# Ensuring Co-benefits for Biodiversity, Climate Change and Sustainable Development

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**Abstract** Significant investments are required by Parties to the three Rio Conventions—Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD), as well as the United Nations 2030 Agenda for Sustainable Development (2030 Agenda), to meet the ambitious goals that countries have agreed to. When the development of national and subnational frameworks to meet global commitments are conducted in isolation, the opportunity is lost to: (1)

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leverage co-benefits from the same investment; (2) use resources more efficiently; and (3) ensure that one action does not negatively affect another policy priority. For example, investments in greenhouse gas reduction have the potential either to positively impact biodiversity and sustainable development, or to result in unintended negative consequences; chances of positive synergies are greatly increased by cooperation and joint policy, planning and implementation. The challenge now is to learn lessons from the vast and diverse number of approaches being tried around the world and to enhance co-benefits. This paper describes the major inter-linkages between global commitments for conservation and development. It demonstrates the importance of enhancing synergies among global agreements and avoiding unintended and negative consequences, particularly on biodiversity, by providing examples of best practices and describing some of the pitfalls that occur when implementation of one agreement does not explicitly seek to enhance co-benefits with other agreements. In conclusion, the paper presents the case for the central role of nature-based solutions in simultaneously attaining global commitments for biodiversity, climate change and sustainable development.

## Introduction

The world is at cross-roads with the convergence of several crises: catastrophic climate change, the sixth mass biodiversity extinction event, land degradation on a massive scale (Ripple et al. 2017) and increasing economic inequality in spite of a reduction in extreme poverty (World Bank 2016). Despite bold global commitments, and some specific successes, progress on all of these issues has been too little and too slow.

The United Nations Convention on Biological Diversity (CBD), Framework Convention on Climate Change (UNFCCC), Convention to Combat Desertification (UNCCD) and the 2030 Sustainable Development Agenda and its associated Sustainable Development Goals (SDGs), all recognize, in various decisions, the inter-linkages between their agreements and the benefits of co-implementation. While commitments have been made to enhance synergies, co-implementation has proven to be difficult in practice and negative impacts on biodiversity in particular, from implementation of other priorities, frequently occurs.

The cost of fully implementing the Aichi Biodiversity Targets of the CBD, the Paris Agreement of the UNFCCC, the SDGs and the UNCCD's target of land degradation neutrality (LDN) is estimated at hundreds of billions of dollars per year until 2030 (CBD High-Level Panel 2014; Stern 2015; Schmidt-Traub 2015). The sheer scale of investment required is argument enough to ensure that progress towards one goal does not hamper progress towards another. Add to that the inter-relatedness of these goals and enhanced effectiveness and efficiency that could be gained from working in concert across issues, and the need to develop ways for effective co-implementation becomes obvious (Science for Environmental Policy 2015; Cadena et al. 2017; Quéré et al. 2014; Executive Secretary of Convention on Biological Diversity 2017; Schultz et al. 2016; Steiner 2017). Despite some notable exceptions, and efforts at the global level, there is little consistency or cross-referencing between global goals (Bodin and Santamari 2016). Potential approaches have been proposed, including enhancing resilience thinking (Cadena et al. 2017; Schultz et al. 2016), the ecosystem approach (Bodin and Santamari 2016; Epple et al. 2016), the landscape approach (Sayer et al. 2013), landscape management (Peterson 2011) adaptive management (Epple et al. 2016), ecosystem-based adaptation (Herr and Landis 2016) and using the CBD's National Biodiversity Strategies and Action Plans as mechanisms to foster integrated thinking (Cadena et al. 2017; Executive Secretary of Convention on Biological Diversity 2017). Even from the perspective of climate change goals alone, taking an integrated approach is essential, including for enhancement of carbon sinks in terrestrial and coastal sectors (IPCC 2014) and placement of renewable energy infrastructure (Science for Environmental Policy 2015). Yet at the national and regional levels there are relatively few successful examples of attaining co-benefits.

Many countries and organizations have already emphasized the importance of taking measures that maximize synergies among global goals and minimize negative impacts and externalities (Bodin and Santamari 2016) [i.e. tackling Aichi Biodiversity Targets on protected areas and ecosystem degradation and specific Sustainable Development Goals (Brooks et al. 2015)]. These provide valuable principles to guide countries towards co-implementation and co-measurements of success. The need now is to go beyond principles and to develop the capacity and concrete tools for making decisions that enhance implementation of global commitments, at different scales, without creating undesirable impacts and unnecessary trade-offs. As 2020 approaches, and progress towards biodiversity, climate change and sustainable development goals are assessed, the importance of turning principles into concrete decision-making tools has become urgent.

In this paper, we analyze—through different approaches—major convergence points between the Rio-Conventions and the 2030 Agenda, exploring entry points that can be useful to regional, national and subnational efforts to increase co-implementation and avoid potential trade-offs.

