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Payments for ecosystem services and the financing of global biodiversity conservation

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It is generally recognized that addressing the ongoing loss of global biodiversity requires a substantial increase in funding for conservation activities, particularly in developing countries. An increasing interest in Payment Mechanisms for Ecosystem Services (PES) begs the question of whether a focus on developing payment mechanisms will also reduce the ongoing loss of global biodiversity. We review, firstly, current flows of funds for biodiversity conservation, including PES and other market mechanisms, and secondly, the opportunities and constraints of PES to contribute to biodiversity protection globally. We argue that PES can and should make an important contribution, but that it will not be sufficient to rely on PES alone to finance the actions necessary to substantially reduce biodiversity loss. In response to the identified constraints, we believe there is a need to develop additional funding mechanisms specifically targeted at biodiversity conservation.

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Introduction

Biodiversity is generally considered to comprise diversity at the level of ecosystems, species, and genetic information. Biodiversity is required to sustain the supply of ecosystem services [1••,2•,3], and is sometimes also seen as an ecosystem service in itself, based on the assumption that it is a final output of the ecosystem for which people are willing to pay [4,5]. The planet is experiencing an ongoing, rapid loss of global biodiversity, and various national and international responses have been put in place to stem this loss [6••]. However, the availability of adequate funding for these and future efforts to conserve biodiversity remains a critical concern, in particular in low-income and middle-income developing countries [1••,7].

In the last decade, projects and activities targeted at finding additional funding for biodiversity conservation have increasingly relied on the development of Payment Mechanisms for Ecosystem Services (PES) [8,9,10•]. PES has been defined as 'a voluntary, conditional agreement between at least one 'seller' and one 'buyer' over a well-defined environmental service — or a land use presumed to produce that service' [11]. Two defining elements of PES are: firstly, the degree to which the mechanism relies on economic incentives; and secondly, the extent to which protection of ecosystem services is targeted directly rather than integrated into broader development approaches [11]. In addition to market forces, the feasibility of PES is also strongly influenced by the project's social, political, and institutional setting [12,13]. To illustrate the increasing faith being placed on PES, the Resource Mobilization Strategy agreed at the Nagoya conference of the Convention on Biological Diversity (COP10) includes PES as a key funding source for biodiversity conservation.

The aim of this paper is to analyze the scope of PES to contribute to funding the conservation of biodiversity in low-income and middle-income developing countries,[3] most of which are in the tropics. We first present a brief overview of the present flows of funds for biodiversity conservation. We distinguish, firstly, non-market funding, in particular government and philanthropy-supported funding for biodiversity conservation, and secondly, funding for biodiversity through market-oriented mechanisms, including PES. We argue that PES can and should make an important contribution but that it will not be sufficient to rely on PES alone to stem the ongoing loss of global biodiversity. In response to the identified constraints, the paper calls for the development of an additional long-term funding mechanism for biodiversity conservation.

Flows of funds for biodiversity conservation

Non-market biodiversity conservation funding

Data on financial support for biodiversity conservation are difficult to collect, because of the sheer number of funding sources, recipients, programs, and projects involved.

[3] As defined by the World Bank: http://data.worldbank.org/about/country-classifications.

Double counting of funds is also a concern, for example when bilateral donors support the global environment facility (GEF). Official development assistance for biodiversity — biodiversity aid — remains a vital source of funding in many developing countries. To be defined as biodiversity aid, a given aid project must include activities that promote at least one of the three objectives of the Convention on Biological Diversity: the conservation of biodiversity, sustainable use of its components (ecosystems, species, or genetic resources), or fair and equitable sharing of the benefits of the utilization of genetic resources [14].

Recent figures from the Organization for Economic Cooperation and Development (OECD) show that aid for projects relevant for biodiversity reached US$ 3.8 billion in 2009, of which US$ 1.3 billion was spent on projects with biodiversity as principal objective [15]. These figures are in line with a recent study of international aid for biodiversity by Miller *et al.* [14], who show that bilateral and multilateral aid specifically for biodiversity conservation averaged US$ 1.1 billion per year from 2002 to 2008. Over the past three decades, the World Bank and GEF provided around 60% of all biodiversity aid, while the Regional Development Banks (ADB, AfDB, and IADB) accounted for around 10%. Direct bilateral aid flows made up for most of the remaining 30% of aid committed [14].

