watersheds through regulatory mechanisms by defining allowable uses and land easement purchases. Another such project was started by the local Council for Administration of Water and Sewage Disposal, Honduras, for the benefit of coffee producers who lived upstream and local people who lived downstream, thereby charging around USD 0.06 per household per month for the upstream farmers. A programme was started for the shade-grown coffee plantations in Chiapas, Mexico, to create a market for its positive externalities. In this programme, the farmers agreed to continue responsible farming and reforestation practices by getting payments for the carbon offsets. The first PES intervention was started for a randomized control trial to determine its impact on deforestation in Hoima and Kibaale, Uganda. In the concerned villages, owners of the forested land were paid USD 28 per annum for two consecutive years for every hectare of land that was not disturbed, with the provision

of additional payment for new plantations. This amounted to 5% of the annual income of the participating land owners.

Role of PES in livelihood improvement in developing countries

PES and sustainable development are closely related. PES is potentially crucial in developing countries as it addresses environmental as well as social concerns, particularly relating to rural livelihoods, thus playing an important role in sustainable development. Apart from ecosystem management, PES schemes are also directed at improving the livelihoods of economically backward communities³⁷. Though the concept of PES is clear and direct, the impacts of such projects on the environmental goals achieved by them may vary along with providing either positive social results or ensuring that no negative social impacts affect the people⁴⁹.

Tropical forests are essential providers of ecosystem services, a large portion of which is in developing countries. Moreover, these countries comprise most of the world's poor population, making them the perfect setting to employ poverty and reduction measures for ecosystem degradation, such as PES³⁵. Pattanayak *et al.*⁴¹ reviewed the literature on PES to ascertain 'whether or not poverty alleviation is an explicit side objective, the poverty impacts of PES are clearly relevant in developing nations through conceptual models suggest PES can alleviate poverty under some conditions^{49,50}, the quantitative, empirical basis for attributing changes in poverty to PES remains limited⁷.

The potential implications of the PES schemes on the poor vary from case to case. Based on the criteria of eligibility (correct location), disposability (payments received greater than the cost incurred) and ability (property rights), it has been identified that the poor population could be the best to participate in the PES programmes⁴⁹. Also, the impact of PES on the poor depends on farm size, diversity of financial sources and other factors like price fluctuation of food and land, as PES schemes may reduce the land availability for agricultural production^{41,51}. It was also found that poor landowners are often reluctant to shift to new land-use practices if the payment is not considerably high⁵². PES schemes can significantly contribute to reducing poverty provided the project participants are paid reasonably high prices than they would naturally earn from their land or from the conservation of ecosystem services⁵². However, this also questions on the incorrect payments and possible trade-offs between poverty alleviation and the efficacy of PES projects. Social equity is another potential concern of PES schemes in developing countries. Majority of the ecosystem services originate from the natural landscapes and rural areas, where the masses are closely related and directly dependent on the natural ecosystems^{37,53}. The PES schemes must safeguard the participation of the beneficiaries and

farmers dependent on subsistence agriculture and small land-holdings. It is evident that appropriate policies and programmes are designed according to the political, social and geographical context of every situation⁵². Thus, it is necessary that the potential trade-offs in the decision-making of such projects need to be analysed carefully based on contextual studies.

Discussion

PES focuses on incentivizing the conservators of ecosystem services. The payment is to be made by the direct or indirect beneficiaries to the providers of the services. For PES to work properly, the buyer of the service must be identified, and the market conditions must be analysed, after which the seller of the service has to be legally recognized. For the PES market to be feasible, the financial structure must be sufficient as well as sustainable. It must benefit both the supplier and the buyer. However, there are many risks and challenges associated with this. The market forces have failed to adequately capture the environmental services⁵⁴. Most of the environmental services come under public goods and are thus characterized by non-excludability and indivisibility in consumption, thereby making it difficult for them to function efficiently. Thus, for the markets to function efficiently, property rights need to be efficiently defined.

In India, the concept of PES is relatively new. However, with increasing insights about the conservation of biodiversity and sustainability, the Indian states are becoming more concerned about the environmental markets. Currently, the focus is on the Himalayan biodiversity, and about 10 Himalayan States in India have voiced a unique demand for payment for clean water that flows down from the hills to the plains and for the forests that remain standing in the Himalayan valley.

