Chapter 3. The socio-economic case for biodiversity action

This chapter highlights the multiple benefits society derives from biodiversity and ecosystem services. It collates global, regional and national estimates of the economic value of these benefits, and the costs of policy inaction. Drawing on case studies and academic literature, the chapter then underscores the importance of biodiversity and nature-based solutions for achieving policy objectives on human health, food and water security, climate change mitigation and adaptation, and disaster risk reduction. Finally, the chapter discusses countries' efforts to better understand and reflect biodiversity values in decision-making, through national ecosystem assessments and natural capital accounting.

3.1. Biodiversity and ecosystem services: the foundation of economic development and human well-being

Biodiversity and ecosystem services underpin the global economy and human well-being. They provide indispensable services at the local, regional and global scales, such as food production, water purification, flood protection and climate-change mitigation. According to one estimate, the economic value of these services was USD 125-140 trillion (US dollars) in 2011 (Costanza et al., 2014[1]), i.e. well over one and a half times the size of the world's gross domestic product (GDP) that year. While these and other estimates (Table 3.1) involve a degree of uncertainty,[1] they indicate the magnitude of the economic value derived from biodiversity.

Failure to address biodiversity loss is (and will continue to be) costly. Between 1997 and 2011, global estimates suggest the world lost USD 4-20 trillion per year in ecosystem services owing to land-cover change (Costanza et al., 2014[1]) and USD 6.3-10.6 trillion per year from land degradation (ELD Initiative, 2015[2]). Meanwhile, poor management of oceans (e.g. invasive marine species carried in ship ballast water, over-exploitation of fisheries and nutrient pollution) costs at least USD 200 billion per year (UNDP and GEF, 2012[3]). Given the current trends in biodiversity loss, the economic costs may continue to rise and, because ecosystems are complex systems with tipping points, potentially increase exponentially. Failure to address biodiversity loss will also compromise efforts to achieve other policy objectives, such as climate-change mitigation, and food and water security.

Table 3.1. Biodiversity and ecosystem service values

Scale	Good or service	Estimated annual value
Global	Seagrass nutrient cycling	USD 1.9 trillion
Global	Annual market value of animal pollinated crops	USD 235-577 billion
Global	First sale value of fisheries and aquaculture	USD 362 billion
Global	Coral reef tourism	USD 36 billion
Europe	Ecosystem services from Natura 2000 protected area network	EUR 223-314 billion
Canada	Value of commercial landings from marine and freshwater fisheries	CAD 3.4 billion
France	Recreational benefits of forest ecosystems	EUR 8.5 billion
Germany	Direct and indirect income from recreational fishing	EUR 6.4 billion
Italy	Habitat provision	EUR 13.5 billion
Japan	Water purification from tidal flats and marshes	JPY 674 billion
United Kingdom	Physical and mental-health benefits of the natural environment	GBP 2 billion
United States	Air purification from trees and forest (avoided morbidity and mortality)	USD 6.8 billion

Note: EUR: euros; CAD: Canadian dollars; JPY: yen; GBP: pounds sterling
Source: (Waycott et al., 2009[4]) (IPBES, 2016[5]) (FAO, 2018[6]) (Spalding et al., 2017[7]) (EU, 2013[8]) (Government of Canada, 2018[9]) (Garcia and Jacob-Revue D, 2010[10]) (Schröter-Schlaack et al., 2016[11]) (Comitato Capitale Naturale, 2018[12]) (Japan Ministry of Environment, 2014[13]) (White et al., 2016[14]) (Nowak et al., 2014[15])

Although biodiversity and ecosystem services deliver considerable benefits, these tend to be undervalued or unvalued in day-to-day decisions, economic accounts and market prices. One reason for this is that decision makers lack knowledge about the interactions between economies and ecosystems. Another, predominant, reason is market failures: the majority of ecosystem services are not priced in the market because they are public goods, i.e. non-excludable and non-rival in their consumption[2]. As a result, there are insufficient economic incentives to conserve and sustainably use biodiversity. Those ecosystem services that are priced (e.g. food and timber provision), are often distorted by subsidies or uncompetitive markets. The failure to account for the full economic values of biodiversity and ecosystem services in decision-making is one of the main contributing factors to their loss and degradation.

Policy makers' understanding of ecosystem-economy interlinkages and the valuation of ecosystem services has improved considerably over the past 30 years. International assessments and initiatives, such as the Millennium Ecosystem Assessment (MEA); The Economics of Ecosystems and Biodiversity (TEEB), initiated in response to a proposal by the Group of Eight + Five countries meeting in Potsdam, Germany, in 2007; and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have contributed to this progress. They have also brought international attention to the socio-economic benefits of biodiversity and the impacts of biodiversity loss. A large number of empirical studies that estimate the monetary values associated with the various benefits provided by ecosystem services at the local, regional and global scales are now available (Box 3.1).

