



Contribution of Payment for Ecosystem Services in Addressing Adaptation to Climate Change

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: <https://doi.org/10.9734/ijecc/2024/v14i104521>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/125171>

Review Article

Received: 13/08/2024

Accepted: 15/10/2024

Published: 17/10/2024

ABSTRACT

Payments for Ecosystems Services (PES) are market-based mechanisms that are designed to provide incentives to the owners of natural resources to increase the provision of ecosystem services upon which our society depends. PES is a mechanism to deliver additional adaptation benefits by improving the incentive for land owners to invest in the creation and restoration of habitats. The concept of payments for ecosystem services (PES) emerged in 2007 as a promising tool for enhancing or safeguarding the provision of ecosystem services (ES). However, it has been identified that land cover change is one of the most integral drivers of change to ecosystems and their services and a focus on land cover change as a proxy would seem to be a contextually robust approach. The general objective was to evaluate the contribution of payment for ecosystem services in addressing climate change adaptation through systematic literature review methodology. The three specific objectives to be addressed were: to determine the various ecosystem goods and services, the mode of payment for the goods and services and the linkage between PES and climate change adaptation. The findings are that (i) provisioning (ii) regulating,

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(iii) supporting and (iv) cultural as the goods and services provided. The modes of payment include: cash, payment in kind that respects the culture, sellers can be individual or a group of community members. The linkage of PES to climate change adaptation is done indirectly in that when sellers take care of the environment, degradation is reduced and the aspects of climate change are addressed. In conclusion, it is true that there are goods and services accruing from ecosystems when they are conserved, payments are useful for they compensate the work sellers are doing and climate change issues will be addressed indirectly by having in-place various interventions done by sellers. To realize the payments, public private partnerships is crucial. I recommend that the best mode of payment towards the realization of ecosystem services should be in-kind in order to accommodate all stakeholders in a given geographical area. It is important to adopt the approach that Ecosystem based Adaptation (EbA) should operate within interlinked social-ecological systems, using the sustainable management, conservation and restoration of ecosystems to enhance ecological processes and services that are essential for strengthening climate resilience of populations at local scales

Keywords: Public goods; ecosystem services; payment for ecosystem services; climate change; adaptive capacity.

1. INTRODUCTION

Although the concept of Payment for Ecosystem Services (PES) has been extensively scrutinized in terms of its potential positive and negative impacts on the poor in developing countries, less attention has been paid to examining the role of PES in the context of adaptation to climate change. PES has some potential to contribute to adaptation to climate change, but there are also risks that it could undermine adaptation efforts. In order to maximize synergies and minimize trade-offs between PES and adaptation, it is important that the conceptual links between both are made explicit. Human well-being and survival is dependent on the ecosystems in which we live and which support our food production and many forms of economic activity. Millions of people across Africa depend directly and indirectly on ecosystem services for their food, water and energy security, for materials used to build homes, as well as for their health and livelihoods, and thus the survival of their economic and social system. Communities manage ecosystems, and their capacity and motivation to manage them is critical. Payment for Ecosystem Service (PES) has become a tool for sustainable watershed management across the globe due its versatility and capacity to engage multiple stakeholders in the public and private sectors. Its strength lies in the ability to incorporate voluntary economic incentives and market-based instruments which are superior to the conventional command and control approaches of watershed and natural resource management. PES as a paradigm in natural resource management works on the principle that upstream resource managers are rewarded for good resource stewardship through

economic incentives to guarantee sustainable delivery of ecosystem services downstream [1].

2. METHODOLOGY

It involved review of academic literature that examines the domain of Payment for Ecosystem Services (PES) targeting (a) the various goods and services offered by a healthy ecosystem (b) modes of payment for the goods and services and (c) the linkages of PES and climate change adaptation.

