



Investments to reverse biodiversity loss are economically beneficial

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Reversing biodiversity loss by 2020 is the objective of the 193 countries that are party to the global Convention on Biological Diversity (CBD). In this context, the Aichi Biodiversity Targets 2020 were agreed upon by the CBD in Nagoya, Japan in 2010 and this was followed by asking a high-level panel to make an assessment of the financial resources needed to achieve these targets globally. First, we review the literature on the costs and benefits of meeting the Aichi Targets. Second, we provide a summary of the main conclusions of the CBD High-Level Panel (HLP) 1 and 2 on the Global Assessment of the Resources for Implementing the Strategic Plan for Biodiversity 2011–2020. A key conclusion of the HLP is that the monetary and non-monetary benefits of biodiversity conservation and sustainable use to be achieved by implementing the Aichi Targets would significantly outweigh the amount of investments required.

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















Introduction

Based on the scientific knowledge accumulated over the years, the world has come to recognize the central importance of biodiversity to humanity in terms of the crucial contribution it makes to the economic, cultural, spiritual and social well-being of people worldwide. Research has also demonstrated that over the years humans have been over-exploiting and eroding the world's stock of biodiversity (e.g. [1]). These two pieces of knowledge led the global community to come to agreement on the crucial need to conserve and sustain biological diversity. The world's hopes and ambitions for biodiversity conservation was captured in the Strategic Plan for Biodiversity and the associated Aichi Targets (Table 1), which was agreed upon by Parties to the CBD Convention in 2010 [2,3].

To implement these targets, it was quickly recognized by the global community that financial investment from government, industry, civil society and individuals would be needed. While a number of scattered efforts have been made to estimate the costs and benefits of conserving biodiversity at different levels and scales, a comprehensive study was yet to be carried out. Similarly, the equally

Table 1

The 20 Aichi Targets.

| | | | |
|--|---|---|--|
|  1 Public awareness |  6 Sustainable fisheries |  11 Protected areas |  16 Nagoya ABS Protocol |
|  2 Value of biodiversity understood |  7 Sustainable agriculture |  12 Species |  17 NBSAP revision |
|  3 Removal of perverse incentives |  8 Pollution |  13 Genetic diversity |  18 Traditional environmental |
|  4 Sustainable production / consumption |  9 Invasive alien species |  14 Ecosystem services |  19 Knowledge transfer |
|  5 Loss of natural habitats |  10 Climate change / ocean acidification |  15 Ecosystem-based carbon sequestration |  20 Resource mobilisation |

important question of what is to be gained by meeting the Aichi Targets has not yet been answered in a meaningful and comprehensive manner.

To begin to fill these important knowledge gaps, a CBD High-Level Panel (HLP 1 and 2) was sponsored by the United Kingdom, Japan and Norway to provide information on the Global Assessment of the Resources for Implementing the Strategic Plan for Biodiversity 2011–2020 (<http://www.cbd.int/hlp/background/>). Our objective in this paper is to provide a summary of the work of the HLP reported in [4,5] after presenting a review of the literature on the costs and benefits of meeting the Aichi Targets.

Measuring the cost and benefits of meeting the Aichi Targets

Balmford *et al.* [6] estimated that the failure to protect biodiversity leads to the loss of natural services worth US\$ 140 billion a year, and that developing a global network of nature reserves on land and at sea would cost about US\$ 45 billion a year to maintain, while protecting ecosystem services worth between US\$ 4400 billion and US\$ 5200 billion annually. Another global study examining the cost of policy inaction found that a failure to halt the loss of biodiversity could result in annual losses in ecosystem services worth US\$ 14 trillion per annum by 2050, equivalent to 7% of world GDP [7].

A recent TEEB Quantitative Assessment [8] modelled the benefits of a number of global change scenarios and estimated that a ‘reduced deforestation scenario’ could deliver annual net benefits of US\$ 183 billion by 2030, as a result of the high per hectare values estimated for forest biomes. Other scenarios involving increased agricultural

productivity and dietary changes could also deliver substantial net benefits. A 2007 study found that the total value of ecosystem services and products provided by the world’s coastal ecosystems, including natural (terrestrial and aquatic) and human-transformed ecosystems, added up to US\$ 25 783 billion per year [9].

As well as providing direct benefits to people and economies, action for ecosystems also creates new market opportunities for green products and services. For example, the TEEB Synthesis report [10] cited estimates that revealed that global sales of organic food and drink have recently been increasing by over US\$ 5 billion a year, reaching US\$ 46 billion in 2007; the global market for eco-labelled fish products grew by over 50% between 2008 and 2009; and ecotourism is the fastest-growing area of the tourism industry with an estimated increase of global spending of 20% annually.