Not only the Himalayan valley but also with the increasing degradation of natural resources and rising demand for ecosystem services in India, its high time to adopt market-best approaches like PES to protect and conserve the environment. With the vast array of natural resources and diverse ecological conditions, India has a huge potential to adopt schemes like PES for biodiversity conservation and social security through livelihood promotion programmes. India is an agrarian economy. However, with the bulging buffer stocks of food hides, India has been witnessing an increasing trend of farmer suicides in almost all states. The income of farmers has been dwindling, and the debt is increasing⁵⁵. The agrarian crisis is mushrooming, and it has been in the limelight due to the numerous protests by farmers from various states across India⁵⁶. To mitigate this, the Government of India proposed doubling the farmers' income by 2022. In this context, one must understand the market as well as the non-market benefits from healthy agro-ecosystems to support the farmers⁵⁷. Farmers have always

been paid the value for marketable agricultural goods. However, many non-market uses of agro-ecosystems have been generated from various agricultural practices that remain invariably unrecognized and unassessed. Kumar *et al.*⁵⁷ generated the values for agro-ecosystem services in the Indian context from the estimates of Van der Ploeg *et al.*⁵⁸ and the TEEB database. They observed that as an institutional framework for PES already exists, it could be used to persuade the farmers to take up sustainable agriculture that could benefit the ecosystem. Compared to the MSP approach for improving farm income, the PES strategy is better in terms of its long-term effects of sustaining agriculture, increasing the natural capital and fighting the ecological crisis due to various agricultural practices. This approach was also previously put forward by Indira Devi *et al.*⁵⁹ who proposed that paying for the ecosystem services in agriculture could provide a novel way to reduce the gaps between the rural and urban areas, thereby decreasing the migration of rural youth to the cities and also ensuring the goal of doubling the farm income. According to them, PES is one of the strategies to incentivize sustainable agricultural practices in India, and it could make agriculture a more profitable and attractive sector as the farmers would be paid for those services that have no direct market mechanism but are, however, reaping benefits to the entire society⁵⁹.

However, the factors that are essential for successfully implementing the PES strategy are not easily available in the Indian context. The most crucial challenge is the ill-defined property rights in the country. Another important aspect is that most of the ecosystem management institutions in India work under state sponsorship with a lack of proper participation by the local people. With the complex socio-economic and political-set up in the country, reforms in terms of property rights might give rise to both winners and losers, creating a conflict of interest. The agents with greater access to information and institutions may benefit in a better way by seeking rent. It is important to note that defined and secure property rights may become disincentives for the landowners to use their natural resources, which might lead to social inequality⁶⁰. Thus, to restrict this asymmetry in information, a proper institutional framework needs to be developed along with a combination of incentive structures that can promote equitable use of natural resources by the landowners. Another challenge in India is that the most farmers are marginal and landless, thus depending on the state-owned natural resources or common village properties for their subsistence. Therefore, initiating PES programmes in such areas requires tenure-based rights over lands for getting long-term benefits, and use of land resources and developing markets for ecosystem services. If the PES schemes are made location-specific with extended policy support, then it can help in efficiently allocating land rights in the country. Nevertheless, more support can come from the informal institutions at the community level that can help conserve the environment. However, one of the

biggest challenges in India is the consolidation of fragmented lands of the small and marginal farmers and alternating their land-use patterns. Again, here arise two major issues – first, it takes more effort to communicate and coordinate among a larger number of small landholders than with fewer large landholders. Second, more time and capital required in organizing and implementing capacity-building measures makes it a costly affair. Another issue in the Indian context is the failure to adopt technology correctly, particularly under the imperfect market conditions³⁶. Also, the lack of proper credit facilities in the rural areas makes technology adoption difficult due to high cost. In addition, it requires adequate skill and knowledge that may be imparted by appropriate training programmes. However, since most farmers in India are unskilled and illiterate, good extension and educative services to them are a pre-requisite for successful implementation of the PES projects.

Conclusion

The Industrial Revolution has already covered a major part of the globe in grime, but the worst of its effects seems to be localized. However, humans are not aware of how their activities affect the environment tremendously, leading to anthropogenic changes like deforestation, pollution and overuse. It is important to realize that our economies are vitally dependent on various ecosystem services and are nested within ecosystems. Thus, developing PES programmes will provide economic incentives to conserve the depleting natural resources, especially in a developing country like India. They aim to generate a continuous flow of ecosystem services and maintain quality in the long run. However, for a country like India, its success highly depends on the participation of a larger section of society, including the marginal farmers and especially women, in adopting market-based technology. Nevertheless, extension programmes and other systems need to be implemented to combat the social heterogeneity arising from diverse caste systems, gender inequality, and existing religious and political differences. Strengthening technology transfer and extension services, integration of ecosystem services using a system-wide approach in decision-making and in national agricultural policies are highly essential. Comprehensive research work is required on designing context-specific tools to identify and measure ecosystem services and designing appropriate policy mix by including synergies and trade-offs among different. These are some of the policy suggestions that can be implemented for the improvement of PES within the country and across the globe as well.

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