## Biodiversity and Nature-Based Solutions to Climate Change Mitigation

1. *Terrestrial Ecosystems*

To keep global temperature rise this century well below 2 °C, relative to pre-industrial levels, emissions of greenhouse gases into the atmosphere must be reduced by 50–70% by 2050 and to zero by 2100 (IPCC 2014). Several actions will have to be taken simultaneously: (i) reduction and eventual phase-out of fossil fuels; (ii) reduction of emissions from land use and land use change; (iii) removal of carbon dioxide from the atmosphere (The Economist 2017; Rockström et al. 2017; IPCC 2014); and (iv) maintenance of natural carbon sinks and storage (Rockström et al. 2017). Recognizing that Land Use, Land-Use Change and Forestry (LULUCF) account for approximately 24% of total greenhouse gas emissions—almost equivalent to energy and heat production (25%) and more than transportation (16%) or industrial activity (21%) (Thompson 2014)—the Paris Agreement on Climate acknowledges that nature-based solutions will play an important role in reducing greenhouse gas emissions (see Article 5, UNFCCC 2015). The necessity of this approach has been reinforced by the International Declaration on Nature-Based Solutions for Water Management Under Climate Change (Marrakech Partnership et al. 2017), the RED-PARQUES Declaration (REDPARQUES 2015b), the inclusion of nature-based solutions in some—albeit only a few—Nationally Determined Contributions (NDCs) to climate change (Laurans et al. 2016) and in the scientific literature (Rockström et al. 2017). According to some estimates, nature-based solutions to climate change, such as restoration of forests, wetlands, grasslands and agricultural lands, afforestation and protection of ecosystems that are currently sequestering and storing carbon, could reduce greenhouse gas emissions by as much as 37% by 2030 (Griscom et al. 2017). In the interest of advancing an integrated approach the CBD, at its thirteenth Conference of the Parties, expanded the sectors in which it intends to mainstream biodiversity to include energy and mining, manufacturing, processing and health sectors (CBD 2016).

One important feature of nature-based solutions to climate change mitigation is that LULUCF can reverse the negative impacts of past activities (UNFCCC 2014). Carbon stocks in forest biomass decreased by an estimated 0.22 Gt annually from 2011–2015, mainly because of a reduction in forest area. Through better forest management, forest restoration and afforestation these losses can be reversed.

Brazil's NDC to the Paris Agreement provides an example of how nature-based solutions can be integrated into climate change mitigation. Brazil aims to reduce greenhouse gas emissions by 37% below 2005 levels by 2025, through the implementation of policies that also build resilience of populations, ecosystems, infrastructure and production systems, by reducing vulnerability, and through the provision of ecosystem services [Federative Republic of Brazil (FRB) 2016].

2. *Marine Ecosystems*

Oceans, including coastal ecosystems, have sequestered approximately 30% of the carbon dioxide in the atmosphere since pre-industrial times (Thompson 2014). Blue carbon—the carbon stored in mangroves, salt marshes and seagrasses—is a major carbon sink, covering less than 20% of the total ocean area, but accounting for approximately half of the total carbon sequestered and stored in marine sediments. These habitats are found on every continent except Antarctica and combined cover 49 million hectares (The Blue Carbon Initiative 2017).

The role of coastal ecosystems in climate change mitigation is better understood than open ocean ecosystems, and is often included in calculations of the importance of ecosystems in climate change mitigation (Duarte et al. 2013; Roberts et al.

2017; Epple et al. 2016). For example, the loss of vegetated marine habitats, such as seagrasses, salt-marshes, macro-algae and mangroves is estimated to result in a net emission of 1 Gt $CO_2$ per year (Duarte et al. 2013). This compares to the 4.9 Gt annual emissions from land use change, including forestry (Griscom et al. 2017). IUCN estimates that if half of the annual coastal wetlands loss was halted, emissions would be reduced by a 0.23 Gt $CO_2$ per year (Herr and Landis 2016)—equivalent to taking 50,000 cars off the road (calculated from US Environmental Protection Agency 2017). Although the potential for forest activity to sequester carbon is greater than for coastal marine habitats, the coastal marine habitats provide a significant contribution and their importance to biodiversity is equal to that of forests (Duarte et al. 2013; Herr and Landis 2016).

As of 2016 only 28 countries had included coastal wetlands as part of their NDCs for climate change mitigation, most of which specifically refer to mangrove protection, conservation and restoration. More widespread inclusion of coastal wetlands in NDCs would have significant co-benefits for both biodiversity and sustainable development (Herr and Landis 2016).

Ocean acidification is increasingly recognized as a carbon-driven problem threatening ocean food webs, food security and livelihoods. Since the industrial revolution, the acidity of ocean water has increased by about 30%, potentially threatening shell-building marine life, including phyto- and zoo-plankton, which are the base of the marine food web (Pacific Marine Environmental Laboratory Carbon Program 2017). The need to reduce ocean acidification is prominent in both the SDGs and the Aichi Biodiversity Targets, further highlighting the need to integrate efforts.

Marine protected areas (MPAs) can enhance the ability of the oceans to sequester more carbon without increasing ocean acidification and without negatively impacting marine species. There are two mechanisms by which this can occur. First, fish excrete ammonia or ammonium through their gills, making the most bioavailable form of nitrogen available to primary producers, which in turn sequester $CO_2$ from the atmosphere. Enhanced fish populations, which are protected from overfishing in MPAs, will make more nitrogen available, resulting in increased primary productivity. This effect can be significant. One study showed that nitrogen cycling can be enhanced by four to fivefold in unfished sites compared to fished sites. The second mechanism by which marine systems can increase carbon sequestration is just beginning to be better understood. Fish are known to affect the marine inorganic carbon cycle by calcifying carbon in their guts and excreting carbonate [i.e. calcified carbon], much of which ends up as stored carbon in marine sediments. However, information is lacking on several aspects of this process, making it difficult to determine its overall contribution to removal of atmospheric $CO_2$ (Roberts et al. 2017).