3. RESULTS AND DISCUSSION

Objective One: To determine the various ecosystem services: The Millennium Ecosystem Assessment (MEA) defines ecosystem services (ES) as 'the benefits people obtain from ecosystems' [2]. These multiple benefits are supplied by natural ecosystems as a result of their structure and function – the conditions and processes through which nature sustains human life on Earth [3] – and include a range of goods and services which satisfy human needs directly or indirectly (De Groot *et al.*, 2002) [4]. ES can be divided into four broad categories as illustrated in Table 1.

- (i) provisioning, such as the provision of water, food, medicine, grazing, building materials, genetic resources and energy;
- (ii) regulating, such as the regulation of climate, water, sediment, waste, pests and diseases;
- (iii) supporting, such as nutrient cycling and seed dispersal; and
- (iv) cultural, such as spiritual and recreational benefits

The four categories operate across a range of geographical scales from local to sub-national, national, regional or global scale. For example, tropical rainforests and the services they provide in terms of sequestering carbon dioxide are viewed as globally important services, integral to human life. At the other end of the scale, local patches of forest surrounding human settlements in southern Africa provide edible fruits and products (such as honey) which support families. While the direct use of provisioning services is fairly straightforward to calculate, the values of regulating and supporting services are more indirect and thus challenging. Values provided directly or indirectly can also be estimated for

each type of ecosystem (forest, wetlands, coral reefs, etc.). However, it has been identified that land cover change is one of the most integral drivers of change to ecosystems and their services [5], and a focus on land cover change as a proxy would seem to be a contextually robust approach. It is important to adopt the approach that Ecosystem based Adaptation (EbA) should operate within interlinked social-ecological systems, using the sustainable management, conservation and restoration of ecosystems to enhance ecological processes and services that are essential for strengthening climate resilience of populations at local scales [6,7,8].

Table 1. Categories of ecosystem services (ES)

Types of services		Description
Provisional services	Water	Provision of water for livestock or domestic use
	Food	Production of wild foods, seafood, game, crops
	Medicine	Pharmaceuticals, biochemical and industrial products
	Grazing	Production of grazing for livestock
	Raw materials	Production of fuel, craftwork materials, construction materials
Regulating services	Genetic resources	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species
	Energy	Hydropower and biomass fuel
	Climate regulation	Carbon sequestration, for example wetlands and forests are carbon sinks that contribute towards reducing carbon emissions and aid in climate regulation
	Water regulation	Flood attenuation – reduction of the amplitude and velocity of flood waters by wetlands, reducing downstream damage. Groundwater recharge – differential recharge to groundwater relative to surrounding vegetation types Dry season flows – moderating the seasonality of downstream flows
	Sediment retention	Retention of soil and fertility within an ecosystem
	Pollination	Crop and natural plants are pollinated
	Waste treatment	Breaking down of waste, detoxifying pollution; dilution and transport of pollutants
	Refugia	Change in ecosystem health affects the abundance or prevalence of malaria, bilharzia, liver fluke, black fly, invasive plants, etc. Ecosystems integral to pest and disease control Critical breeding, feeding or watering habitat for populations that are utilised elsewhere
Supporting services	Nutrient dispersal and cycling	Soil habitat is maintained and natural soil cycle ensures continued fertility
	Seed dispersal	Critical service of dispersing seeds to allow new fertilisation
Cultural services	Abundance, rarity and beauty of species, habitats and landscapes	Providing opportunities for: cultural activities and heritage spiritual and religious activities and wellbeing social interaction recreational use and enjoyment research and education spiritual inspiration scientific exploration

Source: (De Groot et al., 2002) [4]

Objective Two: To assess the various modes of payment for ecosystem services:

The basic idea behind PES is that those who provide ecosystem services – like any service – should be paid for doing so. PES therefore provides an opportunity to put a price on previously un-priced ecosystem services like climate regulation, water quality regulation and the provision of habitat for wildlife and, in doing so, brings them into the wider economy. In practice, PES is often used in reference to schemes that involve a continuing series of payments to land or other natural resource managers in return for a guaranteed flow of ecosystem services, or management actions likely to enhance or secure their provision. However, PES is only one instrument among many for combating ecosystem degradation. Others include regulation; the provision of services by government (for example, the Public Forest Estate provides numerous services of public benefit); private contracts between providers and recipients; voluntary efforts on the part of businesses, communities and individuals; and incentive-or market-based mechanisms, including taxes and charges, subsidies, tradable permits and PES. What differentiates PES from the other market-based instruments is its focus on the ‘beneficiary pays’ (rather than ‘polluter pays’) principle. PES provides financial incentives (paid for by the service *beneficiaries*) to land or resources managers in return for specific actions that are reliably known to enhance ecosystem service provision. These incentives can be either output-based (i.e. the buyers pay the sellers for the actual ecosystem services provided) or input-based (i.e. providers are paid for implementing an intervention). Globally, the majority of PES schemes typically focus on four broad types of ecosystem service: watershed protection (including erosion management); carbon sequestration; biodiversity conservation; and landscape aesthetics. A further type of service that sometimes forms part of PES is public access (i.e. for recreation or cultural services) OECD [9]. In 2007, the World Bank released a document outlining the place of PES in development [10].

The Global Environment Facility (GEF) supported Costa Rica’s national PES scheme through the Ecomarkets project implemented by the World Bank. This project, which is considered the world’s most successful national-level application of the environmental services approach, compensates landowners for activities that have been identified as contributing to a

sustainable environment, including conservation of natural forests, reforestation through sustainable plantations and agro-forestry. Funding sources for this program are obtained from a fuel tax (80 percent of funds), revenues from a forestry tax and from a World Bank loan, and grants from the Government of Germany (for forest protection), the Government of Norway (for carbon sequestration) and the GEF. The GEF has invested \$8.3 million and leveraged an additional \$51.9 million in co-financing for this project. The GEF is interested in promoting partnerships with the private sector to foster innovation, open new markets, and achieve greater scales of investment. These partnerships should subsequently be operated as sustainable long-term instruments to promote private sector participation in the conservation of biodiversity and environmental benefits of global importance [11].

The beneficiaries of ecosystem services are usually considered to be a subset of people who benefit from either a purely private good (for example a food crop which an ecosystem generates) or they are exchanges in regular commodity markets. The beneficiaries of ES also benefit from non-provisioning services, which markets have as yet been inadequately able to capture (market failures) because of factors such as a non-rivalrous consumption (i.e. consumption by one user does not affect consumption by another), significant externality effects and high exclusion costs (due to non-excludability – i.e. users cannot be prevented from using or benefiting from the good) [12,13]. A range of payment systems exists [12]:

- (a) Public payment schemes to private land, to maintain or enhance ecosystem services – for example initial government sponsorship for alien invasive clearing for the Working for Water (WfW) programme in South Africa.
- (b) Open trading between buyers of ecosystem goods and services, where a system of a cap or floor on the level of ecosystems services is provided. This tradable permit or credit system is most notably seen in developed country examples – for example the European Union Emissions Trading System (EU ETS) where carbon credits can be traded.
- (c) Self organized deals, usually small scale and private in nature, which normally link beneficiaries of ecosystem services directly with providers of services. These

can be self-negotiated or organized along a community scheme type arrangement.

The PES mechanism looks to bring the exploitation of the environment and natural resources to a socially optimal level by placing a value on these non-market goods and creating incentives for land owners to conserve their property/land which in turn should allow for the provision of ecosystem services. Essentially PES attempts to implement the Coase theorem [14], which theorises that the problems of external effects can (under certain conditions) be overcome through negotiations between the affected parties (Coasean Bargaining) [15].

A possible solution comes with the creation of a monopsony (the creation of an entity/body which represents the interests of all buyers involved) which has the potential to diminish transaction costs by reducing the 'number of parties' involved in negotiations [16]. Kemkes et al. [16] note that the establishment of monopsony power effectively assists with the facilitation of processes between parties within a PES scheme. Bracer et al. [17] comment on studies which have shown that when producers of services organize themselves into structured units (in the form of formal or informal associations), they are able to be represented by intermediaries which then help in the negotiation and implementation phases. This grouping attempts to reduce transaction costs by reducing the number of parties involved in the negotiation process. In the southern African context of cultural and socioeconomic diversity this could, however, be challenging in practice. Conflict resolution mechanisms would thus be important.