Table 1 presents an overview of the estimated flow of funds for biodiversity conservation in developing countries. The table does not include the Norwegian agreements with Indonesia and Guyana, where payment of a substantial amount of funds (US$ 1 billion in the case of Indonesia) is conditional on the actual reduction in deforestation to be achieved. These agreements involve a novel approach, but they have not been included in the table because it is at present uncertain if and when this amount will be paid. Our analysis focuses on funding that makes a potential positive contribution to biodiversity conservation. There are also many donor and domestically funded projects that may have a negative residual impact on biodiversity even with environmental safeguard procedures in place. However, an analysis of these effects is outside the scope of this paper.

It is noteworthy that estimates of recent domestic funding for biodiversity conservation in developing countries considerably exceed the transfer of funds for biodiversity conservation purposes from OECD countries. The rapid economic development of many developing countries, including Brazil and Indonesia, may enhance the amount of domestic funds available for biodiversity conservation — at the same time posing additional pressure on remaining biodiversity.

Funding for biodiversity conservation through market-oriented mechanisms

In this section, we review five market-oriented funding mechanisms that are of particular relevance to biodiversity conservation. These include two mechanisms that are not generally classified as PES (i.e. ecotourism and green commodities) and three mechanisms that qualify as PES according to our earlier definition (i.e. payment mechanisms for hydrological services, REDD and voluntary carbon markets, and markets for biodiversity).

(i) *Ecotourism*. Ecotourism can generate significant revenue. For instance, in ten countries in Southern Africa, ecotourism generated approximately US$ 3.2 billion in 2000–2001 [21]. However, only a minor part of these revenues are transferred to the actual conservation of biodiversity [22•]. Giongo [23] surveyed 319 protected areas in the world and found that over 50% of revenues for protected areas in developing countries were from visitor entrance fees. Where parks are located close to urban centers and harbor ecosystems or species of particular interest, the flows of funds can be very significant, but revenue from ecotourism is often inadequate for the conservation of biodiversity in remote areas [22•]. There is a severe lack of data on the contribution of ecotourism to biodiversity funding. Assuming that tourism still contributes around half of the budget spent on protected area management in developing countries — the equivalent of some US$ 1.3–2.6 billion per year [24] — tourism would directly contribute around US$ 0.7–1.3 billion to biodiversity protection. This would be a minimum given that tourism also generates other funds that provide

Table 1

Current available estimates of non-market funding delivered for biodiversity conservation in developing countries.

Funding source	Finance delivered (US$ billion)	Data source
Domestic budget allocation	~11	[16–18]
Biodiversity-related multilateral and bilateral aid	~4 for activities with a potential positive impact on biodiversity; ~US$ 1.1–1.3 billion specifically for biodiversity projects	[14–17]
Debt-for-nature	<0.1	[19]
Philanthropy (private foundations and charitable trusts and conservation NGO funding)	0.5–1.0 (excluding grants and official aid to NGOs to avoid double counting)	[16,20]
Total (non-market)	13–16	

incentives for conservation, for example, through lodging and other local expenses.

(ii) *Green commodities*. Another market flow concerns green, certified commodities (such as Forest Stewardship Council wood and Rainforest Alliance coffee). The amount of funds involved in the trade of green commodities is estimated at US$ 2.6 billion per year [17]. Plantations under ecological friendly management are generally higher in species diversity, for instance in birdlife [25]. However, the impact of such management in plantations is limited to species whose presence can be reconciled with agricultural production, which excludes a range of threatened species, such as large mammals.