Just as deforestation results in $CO_2$ emissions to the atmosphere, activities that disturb the ocean floor, such as bottom trawling and seabed mining, can readily remobilize stored $CO_2$ with unknown consequences to the marine carbon cycle. MPAs have the potential to serve as a valuable tool to manage these impacts.

All nature-based solutions to reduce greenhouse gases emissions and improve carbon sequestration can have an impact on biodiversity and on the livelihoods and well-being of people who depend on biodiversity. There is no magic, one-size-fits-all tool that will ensure that decisions to meet one goal do not have a negative impact on others. At the project assessment level, a decision-screen that weighs impact and maximizes all benefits is needed.

## The Relationship Between Biodiversity and the Sustainable Development Goals

Biodiversity is relevant to all SDGs, including those that do not directly reflect the Aichi Biodiversity Targets. An overview of the importance of the 2030 Agenda for Sustainable Development, and associated SDGs, as an enabling environment for the achievement of the Aichi Biodiversity Targets has been provided by the Convention on Biological Diversity (Executive Secretary of Convention on Biological Diversity 2017; Schultz et al. 2016). Briefly, achieving the SDGs addresses the drivers of biodiversity loss, builds the institutional capacity for governing biodiversity and aids in mainstreaming biodiversity through recognition of the ecosystem services provided by biodiversity (Schultz et al. 2016). Aware of the strong links between the SDGs and the Aichi Biodiversity Targets, the 13th Conference of the Parties (COP 13) to the CBD decided that Parties and all relevant stakeholders should integrate and mainstream biodiversity into implementation of the SDGs.

## The Relationship Between Land Degradation Neutrality and Other Biodiversity and Climate Targets

The UNCCD has made land degradation neutrality [LDN] the central focus of its global strategy, recognizing the health of the land as a unifying theme that influences biodiversity, human livelihoods and climate change in equal measure. The SDGs explicitly support attainment of LDN in SDG 15.3, to: "combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation neutral world". Attaining LDN implies a drastic reduction in land use change such as deforestation and loss of natural grasslands, which in turn has positive impacts on climate change mitigation and biodiversity conservation.

## Mitigating Climate Change, Safeguarding Biodiversity, Reducing Land Degradation and Supporting Sustainable Development Goals

1. *Spatial Planning*

Spatial planning—on both land and in the ocean—is the first step to enable integrated thinking across a landscape. There are good examples of how spatial planning can work for safeguarding or enhancing biodiversity, mitigating climate change and taking into account sustainable development. Several European countries have implemented a project screen for renewable energy projects in which sensitivity mapping locates important biodiversity areas, including protected areas, and avoids these when locating wind or solar energy infrastructure (Science for Environmental Policy 2015). German law prevents the siting of renewable energy infrastructure at locations that conflict with conservation goals (Peschel 2010). In response, the German Solar Industry Association, in conjunction with the German Society for Nature Conservation, has drawn up criteria to guide nature-friendly solar development (Peschel 2010). Solar photovoltaic arrays and wind installations—both of which are important for reducing fossil fuel use—are situated to avoid protected areas and carbon sequestering ecosystems, retain trees and hedges, avoid disturbance of birds and bats during breeding season and surrounding vegetation is managed for the benefits of wildlife.

South Africa has taken a landscape approach in which sensitivity mapping, at various scales, identifies protected areas, endangered ecosystems and ecological support areas needed to maintain resilient ecosystem services. This spatial mapping allows for the identification of appropriate areas for production, development and conservation, thus implementing CBD, UNCCD, UNFCCC and the SDG goals, with one comprehensive process (Peterson 2011).

Supported by spatial mapping, several tools are available to facilitate decisions that provide multiple benefits. At a global or national scale, Key Biodiversity Areas (KBAs) are "sites contributing significantly to the global persistence of biodiversity" and therefore help to plan development in ways that minimize negative impacts on biodiversity (IUCN 2016a). Similarly, the identification of High Conservation Value Areas (HCVA) is a tool widely used in landscape mapping, conservation and natural resource planning and advocacy. Its six values cover environmental and social priorities shared by a wide range of stakeholders (Senior et al. 2015). The many gap analysis tools available, such as the USGS Gap Analysis Program (USGS 2017), help to maximize the effectiveness of protected area networks by locating protected areas in the most suitable locations for multiple benefits. IUCN has developed a framework for countries to rapidly identify areas suitable for forest landscape restoration—Restoration Opportunities Assessment Methodology (ROAM). This tool allows for optimizing positive impacts of land use transitions on key ecosystem services, including carbon sequestration, the provision of hydrological services, water yield and sediment retention and nutrient retention (IUCN 2016b).

It is important to note that spatial planning is somewhat controversial because its use can make trade-offs among different values and sectors more immediate and tangible. For this reason, it is essential to build in robust stakeholder and public participation into planning processes.

2. *Land and Freshwater Management*

Once spatial planning has identified current land and water use, and made proposals about future uses, many land management tools are available to protect multiple values across a landscape.

*Protected Areas and Other Effective Area-Based Conservation Mechanisms (OECM)*

The pivotal role that connected, well-funded, well-managed protected areas play in supporting not only biodiversity goals, but also sustainable development and climate change goals, is increasingly recognized (Nature Needs Half 2017; Ripple et al. 2017; REDPARQUES 2015a; Dudley et al. 2010, 2014, 2017; Secretariat of the Convention on Biological Diversity 2016). About 312 Gt of $CO_2$ are stored in the world's protected area network, equivalent to 15% of the world's terrestrial carbon stock (Dudley et al. 2010).