However as Corbera et al. [18] highlight, while transaction costs are lower when engaging with groups rather than individuals, knowledge (amongst individuals in terms of the happenings within the initiative) is believed to be lower in such instances too. Vatn [19] thus notes that there is a trade-off here between lowering transaction costs and reducing overall knowledge dispersal when bodies are used as representatives for the parties involved. This trade-off must be borne in mind when considering the establishment of monopsony power. The overarching aim of a PES adaptation project would be the achievement of climate change adaptation; however, within this 'systems' approach the key factor is to ensure the flow of ES. This flow is fundamentally affected by ecosystem change, primarily

anthropogenically induced but caused by a linked range of factors – namely economic activity, development, climate change and the alteration of natural processes .

The integration of exchange or payment systems for a range of ecosystem services needs to be sensitive to the cultural underpinnings of both the beneficiaries and the sellers in an area. This is especially true in the context of contributing towards an enhanced adaptive capacity of these communities, most of them dependent on natural resources. This cultural understanding within any PES scheme ensures 'renewal' of the system. Essentially, ILK needs to be used to understand existing systems of exchange, how these are framed, and whether the understanding and mechanism of these can be enhanced to allow communities to adopt livelihoods more adapted to the implications of climate change. Literature on PES typically distinguishes between four different kinds of services for which payments are made: hydrological or watershed services, carbon sequestration, biodiversity protection, and landscape beauty [20,21].

3. To evaluate the role of payment for ecosystem services in climate change adaptation:

Global warming is as evident in Africa as in other parts of the globe [22]. Mean annual temperatures have increased across southern Africa over the last 40–50 years, and the number of hot days per year has increased whereas the number of cold nights per year has decreased [22]. Regional climate change projections based on Global Circulation Models (GCMs) [23] indicate that southern Africa will warm by between 3.1°C and 3.4°C, with warming of up to 4.8°C possible towards the end of the 21st century. Heat stress events will likely be more frequent in future [24], with heat thresholds being exceeded more regularly. Warming could be higher during late winter and early spring. Strong warming before the start of the rains would significantly reduce soil moisture during this period through high rates of evapotranspiration from plants and soil. Warming also increases evaporation of water from surface bodies such as reservoirs and wetlands. Other impacts of warming include biome shifts and loss of biodiversity, and increased frequency and intensity of wildfires.

Some examples of the possible impacts of climate change on biodiversity and ecosystem services in the context of food, water and energy security, health, and potential for conflicts. Three

countries and two trans-boundary river basins are used for this example, based on their climate risk and vulnerability [25,26]. More broadly, the main pathways include [27]:

- (i) Rising temperatures will impact on the ecology and productivity of the region's many ecologically and economically important lakes and wetlands;
- (ii) High temperatures, carbon dioxide (CO₂) fertilization and nutrient losses during floods will drive eutrophication and proliferation of aquatic invasive species;
- (iii) Heavy rainfall will exacerbate high rates of soil erosion and siltation of rivers, lakes and reservoirs. This will impact negatively on fisheries, forestry and hydropower production.
- (iv) Flood damage to riparian environments could reach tipping points, shifting rivers into new hydro-ecological states from which recovery is impossible;
- (v) Potentially positive influences on forest net primary productivity are expected from CO₂ fertilization, moderate warming and increased rainfall (if spread evenly). Certain forest and woodland types, such as those along the sub-tropical coastal zones, will likely expand at the expense of grasslands, with impacts on grazing. Supply of biomass for wood fuel could increase. However, this could be offset by greater frequency and intensity of wildfires, and continued high rates of deforestation;
- (vi) Estuaries and their ecosystem services could be severely impacted through reduced water flows, deteriorating water quality and sea level rise.
- (vii) Salt-water intrusion in shallow coastal groundwater aquifers will result in significant damage to coastal forest and wetland systems;
- (viii) Increased floods and cyclones will cause increasing damage to coastal infrastructure, fisheries and agriculture;
- (ix) Increased poverty and hunger, leading to greater reliance on natural resources will drive unsustainable harvesting of marine and terrestrial resources in the search for alternative livelihoods.
- (x) The need for increasing food production will drive land use changes and encroachment of agriculture into species-rich and sensitive environments. Whilst this will achieve short-term food security gains, these could be offset by the longer term