Braat and ten Brink [7] found that the costs of policy inaction with respect to a failure to halt biodiversity decline would give rise to increasing and cumulative economic losses, which could grow to a value of \$14 trillion per annum by 2050, equivalent to 7% of world GDP. Costanza *et al.* [11] estimated the annual global value of ecosystem services at US\$ 125 trillion in 2011. The authors estimated that global land use changes between 1997 and 2011 have resulted in a loss of ecosystem services of between US\$ 4 and US\$ 20 trillion per year.

Many of the world’s poor are directly dependent on biodiversity for acquiring a diversity of foods and nutrients, and for household coping strategies during times of stress [12]. Bushmeat and other edible wild mammals, reptiles, birds and insects that live in trees and forests can

account for up to 85% of the protein intake of people living in or near forests. One study found children in Madagascar were three times more likely to develop anaemia when bushmeat and its associated micronutrients were removed [13]. Some 30 million people in coastal and island communities are totally reliant on reef-based resources as their primary means of food production, income and livelihood. The world's fisheries provide about 16% of the protein consumed worldwide [14]. Thus investments in biodiversity, and particularly in conservation, sustainable use and community management of those species that are primary food resources could make an important contribution to action to achieve food security and nutrition.

It is estimated that the value of ecosystem services (e.g. organic waste disposal, soil formation, bioremediation, nitrogen fixation and biocontrol) provided each year in agricultural systems worldwide may exceed US\$ 1542 billion [15]. About 100 000 species of insects as well as birds and mammals pollinate more than two-thirds of food plants. Pollinators have been found to be worth more than US\$ 200 billion per year to the global food economy, which amounts to 9.5% of the total value of the world's agricultural food production [16]. Also, genetic diversity is central to the seed industry. The top 10 companies had commercial seed sales of US\$ 15 billion in 2006 [14].

By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under water stress conditions. Investments in the protection, sustainable management and restoration of biodiversity and ecosystems such as wetlands, forests, grasslands and soils offer significant solutions to water security, including, through regulating climate and rainfall, enhancing water storage, controlling land erosion and regulating water quality [17].

Evidence from all regions of the world strongly endorses the value of 'natural infrastructure' for water quality and supply. In Chingaza National Park, Colombia, the Bogota Water and Aqueduct Company saved more than US\$ 15 million in treatment costs in 2004 by investing in watershed improvements. In Honduras, the cloud forests of La Tigua National park (23 871 ha) provide over 40% of the annual water supply to 850 000 people of Tegucigalpa. In 2008 it was estimated that about 80% of Quito's 1.5 million people relied upon drinking water from two protected areas; Antisana and Cayambe-Coca Ecological Reserve, and water companies were therefore contributing to protected areas management costs [18]. In Africa, the capacity of natural wetlands in the Western Cape, South Africa to remove excess nutrients was estimated to be worth US\$ 1913 per ha per year [19].

The world's fisheries employ around 200–260 million people [20,21] and generates a landed value estimated

at US\$ 100 billion. Global fisheries 'underperform' by US\$ 50–67 billion annually [20,22]. Competition between highly subsidized industrial fishing fleets coupled with poor regulation and weak enforcement of existing rules has led to over-exploitation of the most commercially valuable fish stocks, reducing the income from global marine fisheries by US\$ 50 billion annually, compared to a more sustainable fishing scenario [8]. The aggregate costs for transitioning towards green agriculture were estimated to be US\$ 198 billion per year (between 2011 and 2020) and represent a yearly increase in value added of about 9% and an additional 47 million jobs in comparison with business as usual scenarios [5,23].

In Sub-Saharan Africa, the agriculture sector accounted for 12.7% of GDP in 2009, and employed more than 60% of the labour force. The formal forest sector employs some 13.2 million people across the world and at least another 41 million are employed in the informal sector. Ecotourism generates significant employment and is now worth around US\$ 100 billion/year [14]. These economic sectors will benefit significantly from investments in biodiversity, the sustained delivery of ecosystem services and in improved sustainability of production systems.

Maintaining healthy oceans and restoring and conserving forests and wetlands are key strategies for climate change mitigation. Halving deforestation rates by 2030 would reduce global greenhouse gas emissions by 1.5–2.7 GT CO₂ per year, thereby avoiding damages from climate change estimated at more than US\$ 3.7 trillion (net present value) globally [24]. It is well established that carbon stocks in intact forests are more resilient than those in degraded fragmented forests. Other mitigation actions include protection of soil carbon, and reducing emissions from wetland, marine and agricultural systems.