Emerging information supports the benefits of well-planned and managed protected areas in implementation of the SDGs. For example, in Costa Rica and Thailand, districts adjacent to protected areas experience 10 and 30% less poverty, respectively, than districts without protected areas (Turner et al. 2012). The natural ecosystems maintained by protected areas contribute to a range of ecosystem services, including food and water security, disaster risk reduction and health and recreational services and the economic values of these are increasingly being recognized.

REDPARQUES (Latin American Technical Cooperation Network on National Parks, and other Protected Areas and Wildlife) is a unique network of protected area agencies that seeks to improve the management of national parks and other protected areas through technical cooperation and the exchange of knowledge and experience among its 19 member countries. One of the unique elements of REDPARQUES is that it has expanded recognition of the importance of protected areas in mitigation of and adaptation to climate change, thereby providing a model for using protected areas to attain multiple goals. The Amazon Vision, one of the REDPARQUES partners, includes an initiative on "Protected Areas, Natural Solutions against Climate Change (NASCC)". This initiative recognizes that protected areas are key to building resilience to mitigate the impacts of a changing climate, to ensuring the provision of ecosystem services on which people depend and to protecting biodiversity (REDPARQUES 2015a; Suarez et al. 2015). The Amazon Vision makes extensive use of spatial mapping to identify climatic conditions, climate risk and opportunities to enhance resilience in the Amazon's protected areas network. This tool provides a foundation for decisions on management of existing protected areas and creation of new ones that include multiple goals and values and facilitates a climate smart-landscape approach to other agendas, including participatory land use planning and the development of infrastructure (Suarez et al. 2015).

Global efforts to encourage different forms of conservation management, which allow for economic activity without losing the ecosystem values of the natural systems, could lead to recognition of new types of protected areas and the prevention of carbon-emitting land conversions such as deforestation. Furthermore, the potential of conservation outside the protected areas network is gaining increasing recognition. The initially confusing wording of Aichi Target 11, which referred to "protected areas and other effective area-based conservation measures" has been the trigger for debate on the definition and recognition of a set of sites that, whilst not being full protected areas or having nature conservation as a primary aim, are nonetheless managed in ways compatible with the long-term maintenance of biodiversity, reduction of land degradation and integration into climate change strategies (Laffoley et al. 2017). Indigenous conservation areas could play a previously unrecognized role, as could watershed protection areas, well-managed forestry and traditional grazing areas. Tenure-secure indigenous forest lands—some of which would be considered conservation areas—in Bolivia, Brazil and Colombia are equivalent, in terms of carbon sequestration, to taking 9–12.6 million passenger vehicles off the roads for a year (Watts 2017).

The potential for leakage highlights the importance of considering the effects of protected areas creation and other conservation actions such as logging bans across different spatial scales. Leakage happens when the creation of protected areas in one location leads to compensatory increases in habitat loss in another. For example, in South East Asia, some countries have reversed the trend of conversion of natural forests through strong policies and enforcement. In neighboring countries, where policies, enforcement and governance are weaker, the pressure for conversion of natural forest lands, particularly to agriculture, has increased (Leadley et al. 2016; Bodin and Santamari 2016).

*Ecosystem Restoration*

Given the significant contribution of degraded or converted natural ecosystems to greenhouse gas emissions, many people have turned their attention to ecosystem restoration as part of the solution to climate change mitigation. Opportunities exist in drylands to halt and reverse desertification, in agricultural lands to increase carbon in soils as a climate mitigation strategy and also to reduce soil erosion, and in restoration of peat and other wetlands for multiple ecosystem functions. It is estimated that restoration of degraded forests, grasslands and wetlands could reduce greenhouse gas emissions significantly by 2030 (Leadley et al. 2016; Griscom et al. 2017), ensure habitat for species, including those at risk and provide an array of ecosystem services, such as disaster risk reduction and provision of fresh water. However, despite a plethora of guidance on how to restore specific ecosystems (Society for Ecological Restoration 2012), there is still a net loss of forests and ecosystems that sequester and store carbon (Secretariat of the Convention on Biological Diversity 2014).

Although ecosystem restoration was originally intended as a process to restore ecosystems to their historical state (Society for Ecological Restoration 2012), in more recent years the term has also been used more loosely to describe reforestation or afforestation efforts that might aim to gain carbon sequestration potential without considering other ecosystems services and biodiversity. Reforesting with monocultures of exotic species falls into this category, where reforested area may indeed sequester carbon, while being detrimental for biodiversity (Ferez et al. 2015). Furthermore, climate change increases the possibility that restoration to an “original” state is impossible from a practical perspective and that restoration to a new but ecologically functioning ecosystem may be more realistic.

The New York Declaration on Forests—an update of the Bonn Challenge—aims to bring 150 million hectares of degraded and deforested land into restoration by 2020 and 350 million hectares by 2030. This declaration recognizes that these restoration efforts have to be implemented with national priorities in mind, such as water and food security, rural development, climate change, biodiversity and land degradation neutrality. As of September 2016, commitments for forest restoration under this initiative include 63.3 million hectares in Africa, 23.6 million hectares in Latin America and 22.4 million hectares in Asia (Bodin and Santamari 2016).