Although economic valuation of biodiversity continues to face some methodological limitations and is sometimes criticised on ethical grounds, it remains a useful and necessary tool for integrating biodiversity values into policy making, as they are otherwise effectively priced at zero. The decisions of ministries responsible for national development strategies and budget allocations, for example, are informed predominantly by considerations of economic growth, competitiveness, food security, and other issues that are politically "weightier" or perceived to be more pressing. Putting a monetary value on ecosystem services can help convey their importance, and ultimately lead to more efficient, cost-effective and equitable decisions.

Box 3.1. Valuing ecosystem services

The benefits generated by ecosystem services have direct-use values (e.g. timber), indirect-use values (e.g. pollination), option values and non-use values. Option values are the values people place on the potential for future use of biodiversity. Non-use values refer to the benefits individuals derive from the knowledge that biodiversity exists (existence values) and will be available to future generations (bequest values).

The benefits society derives from ecosystem services accrue at the local, regional or global level, or a combination of these (Table 3.2). The spatial scales of ecosystem services provide an indication of the roles and responsibilities associated with the conservation, sustainable use and restoration of biodiversity. For example, the premise of Reducing Emissions from Deforestation and Forest Degradation, a mechanism through which developing countries receive finance from developed countries to protect their forests, is that forests provide a global public good (carbon sequestration).

Table 3.2. Ecosystem services and the geographical scale of their benefits

Type of value	Examples of ecosystem services	Geographical scale of benefits		
		Local	Regional	Global
Direct use	Food (e.g. fisheries and aquaculture)	✓	✓	✓
	Fuel (e.g. timber)	✓	✓	
	Water	✓	✓	
	Natural products (e.g. sand, pearls and diatomaceous earth)	✓	✓	✓
	Genetic and pharmaceutical products	✓	✓	✓
Indirect use	Atmospheric composition, carbon sequestration and climate regulation			✓
	Shoreline stabilisation/erosion control	✓	✓	
	Natural hazard protection (e.g. from storms, hurricanes and floods)	✓	✓	
	Pollution buffering and water quality	✓	✓	
	Recreation and tourism	✓	✓	✓
Option values	Potential for future use of the above	✓	✓	✓
Non-use values	Cultural and spiritual values, existence and bequest values, e.g. associated with habitat for species	✓	✓	✓

3.2. The economic values of biodiversity and costs of inaction across multiple policy areas

The conservation, sustainable use and restoration of biodiversity is vital to achieving a number of policy objectives beyond biodiversity, such as human health, food and water security, climate-change mitigation and adaptation, and disaster risk reduction. Drawing on a range of local, national, regional and global studies, this section highlights the economic case for scaling up biodiversity action in qualitative and quantitative terms.

3.2.1. Biodiversity and human health

Biodiversity provides services critical for human health and well-being. These services include the provision of basic needs (e.g. food and protection from environmental hazards, discussed in 3.2.2 and 3.2.4) biomedical resources, air purification, and opportunities for recreational and therapeutic activities.

Biomedical resources and insights: many of the drugs used today for health care and disease prevention were discovered from plant sources (e.g. digoxin), lizards (e.g. exenatide), cone snails (e.g. ziconotide), fungi (e.g. penicillin) and other wild species. More than 80% of the small-molecule anticancer drugs approved between 1981 and 2014 are either natural products, based on natural products or mimic natural products (Newman and Cragg, 2016[16]). The most profitable drug to date, atorvastatin (Lipitor), is a cardiovascular drug descended directly from a microbial natural product that posted annual sales of USD 12-14 billion between 2004 and 2014 (Newman and Cragg, 2016[16]).

The untapped potential for future drug discovery and medical insights from biodiversity is vast, but it is diminishing because of biodiversity loss. Although plants have been a major source of natural product drugs, only a fraction of the 400 000 plant species on Earth have been studied for their pharmacological potential.[3] Arthropods, microbes and fungi are even less studied. Given their diversity and the medicines already discovered from them, these taxa hold considerable potential for the development of new drugs (Neergheen-Bhujun et al., 2017[17]; WHO and SCBD, 2015[18]).

Regulating air quality: morbidity and mortality from air pollution is a major health challenge, particularly in urban areas. The OECD estimates the welfare cost from premature deaths stemming from exposure to outdoor fine particles and ozone at USD 5.3 trillion globally in 2017. Investing in nature can help reduce this burden. Trees and forests in the conterminous United States, for example, removed 17.4 million tonnes of air pollution in 2010, providing health benefits (avoidance of human mortality and incidences of acute respiratory symptoms) valued at USD 6.8 billion (Nowak et al., 2014[15]).