loss and further degradation of key ecosystems and their productive potential;

- (xi) Land transformation, increased poaching and biodiversity loss could significantly affect.

An Ecosystem-based Adaptation (EbA) to climate change approach relates to "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" [28]. We adopt the approach that EbA should operate within interlinked social-ecological systems, using the sustainable management, conservation and restoration of ecosystems to enhance ecological processes and services that are essential for strengthening climate resilience of populations at local scales [6,7,8]. In this sense, there is convergence with the community-based adaptation (CBA) and climate integrated conservation strategies (CCS) approaches, where EbA represents the intersection between biodiversity and ecosystem conservation, socioeconomic benefits and climate change adaptation [25] see Fig. 1.

The rationale for Ecosystem based Adaptation (EbA) in southern Africa includes [29]:

- Enhancing ecosystem resilience can restore natural protection against extreme climatic events, thus limiting losses and damages;
- Economic gains from ecosystem or land use conversion may be outweighed by the potential benefits of conservation and/or restoration, especially as multiple ecosystem services are considered in the assessment [6]; and
- The multiple-benefits of EbA offer the opportunity to integrate adaptation priorities with development processes.

Under the broader umbrella of EbA, payment for ecosystem services (PES) is one approach which can be considered amongst a suite of adaptation options. PES represents a set of market-based approaches which have significant potential as part of an overall climate change adaptation strategy. PES creates an innovative option to reward communities (either through payments, compensation or exchange between a willing buyer and a willing seller) for ecosystem services or land use that sustains such services [30]. PES agreements could provide an income buffer and a source of income

diversification, and thus aid communities in increasing their resilience to climate shocks. This is a complex task considering the heterogeneous composition of the region in terms of biophysical resources, ecosystem service flows and their economic and cultural value, farming and land use systems and socioeconomic systems across the region.

However, it has been identified that land cover change is one of the most integral drivers of change to ecosystems and their services [5], and a focus on land cover change as a proxy would seem to be a contextually robust approach. The first PES schemes in developing countries having been initiated during the 1990s [31].

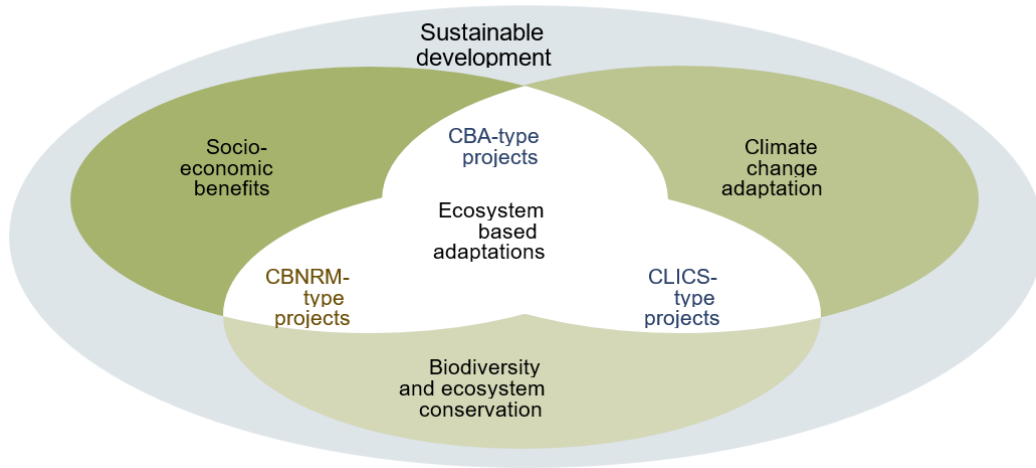


Fig. 1. Ecosystem based adaptation (EbA) conceptual framework.
Source: [11]