Investments in ecosystem restoration have increased over the past few years on all continents (Bodin and Santamari 2016). It is time to measure the successes and challenges from existing approaches in attaining co-benefits for biodiversity, climate change and sustainable development.

*REDD+*

Some initiatives originally intended for climate change mitigation have been expanded to include biodiversity conservation. Reducing emissions from deforestation and degradation (REDD) in developed countries was expanded in the Bali Action Roadmap to include conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) (Harvey et al. 2010). REDD+ supports climate change goals as well as conservation and sustainable development goals articulated in the Aichi Biodiversity Targets and SDGs. Some of the ways in which REDD+ now supports multiple goals are: the expansion of the eligibility for funding to countries with historically low deforestation; use of criteria that ensures REDD+ does not result in the conversion of natural forests to plantations, exotic monocultures or non-forested systems; use of criteria to prevent leakage—ensuring that protecting forests in one place does not result in deforestation in another place; and prevention of funds to projects with questionable mitigation benefits and few or no biodiversity benefits (e.g. palm plantations) (Harvey et al. 2010).

Many REDD+ projects have already demonstrated the benefits of this new approach, including: the Taita Hills Project in Kenya, which generates carbon offsets for the protection of forest and savannah outside Tsavo National Park; the Rukinga Wildlife Sanctuary, also in Kenya, which provides income to the community, government and local landlords for avoiding greenhouse gas emissions from deforestation (IPCC 2014). A model looking at the potential for REDD+ to positively affect biodiversity, demonstrated that in Brazil the number of threatened species could be reduced to 6 species from 311 by simply enforcing Brazil's new Forest Code (Mead 2016), which is now known as the Law of Native Vegetation Protection (LNVP).

Mangroves are now eligible for REDD+ funding, and efforts are underway to establish a voluntary carbon standard to create sustainable financing for other blue carbon habitats.

3. *Management of Marine Systems*

The development of the SGDs and the increasing recognition of the role of oceans in regulating global climate offer important opportunities to better integrate coastal and ocean management with climate mitigation efforts. In addition, the dramatic impacts of climate change on ocean ecosystems, such as the increase in ocean surface temperature, acidification, shrinking of Arctic sea-ice and sea-level rise, will have significant impacts on global food security, biodiversity and risks from disasters (IPCC 2014; Melillo et al. 2016).

Many tools described above for land management—protected areas, ecosystem restoration and spatial planning—are also being applied in coastal and ocean systems. Five per cent of waters under national jurisdiction are now protected (UNEP-WCMC and IUCN 2016) and the United Nations is considering governance mechanisms for managing biodiversity in areas beyond national jurisdiction—the 60% of the planet known as the high seas.

4. *Enabling Policy*

Large scale replacement of fossil fuels with renewable energy is a component of most scenarios to attain climate change goals (IPCC 2014). This approach could be positive or negative for biodiversity and sustainable development, depending on how it is implemented. Tools for identifying trade-offs and minimizing negative impacts are clearly needed. For example, an increase in bioenergy, coupled with carbon capture and storage (BECCS), is prominent in most scenarios that result in attainment of the Paris Agreement. However, a massive increase in bioenergy would require land use change, including the conversion of natural habitats to agriculture and existing agricultural area from food production to bioenergy production. Land use change on the scale required would result in negative impacts on both biodiversity and SDGs (Leadley et al. 2016). The same trade-offs are apparent in planned increases in hydro-electric power, which can result in deforestation, loss of aquatic habitat (Charity et al. 2016) and the release of $CO_2$ and methane (Deemer et al. 2016; Scherer and Pfister 2016).

Some countries have enshrined the importance of multiple benefits in law. The German Renewable Energy Sources Act only allows installations of solar parks on land that has been previously disturbed such as by farming or military use. Ideal sites include brownfield and degraded land—creating so-called “brightfields”.

Increases in economic activity, related to SDG Goal 8 on “decent work and economic growth”, has the potential to result in policies and activities that encourage economic activity at the expense of biodiversity conservation and climate change mitigation and adaptation. An example of this is the 134,866 km of fossil fuel pipelines currently under construction or planned (Tubb 2017) in countries that are Parties to the Paris Agreement on Climate Change in North America (Canada, U.S., Mexico), South America (Brazil, Peru, Colombia), Middle East (Iran, Oman), Russia, Eastern Europe (Turkey), Western Europe (U.K., Denmark, Norway) and Asia (China and India). Given limited financial resources, investments in fossil fuel infrastructure tie up funds that could otherwise be used for renewable energy.

Provision of positive incentives for conservation, climate change and sustainable development, and removal of harmful subsidies, will go a long way towards mobilizing resources for change (Ripple et al. 2017; Secretariat Convention on Biological

Diversity 2010; United Nations 2015). A focus on incentives for implementing nature-based solutions is a highly cost-effective approach. This would include 'strong financial impetus' for afforestation on degraded land, reforestation on converted forest land, restoration of carbon sequestering ecosystems and protection of carbon storing ecosystems (Rockström et al. 2017).

A successful model for mobilizing resources for positive outcomes is the Biodiversity and Protected Areas Management Programme (BIOPAMA). This is a partnership between IUCN and Joint Research Center of the European Commission (EC-JRC). BIOPAMA addresses threats to biodiversity in African, Caribbean and Pacific (ACP) countries, while reducing poverty in communities in and around protected areas. BIOPAMA has had significant success in building the capacity to manage protected areas for multiple values and to improve access to science, knowledge and data that enhances decision-making on biodiversity conservation and sustainable development (BIOPAMA 2016).