Recreational and therapeutic activities: access and proximity to nature and green spaces correlate with reductions in mortality, cardiovascular disease and depression, and increases in perceptions of well-being (WHO and SCBD, 2015[18]). The physical and mental-health benefits of natural environments (e.g. parks, woodlands and beaches) in the United Kingdom are estimated at GBP 2 billion a year (White et al., 2016[14]). With over half of the world's population living in urban areas today, and given current urbanisation trends, the savings in healthcare costs from integrating biodiversity conservation into urban planning and building design are likely only to increase.

3.2.2. Biodiversity and food

Conserving and sustainably managing biodiversity is vital to meeting growing food demand and achieving Sustainable Development Goal 2: Zero Hunger. Biodiversity is the foundation of our food system. Biodiversity is the food we eat – domesticated and wild livestock and crops, aquatic species harvested from the wild or raised through aquaculture – as well as the myriad plants, animals and micro-organisms that underpin production processes such as maintaining healthy soils, regulating water and pollinating plants. Although food production has increased considerably to match growing demand, this increase has often come at the expense of the biodiversity and ecosystem services that underpin global food systems.

The economic value of biodiversity's contribution to food systems is considerable. Pollination from bees, birds, bats and other species contributes directly to between 5% and 8% of current global crop production. The annual market value of these crops is USD 235-577 billion (in 2015 USD) (IPBES, 2016[5]). Higher pollinator density and species diversity can lead to higher crop yields (Garibaldi et al., 2016[19]; Garibaldi et al., 2013[20]). The dramatic decline in the abundance of bees and other insects (see chapter 2), therefore, poses a considerable economic risk. The loss of all animal pollinators would result in an estimated annual net loss in welfare of USD 160-191 billion globally to crop consumers, and an additional loss of USD 207-497 billion to producers and consumers in other markets (IPBES, 2016[5]).

Biodiversity is also important to control pest outbreaks. Maintaining habitat within agro-ecosystems and surrounding landscapes for insectivorous birds and bats, and microbial pathogens that regulate populations of agricultural pest, can reduce the need for pesticides. The estimated value of this service for controlling a single pest – the soybean aphid – in four US states in 2007-08 was USD 239 million (Landis et al., 2008[21]). The total value of natural pest-control services in the United States, based on the value of crop losses to insect damage and insecticide expenditure, is estimated at USD 13.6 billion per year (Losey and Vaughan, 2006[22]). Reducing pesticide use and supporting biological control would help reduce one of the primary threats to bee and other insect populations, while also increasing the efficiency of farms (Lechenet et al., 2017[23]).

Genetic and species diversity among crops and livestock (and the wild varieties of domestic species) is fundamental to ensuring agricultural systems' resilience to drought, flood, pests and disease. Maintaining genetic diversity allows farmers to adapt their livestock breeds and crop varieties to changing environmental conditions, reducing the vulnerability of farmers and the global food system. Nevertheless, the Food and Agriculture Organization of the United Nations (FAO) reports increasing extinction risk among wild varieties and livestock breeds; declining crop diversity; and widespread genetic erosion as a result of poor cross-breeding practices, the use of non-native breeds and the pursuit of more productive breeds at the expense of less productive ones (FAO, 2019[24]).

3.2.3. Biodiversity and water security

A major challenge facing governments across the globe is water security, which is projected to deteriorate in many regions owing to increasing water demand, water stress and water pollution. An estimated 40% of the global population is already affected by water scarcity (UN and WBG, 2018[25]), and around 30% lacks safely managed drinking water supplies (WWAP, 2019[26]).

The mismanagement and degradation of ecosystems is a root cause of water insecurity. To tackle water insecurity, governments must tackle biodiversity loss. Healthy soils, forests, wetlands, grasslands and other ecosystems provide vital hydrological services that can reduce water-related disaster risks (Section 3.2.4), and improve water availability and quality. For example, nearly one-third of the world's 105 largest cities – including Los Angeles, New York, Rome and Tokyo – depend on protected forests for a significant share of their drinking water (Duley and Stolton, 2003[27]).

Conserving or restoring natural ecosystems, or enhancing the creation of natural processes in modified or artificial ecosystems, can be a sustainable solution to water insecurity and may be more cost-effective than grey-infrastructure alternatives, as shown in the examples below:

- *United States:* a cost-benefit analysis conducted for Philadelphia estimated the net present value of low-impact "green" infrastructure for storm-water control (e.g. tree planting, permeable pavement, green roofs) at USD 1.94-4.45 billion over a 40-year period. The net benefits for the grey-infrastructure alternative (e.g. storage tunnels) were much lower at USD 0.06-0.14 billion (Stratus Consulting Inc, 2009[28]). An analysis of options for improving water quality in Portland found that green infrastructure would be 51-76% cheaper (USD 68-72 million cheaper) than water-filtration plant upgrades (Talberth et al., 2012[29]) and would bring ancillary benefits (i.e. salmon habitat and carbon sequestration) estimated conservatively at USD 72-125 million.