Fig. 2. Adaptation framework
Source: IPCC (2007)

Payment for Ecosystem Services is a contract between buyer(s) and user(s), with the 'commodity' being one or more defined benefits derived from an ecosystem. Payment can take the form of financial or non-financial incentives. The seller(s) undertakes to carry out a particular land use or activity on a continuous basis in order to secure the said ecosystem service (ES). In southern Africa, where many people rely heavily on natural resources and ecosystems, adaptation to climate change and the building of resilient livelihoods in the face of climate and disaster risks is intimately linked to the need to secure life-giving services such as the provision of water and food by conserving or restoring key ecosystems. Various types of PES schemes exist, including opportunities for watershed management, carbon sequestration, biodiversity conservation and sustainable land use. PES is characterized by its engagement with previously uninvolved communities (beneficiaries of ES) by providing incentives for conservation and restoration, whilst potentially simultaneously building the resilience of natural-resource based livelihoods against changing climates and disasters. Africa boasts a wealth of ES, the most notable of which are provisioning of fresh water, food, biodiversity, wood fuel and cultural, spiritual, aesthetic and recreational services [2].

The African continent has contributed the least to global climate change; however, it is one of the most vulnerable regions globally to climate change [22] (Hope, 2009). Climate change poses a plethora of new challenges for southern Africa which will be wide ranging and complex to address. A range of biophysical changes linked to shifting precipitation patterns and rising temperatures will see a growing strain on natural capital and ecosystem services. These shifts will also fundamentally affect social and economic systems, both within countries and at trans-boundary scales. Changes in the provision of key ES will affect where land development, production and human settlement occurs [32]. Generally, adaptations are expected to reduce vulnerability [33,34,35]. Adaptation can be planned (such as policy development), reactive (such as emergency repair work), anticipatory (such as building flood defences), or spontaneous/autonomous (such as ecological changes in natural systems). In order for adaptation responses to be effective, these need to be part of comprehensive framework (see Fig. 2) which:

- Considers responses to climate change as a strategic priority;
- Pays special attention to impacts on vulnerable groups, assets, etc.
- Increases the capacity of staff and other stakeholders to improve their understanding of climate change risks;
- Ensures good communication of risks and responses;
- Takes climate change into account in any decisions around the development of infrastructure and the way in which land is managed and used; and
- Embeds adaptation in all policies and activities.

Case Study: Payments for Ecosystem Services in Costa Rica

Case Study Author: Carlos Hinojosa (Technopolis Group)

Background and context of the case: Costa Rica experienced one of the fastest deforestation rates in Latin America during the second half of the XXth century: forest cover dropped from 70% of the country in 1950 to just 20% by 1987. However, at the end of the 1980s, forests began to recover and reforestation and afforestation have shown a steady upward trend – recently flattening out at around 52% of the country's land area [36]. These transformations in the landscape are thought to result from a combination of policies affecting land use, as well as international market and political pressure. The early period of deforestation saw forest rapidly converted into agricultural and cattle ranching areas, which benefited from generous land titling and cheap bank loans as part of the Government's efforts to colonize new land. High international prices for beef and expansive crops such as coffee and bananas further contributed to deforestation. The trend was decreased by pressures which emerged in the 1980s. Political and economic instability created by the wars in Central America, and the collapse in global meat, sugar and coffee markets, led to abandonment of a significant proportion of agricultural land. In parallel in the 1980s, a number of environmental and conservation groups gained importance in calling for a change, as well as for the introduction of measures limiting deforestation and protecting national forests [36]. The government took initial steps to implement a policy framework aimed at protecting the country's forest resources. The creation of

several national parks across the country was an important first step. In addition, the central government implemented reforestation incentives (i.e. subsidies and tax-breaks) which did not always prove to be effective [37]. It is worth highlighting that at the time, incentives were considered a risky policy measure, and in some cases they generated negative effects (i.e. people deforested areas in order to make lands eligible for incentives later). Despite the existence of mitigated results, those early incentives partially paved the way for the creation of the Payments for Ecosystem Services (PES) programme.