Another entry point for enabling policy is to overcome the traditional sectorial silos and avoid tensions and potential trade-offs between different policies (e.g. an increase in deforestation rate due to a policy of agricultural expansion). A shift on the focus of a sectoral perspective of issues in a country's administration into a more holistic one requires policy changes. The SDGs address this systemic issue and encourage Parties to enhance Policy Coherence for Sustainable Development (PCSD). A useful framework to progress on PCSD has been developed by the OECD providing general guidance to: (1) conduct analysis to identify policy coherence issues; (2) align existing institutional mechanisms for policy coherence to other environmental and development agendas; and (3) consider key elements for tracking progress on policy coherence for sustainable development (OECD 2016).

## Conclusions

The world is currently focused on the imperative to reduce atmospheric greenhouse gases and avoid catastrophic climate change. However, the loss of biodiversity and associated ecosystem services, the loss of land and soil resources, the decline of global fisheries and the plight of the world's poorest citizens are equally pressing issues. Given the scale of financial resources required, avoiding unanticipated negative consequences, and finding solutions that enhance synergies are necessary.

The large number of solutions being tried at different scales around the world amount to a global experiment in integrated thinking. The task now is to pull together the lessons learned from the many diverse approaches and actors, and turn them into practical tools that will allow countries to effectively meet their global commitments. A focused effort to integrate the work of the three Rio Conventions with the Sustainable Development Goals has long been discussed; it is now in urgent need of implementation. Unique and sometimes difficult partnerships have to be forged, including among conservationists, poverty-reduction advocates, industries and those concerned with climate change policy.

We demonstrate that among the examples presented, spatial planning, protected areas and ecosystem restoration are distinguished by the multiple benefits they provide—benefits that go far beyond their primary purpose. We also show that nature-based solutions provide an essential tool in tackling several global problems simultaneously. While a few countries have already identified nature-based solutions in their NDCs to the Paris Climate Agreement, and some countries have developed guidelines or legal instruments to ensure that co-benefits are obtained, more countries need to include nature-based solutions in their tool kits to tackle climate change.

This paper has identified the problem and provided suggestions and examples that support a co-benefits approach to implementing multiple agreements. Future work of global organizations such as the International Union for the Conservation of Nature (IUCN) needs to draw on successful approaches already in use, as well as the results of policy and scientific research, to develop comprehensive guidance for simultaneously protecting biodiversity, addressing climate change and implementing the SDGs.

## References

BIOPAMA (2016) Development capacity for a protected planet in Africa, the Carribean and the Pacific. IUCN and European Commission Joint Research Centre, Gland, Switzerland

Bodin B, Santamari C (2016) Updated assessment of progress towards Aichi biodiversity targets 5 and 15. Secretariat Convention on Biological Diversity, Montreal, Canada

Brooks TM, Butchart SHM, Cox NA, Heath M, Hilton-Taylor C, Hoffmann M, Kingston N, Rodríguez JP, Stuart SN, Smart J (2015) Harnessing biodiversity and conservation knowledge products to track the Aichi targets and sustainable development goals. Biodiversity 16(2–3):157–174. https://doi.org/10.1080/14888386.2015.1075903

Cadena M, Virnig A, Tyrrell T, Rhodes A, Ervin J (2017) Resilience thinking: a catalyst to national biodiversity plans. SDG Knowledge Hub. International Institute for Sustainable Development (IISD), Winnipeg, Canada

CBD (2016) XIII/3. Strategic actions to enhance the implementation of the Strategic Plan for BIodiversity 2011–2020 and the achievement of the Aichi Biodiversity Targets, including with respect to mainstreaming and the integration of biodiversity within and across sectors. Secretariat Convention on Biological Diversity, Cancun, Mexico

CBD High-Level Panel (2014) Resourcing the Aichi biodiversity targets: an assessment of benefits, investments and resource needs for implementing the strategic plan for biodiversity 2011–2020. Secretariat Convention on Biological Diversity, Montreal, Canada

Charity S, Dudley N, Oliviera D, Stolton S (2016) Living Amazon report 2016: a regional approach to conservation in the Amazon. WWF Living Amazon Initiative, Brasilia and Quito

Deemer BR, Harrison JA, Li S, Beaulieu JJ, DelSontro T, Barros N, Bezerra-Neto JF, Powers SM, dos Santos MA, Vonk JA (2016) Greenhouse gas emissions from reservoir water surfaces: a new global synthesis. Bioscience 66(11):949–964. https://doi.org/10.1093/biosci/biw117

Duarte CM, Losada IJ, Mazarrasa I, Hendriks IE, Marbà N (2013) The role of coastal plant communities for climate change mitigation and adaptation. Nature Climate Change 3(11):961

Dudley N, Ali N, MacKinnon K (2017) Natural solutions: protected areas helping to meet the sustainable development goals. IUCN, Gland, Switzerland

Dudley N, MacKinnon K, Stolton S (2014) The role of protected areas in supplying ten critical ecosystem services in drylands: a review. Biodiversity 15(2–3):178–184. https://doi.org/10.1080/14888386.2014.928790

Dudley N, Stolton S, Belokurov A, Krueger L, Lopoukhine N, MacKinnon K, Sandwith T, Sekhran N (2010) Natural solutions: protected areas helping people cope with climate change. IUCN, TNC, UNDP, WCS, World Bank, WWF, Gland, Switzerland