(iii) *Hydrological services*. These services encompass the benefits to people produced by terrestrial ecosystem effects on freshwater [26]. Payment mechanisms for hydrological services have been developed with regards to reducing sediment loads, enhancing the reliability of water yield or improving the quality of water extracted from a catchment. Funding for hydrological services can be significant as in for example several Latin American countries, including Costa Rica, Mexico and Columbia, and China. Together payments for hydrological services in these countries are estimated at US$ 5.7 billion per year, the vast majority of which is in China [17]. In most cases such payments involve an intra-country transfer, and the international flow of funds for hydrological services remains small [10•,17].

(iv) *REDD and voluntary carbon markets*. The Reduced Emissions from Degradation and Deforestation (REDD) mechanism was initiated in 2007 by the parties to the United Nations Framework Convention on Climate Change (UNFCCC). REDD aims to financially compensate developing countries for protecting their forests in return for safeguarding their carbon sequestration and storage service [27]. Concern about forest management and other issues led to the formulation of a REDD+ mechanism that also explicitly aims to improve forest conservation and establish sustainable management [28•]. So far there is no official agreement on a REDD mechanism under the UNFCCC. However, an increasing number of pilot projects under voluntary carbon markets have been developed over the past few years. In 2011, two REDD projects were brought to the market, totaling around US$ 90 million, which is equal to the market volume in 2010 [29]. The funding for REDD is at present still dominated by bilaterally and multilaterally funded projects, for a total of US$ 0.7–1.9 billion [30]. These funds are included in Table 1 under non-market mechanisms.

(v) *Markets for biodiversity*. There were 45 compensatory biodiversity mitigation programs worldwide in 2011, including biodiversity credits programs and one-off offset policies [31]. The largest and arguably most well-established of these market mechanisms are the national Wetlands and Stream Mitigation and the Conservation Banking schemes operating in the United States. Total payments in the wetland and stream banking scheme were close to US$ 2 billion for 2008, and for the Conservation Banking around US$ 200 million for 2009 [31]. At the international level, the development of a scheme creating demand for biodiversity credits is much harder. The voluntary Business and Biodiversity Offsets Program ('BBOP') for biodiversity offsets was initiated by industry, NGOs and policy makers in 2004 [32]. The BBOP mechanism has not been adopted beyond the scale of pilot projects, and may be hampered by a general lack of interest from businesses to adopt new mechanisms on a voluntary and individual basis.

A third biodiversity market mechanism is the voluntary biodiversity market. The Malua BioBank, launched in 2008 in Malaysia, presents a recent example. The Sabah Government committed to stop all logging activities in the 34,000 ha Malua Forest for at least 50 years provided that enough funding is secured [33]. Several 'biodiversity conservation certificates' were sold to companies interested in voluntary offsets, and recently the scheme has targeted selling certificates to the general public. Other offset programs and voluntary biodiversity market programs are being developed, in particular in Latin America, but their overall financial turnover is still modest [31]. A challenge for voluntary markets is that a small-scale buyer of one or a few biodiversity certificates has little certainty that the money will actually be used for the long-term conservation of biodiversity. There is at present no independent monitoring and verification mechanism for biodiversity credits, and an individual buyer has few possibilities for monitoring or verification, or for seeking compensation if the market scheme is abandoned at some time in the future (Table 2).

The potential of PES to generate new funding for biodiversity conservation

Funding requirements

There is a general agreement in the literature that a significant increase in funding is required to stem the ongoing loss of global biodiversity, in particular in low-income and middle-income tropical countries [1••,5,17,18,24]. James *et al.* [18] estimated that, on an average across developing countries, protected area budgets represent only 30% of the financial requirements for effective conservation. A recent study estimated that protecting and effectively managing all terrestrial sites of global conservation significance would cost US$ 76 billion annually, and that this requires conservation funding to increase by at least an order of magnitude [35••]. Funds are required for biodiversity management, including monitoring, controlling threats (e.g. poaching)

Table 2

Overview of market-oriented flows of funds relevant for biodiversity conservation from OECD to developing countries.