The Forestry Law 7575 established two complimentary measures which form the basis of the PES programme:

- First, it banned all conversion of established forests punishable by prison sentences rather than fines, effectively lowering the 'opportunity cost' of converting existing forests.
- Second, it introduced the offer of payments for reforesting, protecting forest, or managing existing forest in private properties outside national parks: the PES programme was born.

The PES approach at the time received a significant amount of criticism, particularly since it was seen as unnecessary given the introduction of measures banning deforestation. Some critics considered the PES as 'redundant' given the existence of these bans. Others described it as a 'rebranding' of previous subsidies; or a necessary incentive for keeping forests standing, given low capacity for enforcement; and a quid pro quo or pre-condition for popular acceptability of the ban [36]. In spite of this criticism, the PES scheme is believed to have been introduced in order to respond to some of the failures of previously existing forest conservation programmes and initiatives, particularly from a legal and institutional standpoint.

Mapping the theory of change: The PES programme of Costa Rica was established to protect and regenerate the country's rainforest, which was in rapid decline until the end of the 80s. The dramatic deforestation was threatening water provision, biodiversity and the integrity of the country's landscape, while reducing the planet's absorption capacity of carbon dioxide. The 1996 Forestry Law implementing the PES programme sets out the following dual objectives:

- To conserve, protect and administer natural forests, and oversee the adequate use, industrialization and development of forest-based resources to this end, based on the principle of sustainability
- To ensure the creation of employment and improve the quality of life of rural communities by effectively integrating them to forest-based economic activities

Costa Rica's PES programme acknowledges that owners of forests are entitled to apply for payments for the vital services that these ecosystems provide. A detailed framework defines these ecosystem services, which come under four main categories:

- Carbon sequestration: the capture and long-term storage of atmospheric carbon dioxide.
- Water ('hydrological services'): the protection of water catchment areas.
- Protection of biodiversity: for conservation and sustainable use.
- Scenic beauty

To motivate participation on behalf of landowners, the financial incentive must compensate for the opportunity cost of deforestation plus the costs of compliance. By delivering financial incentives, the programme promotes environmental sustainability while supporting landowners' incomes. The programme can also contribute to poverty reduction through the additional income it may provide to small landowners from fragile or isolated social groups. As well as receiving direct payments, private forest owners who manage their forests through PES are also exempt from property taxes. Property taxes were recently reviewed and raised throughout the country, so the benefits of the exemption have increased. Participation in PES also provides a guarantee of squatter eviction, a further benefit for land tenure [36].

The PES programme focuses on five uses of private land: 1) forest protection, 2) commercial reforestation, 3) agroforestry, 4) sustainable forest management, and 5) regeneration of degraded areas. Contracts signed between the central government and programme participants specify the type of uses that will be given to land providing ecosystem services.

The PES programme is accessible to any private landowner who has a property title or possession

rights, with a minimum land area of one hectare. There are four main categories of participants:

- Individuals
- Legal entities under Costa-Rican law, including micro-enterprises, family businesses, small and medium enterprises (SME), large companies and their subsidiaries.
- Development or conservation cooperatives.
- Indigenous communities

Between 1997 and 2012, FONAFIFO distributed approximately \$340m. The greatest part of these funds went to legal entities (49 per cent), followed by individuals (31 per cent), indigenous groups (13 per cent) and cooperatives (7 per cent). The strategy adopted by the programme in terms of target populations has continuously evolved over time, and has also been a source of criticism. There is significant evidence pointing to the fact that the programme benefits large landowners rather than small and medium ones [36] whereas the Forestry Law 7575 identifies the latter group as priority targets.