Epple C, Jenkins M, Garcia-Rangel S, Guth M (2016) Managing ecosystems in the context of climate change mitigation: A review of current knowledge and recommendations to support ecosystem-based mitigation actions that look beyond terrestrial forests. Secretariat of the Convention on Biological Diversity, UNEP, WCMC and German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Montreal, Canada

Executive Secretary of Convention on Biological Diversity (2017) Biodiversity and the 2030 agenda for sustainable development. Montreal, Canada

Federative Republic of Brazil (FRB) (2016) Intended nationally determined contribution toward achieving the objective of the United Nations Framework Convention on Climate Change. Brasilia, Brazil

Ferez APC, Campoe OC, Mendes JCT, Stape JL (2015) Silvicultural opportunities for increasing carbon stock in restoration of Atlantic forests in Brazil. Forest Ecol Manage 350(Supplement C):40–45. https://doi.org/10.1016/j.foreco.2015.04.015

Griscom BW, Adams J, Ellis PW, Houghton RA, Lomax G, Miteva DA, Schlesinger WH, Shoch D, Siikamäki JV, Smith P, Woodbury P, Zganjar C, Blackman A, Campari J, Conant RT, Delgado C, Elias P, Gopalakrishna T, Hamsik MR, Herrero M, Kiesecker J, Landis E, Laestadius L, Leavitt SM, Minnemeyer S, Polasky S, Potapov P, Putz FE, Sanderman J, Silvius M, Wollenberg E, Fargione J (2017) Natural climate solutions. Proc Natl Acad Sci U S A 114:11645–11650. https://doi.org/10.1073/pnas.1710465114

Harvey CA, Dickson B, Kormos C (2010) Opportunities for achieving biodiversity conservation through REDD. Conserv Lett 3(1):53–61. https://doi.org/10.1111/j.1755-263X.2009.00086.x

Herr D, Landis E (2016) Coastal blue carbon ecosystems. Opportunities for nationally determined contributions: policy brief. IUCN and TNC, Gland, Switzerland and Washington, USA

IPCC (2014) Climate change 2014: synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change. Geneva, Switzerland

IUCN (2016a) A global standard for the identification of key biodiversity areas, Version 1.0. First edition. IUCN, Gland, Switzerland

IUCN (2016b) Restoration of forest ecosystems and landscapes as contribution to the Aichi biodiversity targets. Global Forest and Climate Change Program, IUCN, Gland, Switzerland

Laffoley D, Dudley N, Jonas H, MacKinnon D, MacKinnon K, Hockings M, Woodley S (2017) An introduction to 'other effective area-based conservation measures' under Aichi target 11 of the convention on biological diversity: origin, interpretation and emerging ocean issues. Aquat Conserv Marine Freshw Ecosyst 27(S1):130–137

Laurans Y, Ruat R, Barthelemy P (2016) Counting on nature: how governments plan to rely on ecosystems for their climate strategies. Issue Brief, vol 05/2016, April 2016 edn. Institute du développement durable et des relations internationales, Paris, France

Leadley P, Alkemade R, Arneth A, Krug C, Popp A, Rondinini C, Stehfest E, Dv Vuuren (2016) Relationship between the Aichi targets and land-based climate mitigation. UN Convention on Biological Diversity, Montreal, Canada

Marrakech Partnership, Global Alliances for Water and Climate, French Water Partnership (2017) International declaration: nature-based solutions for water management under climate change. Bonn, Germany

Mead L (2016) Forests and landscape restoration feature at UN biodiversity conference. SDG Knowledge Hub, IISD. http://sdg.iisd.org/news/forests-and-landscape-restoration-feature-at-un-biodiversity-conference/

Melillo JM, Lu X, Kicklighter DW, Reilly JM, Cai Y, Sokolov AP (2016) Protected areas' role in climate-change mitigation. Ambio 45(2):133–145. https://doi.org/10.1007/s13280-015-0693-1

Nature Needs Half (2017) Nature needs half. Wild Foundation. http://natureneedshalf.org/

OECD (2016) Better policies for sustainable development 2016: A New Framework for Policy Coherence. OECD, Paris, France. https://doi.org/10.1787/9789264256996-en