There is a growing body of evidence on the value of 'blue carbon'—carbon sequestration and storage in marine and coastal ecosystems. Mangroves are a significant global carbon store and sink, with the largest average carbon stocks per unit area of any terrestrial or marine ecosystem. The global average carbon stock of mangroves is around 1000 tonnes of carbon per hectare, including soil carbon [25]. It has been estimated that the carbon released as a result of conversion of coastal ecosystems (marshes, mangroves, sea grasses) amounts to 0.15–1.02 billion tonnes of carbon dioxide annually, equivalent to 3–19% of that released from deforestation, and with resultant economic damage of US\$ 6–14 billion annually (Pendleton *et al.*, 2012) [26]. The economic value of the role of high seas carbon sequestration has been estimated at between US\$ 74 and US\$ 222 billion annually [27].

Based on Ref. [4] annual aggregate estimates of investment needs, the global per capita investment needed for biodiversity action is estimated to be between US\$ 20 and

US\$ 60. This translates to investment requirements ranging from 0.002% to 0.007% of global GDP. This level of investment would not only result in the sustainable use and conservation of biodiversity and reversing biodiversity loss by 2020, it would also result in many co-benefits to different sectors of the economy [4].

Insights emerging from the work of High Level Panel

We briefly present ten insights from the work of the HLP (1 and 2) on (i) the cost and benefits of meeting the Aichi Targets; (ii) the investment gap between current investment levels versus what is needed; and (iii) the institutional and capacity developments that needs to be in place to increase the chance of meeting the Aichi Targets. For details of the basis for these insights readers are referred to HLP reports (1 and 2) [4,5].

Meeting the Aichi Targets will deliver substantial benefits to people and to economies across the world: Assessments at the global, regional, national and local levels all highlight the substantial values of the essential provisioning, regulating, cultural and supporting services that ecosystems provide, and the benefits of actions for the conservation and sustainable use of biodiversity, and for restoration of degraded ecosystems.

Biodiversity is essential to sustainable development: Investments in biodiversity and in the implementation of the Aichi Targets will deliver significant co-benefits for sustainable development [28**], and thereby help the world meet its Sustainable Development Goals of United Nations (SDGs). Biodiversity underpins natural capital, which represents, on average, 36% of the total wealth of low-income countries and supports more than half of the 'GDP of the poor', which encompasses all the sectors (e. g., forest, fish, water, soil) from which much of the developing world's poor draw from directly for their livelihood and employment [29]. Nature-based investments will be an essential component of the movement towards inclusive green economies. Sustainable agriculture and fisheries, alongside technological development, is likely to improve incomes; establishing protected areas will create new opportunities for tourism business [30*]; and the control of invasive alien species and restoration will create jobs.

Biodiversity contributes to climate change mitigation, adaptation and resilience: Investing in biodiversity can effectively reduce national and community vulnerability, increase resilience and aid adaptation to climate-related impacts at all scales, and contribute significantly to climate change mitigation, including helping to meet mitigation targets [31*,32]. Maintaining healthy oceans and restoring and conserving forests and wetlands are key strategies for climate change mitigation. Halving deforestation rates by 2030 would reduce global greenhouse gas

emissions by 1.5–2.7 GT CO₂ per year, thereby avoiding damages from climate change estimated at more than US \$ 3.7 trillion (net present value) globally [5]. It is well established that carbon stocks in intact forests are more resilient than those in degraded fragmented forests. Other mitigation actions include protection of soil carbon, and reducing emissions from wetland, marine and agricultural systems.

Investments in biodiversity can strengthen the provision of ecosystem services on which vulnerable communities depend: As biodiversity loss disproportionately affects vulnerable populations, investments in biodiversity will secure the long-term provisioning of key services and access to critical biodiversity resources that are essential for food security, economic opportunities, human well-being and quality of life. Regional evidence demonstrates that vulnerable communities within developing countries are particularly dependent on ecosystems and their services. About 70% of the world's poor — some 870 million people — live in rural areas and many are directly dependent on biodiversity for their survival and well-being, including for the direct provision of food, fuel, building materials, clean water, medicinal plants and other necessary goods.

Biodiversity provides insurance and option values: Investments in biodiversity can provide insurance against uncertain and accelerating future environmental change, and maintain and enhance future development options. Investments made now will reduce future costs and preserve opportunities for current and future generations. Failing to invest in biodiversity now will increase the risks and costs in the future. The World Economic Forum Global Risks report [33] found that four out of the eight worst global risks are ecosystem-based.

Enhancing synergies, addressing trade-offs and promoting alignments across sectoral policies, are prerequisites for effective implementation of the Aichi Targets and of major importance for resource mobilization: developing harmonised objectives across sectors to develop and implement mutually supportive policies and activities, and increased efforts to manage trade-offs are all important steps for achieving the Aichi Targets, delivering co-benefits and developing cost-effective pathways towards a sustainable society. This will help to identify co-funding opportunities and to secure contributions to meeting the Aichi Targets from a wide range of sources across economies and societies.