Description of results: The main indicator used to illustrate the impact of the PES programme in Costa Rica is the forest surface that has been protected or reforested through the programme. Effects are measured as forest gain, forest loss, and net deforestation [38]. According to Porras et al. [36] “between 1997 and 2012, (PES) has protected more than 860,000 hectares of forest, reforested 60,000 hectares and supported sustainable forest management in almost 30,000 hectares. More recently, it promoted natural regeneration of almost 10,000 hectares. This totals nearly one million hectares under the PES scheme at one time or another, as well as 4.4 million trees planted under agroforestry systems since 2003.” By 2010, roughly 52% of the territory was under some sort of forest cover, which is a significant improvement especially considering the 1983 low of 21% [39] These numbers are quite substantial for a developing country of just 51,100km. Forest surface is generally used as a proxy to measure the contribution of the programme to ecosystem services [40-43].

Lessons and Good practices for Policy Makers: The Costa-Rican PES system has gained considerable international recognition and visibility as a pioneer programme aimed at supporting the development of eco-system

services via conditional payments. The programme has been used as the basis to develop similar schemes in other geographical contexts. Programme management and implementation teams are continuously contacted to share their experience and knowledge on the the program and its means of implementation. The existence of the programme of over 20 years has allowed to collect and gather a significant amount of information regarding its history and some of its achievements. There is little consensus however on the extent to which the programme has been effective and able to meet its main objectives.

4. CONCLUSION

Linkages must be created between all parties in the management of ecosystem services. Engagement with communities allows for the creation of awareness around the PES and EbA approaches (mechanisms, rewards, benefits, service provision). A better understanding of these approaches allows for familiarity with the systems and institutions involved in the implementation of the initiative, which in turn should achieve some degree of commitment from the entities that are party to the programme. Thus engagement with communities creates awareness around the incentives which can be achieved; this develops enthusiasm from communities to ensure their activities allow for service provision. This may provide some comfort to buyers and may assist in securing their buy-in. Practitioners have noted that robust valuation techniques are necessary to ensure that the true significance of natural resources and ecosystem services are estimated. These estimations allow for the translation of environmental services into economic impacts and place decision makers in a better position to make comparisons between different options of land use. This facilitates decision making (i.e. shows feasibility of different options) as it provides information which can easily be understood. Incorporating local knowledge into these estimation methods, and communicating scientific findings in layman’s terms, provides, a basis for the development context-specific, evidence-based solutions. The emphasis here is on developing specificity (i.e. who is the most vulnerable) and then implementing PES and EbA strategies accordingly. There are specific goods and services which human beings enjoy as they emanate from ecosystems. Depending on the agreement between the sellers and buyers, it is important for the two separate groups to form

cooperative societies which can negotiate their terms. By conserving the environment, the various interventions are actually addressing climate change.

6. RECOMMENDATION

Although there are various avenues for payment for ecosystem services, the best mode of payment towards the realization should be in-kind in order to accommodate all stakeholders in a given geographical area. The approach towards such payment should be bottom-up and all voices of stakeholders should be listened to.

TERMINOLOGIES:

Public goods: Ecosystem services are often public goods, which means that the consumption of a service by one individual does not decrease the amount or level of that service available to another individual (non-rivalry) and that nobody can be effectively excluded from using the good (non-excludable).

Ecosystem approach: A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD).

Ecosystem services: The benefits that people obtain from ecosystem [2].

Payment for ecosystem services: A voluntary agreement to enter into a legally-binding contract under which one or more buyers purchase a well-defined ecosystem service by providing financial or other incentives to one or more sellers who undertake to carry out a particular land use on a continuous basis, which will generate the agreed ecosystem service at specified levels (IUCN).

Climate change: any change in climate over time, whether due to natural variability or as a result of human activity [42].

Adaptive capacity: The ability of a system to adapt to a changing climate (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences [42].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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