Funding source	Volume (US$ billion/year)	Data source
PES for watershed services	<0.1	[10•,17,34]
REDD+ market	0.1	[29]
Voluntary biodiversity markets	<0.1	[17,31]
Green commodities	~2.6	[17]
Ecotourism	0.7–1.3 for park management	This is a minimum figure, see text
Other (e.g. bio-prospecting, direct ecosystem service and biodiversity fees)	0.2–0.3	[17]
Total (market oriented)	3.6–4.5	

and ecosystem rehabilitation, and for compensating local stakeholders for restrictions on ecosystem use [36]. The small increase in biodiversity aid over the last decade [14] has been insufficient to generate the amount of funds required [17,24,35••]. Donor contributions to protected area management, however, appear to have decreased in the past decade, and domestic funding has generally not been able to compensate for the lost external funding [24].

PES versus non-market funding mechanisms

Bruner *et al.* [37] find that funding 'traditional' national park management is relatively efficient, and that even modest increases in funding would directly increase the ability of parks to protect tropical biodiversity, see also [38•]. A concern, however, is that donor funding is often for specific projects and periods, even though biodiversity conservation requires a steady, long-term flow of funds [39]. Compared to traditional funding mechanisms, an advantage of PES is that it can potentially lead to a long-term flow of funds, provided that the participants in the PES scheme have incentives to maintain the service over the long term [40]. In addition, PES (including REDD+) tap additional sources of funding hence increasing the amount of funds available for projects with potentially a positive impact on biodiversity. It is important to note, however, that the efficiency with which funds can be used for biodiversity conservation depends on a whole set of institutional and social factors, including clarity of property rights, enforcement arrangements, and corruption, among others [41].

General constraints of PES

The relative novelty and complexity of many PES mechanisms means that transaction costs (project design, monitoring and reporting, distribution of funds, etc.) are often relatively high. For instance, it has been estimated that transaction costs of forestry projects aimed at capturing or sequestering carbon range from 9 to 19% of total costs [42]. In addition, several case studies show that PES mechanisms do not always lead to a significant change in ecosystem management practices compared to the situation without PES, indicating the difficulty of designing effective PES [43], see also [44].

In addition, PES mechanisms are often not well aligned with the supply of multiple services by ecosystems [45]. Many ecosystems provide multiple services, and the aggregated value of these services may surpass the benefits generated by alternative land uses (such as plantations), even though the value of one single service may not. However, current PES mechanisms do not allow 'stacking' of ecosystem services in a trading scheme [46]. For instance, if REDD payments are being made to conserve an ecosystem with a significant carbon stock (e.g. a tropical peatland forest), the marketing of biodiversity credits for the same area becomes more difficult because the forest is considered to be protected already.

Finally, the complexity of ecosystem functioning is not easily transferred to market prices. Ecosystem changes are subject to complex dynamics including thresholds and irreversible changes. These complex behaviors are subject to uncertainty and therefore often difficult to predict a priori. Consequently, there may be major variations in the societal costs and benefits of preserving one additional unit of an ecosystem, depending on the changes in ecological processes as a function of that change [45]. Payments for conserving an ecosystem and the services it provides will not usually reflect these complex dynamics (e.g. by increases in the price of ecosystem units when critical thresholds are approached).

PES and biodiversity conservation

The impacts of PES on biodiversity vary substantially with the type of PES involved. The REDD+ mechanism gives explicit attention to the positive side effects of forest carbon conservation on biodiversity. The number of threatened mammal, amphibian and bird species occurring in an ecosystem is correlated with its above and below ground carbon stock, and REDD+ will therefore contribute to conservation of these species [47]. Biodiversity conservation, however, requires attention to non-forest ecosystems as well. In addition, a new international climate agreement incorporating REDD+ has been postponed, potentially to at least 2020, and a major expansion in the volume of funds involved may not take place in the coming 10 years [48•]. Hence, REDD+ will be an important contributor to funds for biodiversity

conservation, but it is likely to be insufficient to stem biodiversity loss.

Hydrological and other PES schemes are other valuable sources of funding relevant for biodiversity conservation. However, safeguarding the supply of a specific ecosystem service does not necessarily involve protecting the species or genetic diversity in the ecosystem. The relationship between biodiversity and ecosystem services is complex, with the diversity of species within each functional guild generally seen as critical to maintaining ecosystem resilience and functioning [49].