All countries need to invest in institutions and policy frameworks, direct conservation and sustainable use actions, incentives and economic instruments: cohesive, well-designed institutions and effective policy frameworks are a prerequisite for effective and efficient biodiversity financing. The full report presents a typology of the investments needed to meet

the Aichi Targets, and reviews evidence about investment needs in different countries and regions. It shows that ‘bottom-up’ assessments of investment needs are broadly consistent with the ‘top-down’ global assessment of investments needed to meet each Target presented in Ref. [4]. There is a need to respect and learn from indigenous peoples and local communities’ knowledge and their contribution to the sustainable use and conservation of biodiversity, including recognizing property and access rights, and enhancing their participation and involvement in planning and implementation processes.

Design and implementation of appropriate economic and policy instruments is essential to halt the loss of biodiversity: Achieving the Aichi Targets at least-cost will require more efficient use of public budgets, together with the application of a wider range of economic instruments and incentives. The actions required to meet the Aichi Targets require major investments and, given the very real constraints, trade-offs and priorities will have to be made. Nevertheless, resources acquired through grants and government funding can and should be stretched using better financial strategies, providing better incentives and encouraging investments from the private sector as far as possible, recognizing the multiple benefits and beneficiaries. There is equally a role for national governments in the establishment of the enabling conditions that allow for further involvement of the private sector. At a global scale, it has been estimated that the removal of harmful fisheries subsidies, which currently amount to ~US\$ 20 billion [34], would contribute to obtaining a net gain in the returns to fisheries of US\$ 124.8 billion (\$77.6–170.6 billion) by 2020 [35]. Further work to identify and address the barriers to subsidy reform will aid this process.

The monetary and non-monetary benefits of biodiversity conservation and sustainable use frequently outweigh the costs: The benefits of biodiversity conservation and sustainable use have been shown to greatly exceed the investment costs for all regions and for a wide range of Aichi Targets. Based on Ref. [4], annual aggregate estimates of investment needs, the average global per capita investment needed for biodiversity action is estimated to be between approximately US\$ 20 and US\$ 60.¹⁷ This translates to investment requirements ranging from 0.002% to 0.007% of global GDP. The first report of the High-Level Panel [4] provided a first overall estimate of the level of resources required to deliver the Aichi targets globally, by aggregating global ‘top-down’ estimates for each of the 20 targets. Through simple addition of the resource requirements identified for each Target, the resources needed to implement the twenty Aichi Biodiversity Targets were estimated at between US\$ 150 billion and US\$ 440 billion per year. These estimates include existing expenditures.

¹⁷ Based on a global population of approximately 7 billion people.

There is a need to increase investments substantially to bridge financing gaps: Estimates at global, regional and national levels all point to a substantial gap between the investments needed to deliver biodiversity targets and the resources currently allocated. This is true for all of the Aichi Targets. The first High-Level Panel report found that, for most of the Aichi Targets, there is a substantial gap between the resources required and those currently being allocated nationally and internationally. This finding is supported by assessments at global, regional and national levels. For example, one review estimated current levels of global funding for biodiversity at between US\$ 51 and 53 billion annually, compared to estimated needs of US\$ 300–400 billion annually [36].

Concluding remarks

Both the literature review and the HLP reports highlighted the benefits of policy action on biodiversity, reflecting that meeting the Aichi Targets would have benefits far beyond biodiversity, for human health and well-being, as well as economic and environmental stability. Understanding, communicating and potentially enhancing the role of biodiversity in delivering a range of goals across the economy and society is strongly emphasised alongside the role of institutions, policy frameworks and incentives to ensure that this role is captured in decisions across all sectors.

The need to work broadly with stakeholders outside the biodiversity community and to explore and exploit synergies where co-benefits can be revealed (e.g., with regard to investments in climate change mitigation/adaptation) feature strongly. Building on this, the need to ensure that investments in biodiversity are understood as real options to deliver sustainable development, growth and poverty alleviation is emphasised.

For the world to increase its chance of meeting the Aichi Targets and the SDGs, we suggest that countries should identify actions through which mainstreaming biodiversity can directly contribute to achieving national sustainable development goals and plans, and find ways to enhance the links between climate change policies, projects and programmes and biodiversity conservation and sustainable use. The latter is a way to leverage available funds for both climate change and biodiversity actions, thus achieving co-benefits. Further, it is crucial that the in-kind contributions of indigenous peoples and local communities’ collective actions, efforts and knowledge on the conservation and sustainable use of biodiversity are duly recognized; and there is a strong need to integrate into training, education and capacity building programmes, awareness of the economic rationale for action for biodiversity and ecosystem services, and their role in achieving sustainable development. Finally, it is vital to ensure that investments are made to improve knowledge generation regarding the insurance value of biodiversity.

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- of outstanding interest

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