Pacific Marine Environmental Laboratory Carbon Program (2017) A Primer on pH. NOAA Pacific Environmental Laboratory. https://www.pmel.noaa.gov/co2/story/A+primer+on+pH
Peschel T (2010) Solar parks—opportunities for biodiversity. German Renewable Energies Agency, Berlin, Germany
Peterson C (2011) Integrating biodiversity into spatial planning and environmental assessment. Botswana
Quéré CL, Moriarty R, Andrew RM, Peters GP, Ciais P, Friedlingstein P, Jones SD, Sitch S, Tans P, Arneth A (2014) Global carbon budget. Earth Syst Sci Data Discuss 7:521–610
REDPARQUES (2015a) About REDPARQUES. REDPARQUES. http://redparques.com/?lang=en. Accessed 15 Dec 2017
REDPARQUES (2015b) Declaration by the Latin American network for technical cooperation on national parks, other protected areas, and wild flora and fauna (REDPARQUES) to the 21st conference of the parties (cop) of the united nations framework convention on climate change. REDPARQUES, Paris, France
Ripple WJ, Wolf C, Newsome TM, Galetti M, Alamgir M, Crist E, Mahmoud MI, Laurance WF (2017) World scientists' warning to humanity: a second notice. BioScience 1–3. https://doi.org/10.1093/biosci/bix125
Roberts CM, O'Leary BC, McCauley DJ, Cury PM, Duarte CM, Lubchenco J, Pauly D, Saenz-Arroyo A, Sumaila UR, Wilson RW, Worm B, Castilla JC (2017) Marine reserves can mitigate and promote adaptation to climate change. Proc Natl Acad Sci U S A 114(24):6167–6175. https://doi.org/10.1073/pnas.1701262114
Rockström J, Gaffney O, Rogelj J, Meinshausen M, Nakicenovic N, Schellnhuber HJ (2017) A roadmap for rapid decarbonization. Science 355(6331):1269
Sayer J, Sunderland T, Ghazoul J, Pfund J-L, Sheil D, Meijaard E, Venter M, Boedhihartono AK, Day M, Garcia C (2013) Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses. Proc Natl Acad Sci U S A 110(21):8349–8356
Scherer L, Pfister S (2016) Hydropower's biogenic carbon footprint. PLoS ONE 11(9):1–11. https://doi.org/10.1371/journal.pone.0161947
Schmidt-Traub G (2015) Investment needs to achieve the sustainable development goals—summary for policymakers. Sustain Dev Solut Netw, New York, USA
Schultz M, Tyrrell TD, Ebenhard T (2016) The 2030 agenda and ecosystems—a discussion paper on the links between Aichi biodiversity targets and the sustainable development goals. SwedBio at Stockholm Resilience Centre, Stockholm, Sweden
Science for Environmental Policy (2015) Wind and solar energy and nature conservation. Future Brief 9. Science Communication Unit, Bristol
Secretariat Convention on Biological Diversity (2010) AIchi biodiversity targets. Secretariat Convention on Biological Diversity. https://www.cbd.int/sp/targets/. Accessed 4 Dec 2017
Secretariat of the Convention on Biological Diversity (2014) Global biodiversity outlook 4: a mid-term assessment of progress towards the implementation of the strategic plan for biodiversity 2011–2020. Convention on biological diversity, Montreal, Canada. Doi: ISBN- 92-9225-539-8
Secretariat of the Convention on Biological Diversity (2016) Decisions XIII/2, paragraph 9 (III): Progress towards the achievement of Aichi biodiversity targets 11 and 12. Decision adopted by the Conference of the Parties to the Convention on Biological Diversity, XIII/2. Convention on Biological Diversity, Montreal, Canada
Senior MJM, Brown E, Villalpando P, Hill JK (2015) Increasing the scientific evidence base in the "high conservation value" (HCV) approach for biodiversity conservation in managed tropical landscapes. Conserv Lett 8(5):361–367. https://doi.org/10.1111/conl.12148
Society for Ecological Restoration (2012) Available guideance and guidelines on ecosystem restoration. Montreal, Canada
Steiner A (2017) Investing in innovative nature-based solutions. UNDP
Stern N (2015) Climate negotiations, sustainable development and growth—speech. London School of Economics and Political Science, Grantham Research Institute on Climate Change and the

Environment. http://www.lse.ac.uk/GranthamInstitute/publication/negociations-climatiques-developpement-durable-et-croissance/. Accessed 4 Dec 2017

Suarez C, Prussman CL, Abud M, Guevara O, Vergara A, Zuniga LA, Gorricho J, Naranjo LG (2015) Vulnerability analysis of the Amazon Biome and its protected areas

The Blue Carbon Initiative (2017) The blue carbon initiative. IUCN, CI, IOC-UNESCO. http://thebluecarboninitiative.org/. Accessed 19 Dec 2017

The Economist (2017) Sucking up carbon: Greenhouse gases must be scrubbed from the air. The Economist (Nov 16)

Thompson A (2014) Major greenhouse gas reductions needed by 2050: IPCC. Climate Central. http://www.climatecentral.org/news/major-greenhouse-gas-reductions-needed-to-curtail-climate-change-ipcc-17300. Accessed 15 Nov 2017

Tubb R (2017) P&GJ's 2017 Worldwide pipeline construction report. Pipeline Gas J 244(1)

Turner WR, Brandon K, Brooks TM, Gascon C, Gibbs HK, Lawrence KS, Mittermeier RA, Selig ER (2012) Global biodiversity conservation and the alleviation of poverty. Bioscience 62(1):85–92

UNEP-WCMC, IUCN (2016) Protected planet report. Cambridge UK and Gland Switzerland

UNFCCC (2014) Paris agreement: essential elements. (Oct 23)

UNFCCC (2015) Paris agreement. UNFCCC, Paris, France

United Nations (2015) Sustainable development goals: 17 goals to transform the world. UN Web Services Section. http://www.un.org/sustainabledevelopment/sustainable-development-goals/. Accessed 4 Dec 2017

US Environmental Protection Agency (2017) Greenhouse gas emissions from a typical passenger vehicle 2017 (Dec 18)

USGS (2017) National gap analysis project USGS. https://gapanalysis.usgs.gov/data/. Accessed 16 Dec 2017

Watts J (2017) For us, the land is sacred: on the road with the defenders of the world's forests. The Guardian

World Bank (2016) Poverty and shared prosperity: taking on inequality. License: creative commons attribution CC BY 3.01 IGO, Washington, DC. https://doi.org/10.1596/978-1-4648-0958-3