PES provides an incentive to maintain the overall ecosystem and habitat, but although ecosystem managers may be aware of the need of protecting specific species to maintain functioning of the ecosystem, they may not perceive a need to protect rare or threatened species. For instance, in the case of community forestry programs in Nepal, local communities emphasized forest cover maintenance in order to ensure the supply of locally important forest services. Thus, three decades of community forestry have resulted in a marked increase in forest cover. While this effort has had a positive effect on biodiversity at large, protection of rare or threatened species was not a priority for local communities and management of the forest by local users has not led to the preservation of many rare species [50]. Ecotourism, sport hunting, and other forms of nature-based tourism have similar limitations. Land owners may not be directly interested in maintaining the overall ecosystem, but may instead intervene to shape the ecosystem to heighten specific attributes or the presence and visibility of species attractive to tourists. In addition, ecotourism depends on the availability of working tourist facilities and infrastructure and may not be viable in remote and inaccessible areas.

Hence, PES mechanisms are essential for generating new funding for biodiversity conservation [10•,51•], but PES cannot be expected to close the funding gap between funds delivered and funds needed for biodiversity conservation. The volume of PES transactions may increase in the years ahead, but there is also a critical issue that the funds are targeted at maintaining specific, marketable ecosystem services, and that high-biodiversity ecosystems that do not deliver economically profitable services may not be conserved.

Conclusions

Our review shows that PES, while holding significant promise, may not be sufficient to arrest further losses of global biodiversity. Given the urgent need to increase funding for biodiversity conservation, in particular in low-income and middle-income tropical countries [35••,36,37], there is a need to contemplate an additional funding mechanism for global biodiversity. Contrary to existing PES schemes, the funding mechanism should finance the long-term conservation of biodiversity in low-income and middle-income developing countries per se, that is, regardless of any other ecosystem services provided by an ecosystem. It should use the most cost-effective way of conserving biodiversity, which may include supporting existing, but underfunded, protected areas. Contrary to current non-market funding schemes, the new mechanism should focus on the long term (i.e. decades). The demand for such a mechanism is illustrated by statements in the past years from several tropical countries, including Cameroon, Ecuador, and Guyana (e.g. [52]), that they are willing to preserve biodiversity if a fair level of financial support can be provided.

A full assessment of different possibilities for an additional funding mechanism is beyond the scope of this paper, but we begin by briefly sketching the broad outlines such a mechanism might take. First, the funding mechanism should take a long time perspective, say, on the order of 50 years or more, given that biodiversity conservation requires a long-term perspective. Second, the funding mechanism should be based on the principles of transparency and mutual agreement, learning from the lessons derived from current PES schemes (e.g. [44]). Third, the fund should respect and engage with indigenous and other local communities that are the traditional managers of the ecosystems they inhabit. Fourth, such a fund should make maximum use of new technology, particularly remote sensing, to monitor and verify contractual arrangements entered. Potentially, the mechanism should engage in annual payments, based on a long-term contractual agreement, for implementing conservation management plans of areas rich in biodiversity. Note, however, that funding, although essential, is not the only constraint to better management of biodiversity in low-income and middle-income countries. For instance, there is also a need to enhance capacities and monitoring mechanisms, and to address institutional weaknesses [41].

There are different options for a new funding mechanism, such as expanding the GEF's portfolio with a new stream of financing focused on long-term biodiversity conservation. Contrary to existing GEF projects, this new stream of financing would need to cover operational and perhaps opportunity costs for biodiversity conservation, over an extended time horizon. Alternatively, a new global funding mechanism specifically for biodiversity (a 'Global Biodiversity Fund'), or different funding mechanisms at other policy-relevant levels could be contemplated. Given the rapid loss of biodiversity, especially in tropical low-income and middle-income countries, time is of the essence: there is an urgent need to mobilize substantial additional funds and develop effective mechanisms for global biodiversity conservation.

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