- *Kenya*: Tana River provides 80% of Nairobi's drinking water and 70% of Kenya's hydropower. However, ecosystem degradation from unsustainable agricultural practices has led to higher levels of erosion and sedimentation. As a result, the cost of water treatment for Nairobi has increased, and the hydropower reservoir capacity has declined. Planned investment of USD 10 million in sustainable land-management measures in the Tana River Delta is expected to deliver a return of USD 21.5 million over 30 years as a result of increased power generation and agricultural crop yields, and savings in water and wastewater treatment (TNC, 2015[30]).

3.2.4. Biodiversity, climate change and disaster risk

Countries need to decrease greenhouse gas emissions by 25% by 2030 compared to 1990 levels to achieve the 2 degrees Celsius (°C) target of the Paris Agreement and 55% to reach the 1.5°C target (IPCC, 2018[31]). Conserving, sustainably managing and restoring ecosystems can provide a substantial and cost-effective contribution to these efforts. Plants and soils in terrestrial ecosystems absorb an estimated 9.5 billion tonnes of carbon dioxide equivalent every year (Le Quéré et al., 2015[32]). However, land-use change and poor management have depleted carbon stocks in terrestrial ecosystems, resulting in large emissions of carbon into the atmosphere. For example, deforestation and forest degradation account for around 12% of global emissions of carbon dioxide (CO_2) (Van der Werf et al., 2009[33]). The destruction of marshes, mangroves and seagrasses alone releases an estimated 0.15-1.02 gigatonnes of carbon dioxide ($GtCO_2$) per year, resulting in annual economic damages of USD 6-42 billion (Pendleton et al., 2012[34]).[4]

Griscom et al. (2017[35]) estimate that conservation, restoration and improved management of forests, grasslands, wetlands and agricultural lands could deliver 23.8 $GtCO_2$ of cumulative emission reductions by 2030. About half of this mitigation potential represents cost-effective climate mitigation, defined as a marginal abatement cost of less than or equal to 100 USD per tonne of CO_2 by 2030.[5] Deploying these approaches could deliver up to 37% of the emission reductions needed by 2030 in order to have a greater than 66% likelihood of holding warming below 2°C, and up to 20% of the emission reductions needed between now and 2050.

In addition to mitigation, biodiversity and ecosystem services play an important role in adapting to the impacts of climate change, and reducing the risk of climate-related and non-climate-related disasters. For example, floodplains and wetlands can protect communities from floods. Coral reefs, seagrass and mangroves buffer coastlines from waves and storms. Forested slopes stabilise sediments, protecting people and their assets from landslides.

Healthy, connected and biodiverse ecosystems also tend to be more resilient to the effects of climate change than degraded ecosystems (Oliver et al., 2015[36]; Spalding et al., 2017[7]). Hence, conserving, sustainably using and restoring biodiversity is critical to ensuring ongoing ecosystem function and service provision in a changing climate. In some cases, the speed and scale of climate change will make it difficult – if not impossible – for some species and ecosystems to adapt. The Fourth National Climate Assessment of the United States highlights some of the economic implications (Box 3.2).

Box 3.2. The costs of inaction – Insights from the U.S. Fourth National Climate Assessment

The Global Change Research Act of 1990 mandates that the U.S. Global Change Research Program deliver a climate change report to Congress and the President no less than every four years. The Fourth National Climate Assessment (2018) finds that climate change is having widespread impacts on ecosystem services. Changes are occurring in agricultural and fisheries production, the supply of clean water, protection from extreme events and culturally valuable resources. The report provides estimates of the economic costs of some of the (projected) impacts:

- By mid-century, the annual area burned in the western United States could increase 2-6 times, partly because of increased temperatures, earlier snowmelt and more intense droughts. The associated costs are large. For example, over 2000-16, a period of increased wildfire (due in part to climate change), US federal wildfire suppression expenditures ranged from USD 809 million to USD 2.1 billion per year.
- By 2090, cold-water recreational fishing days in the United States are predicted to decline, costing USD 1.7 billion per year under a low greenhouse gas scenario (representative concentration pathway [RCP] 4.5) or USD 3.1 billion per year under a higher scenario (RCP 8.5).
- By 2100, climate change is projected to result in the loss of USD 140 billion in recreational benefits associated with coral reefs (in 2015 dollars) under a high scenario (RCP 8.5).
- Ocean acidification is expected to reduce harvests of US shellfish, with cumulative consumer losses of USD 230 million (in 2015 dollars) anticipated by 2099, under a high greenhouse gas-emission scenario.

Note: RCP is a plausible greenhouse gas concentration trajectory adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. RCP 4.5 is the second lowest of four modelled pathways. RCP 8.5 is the highest.
Source: (Reidmiller et al., 2018[37])

The concepts of ecosystem-based adaptation[6] (EbA) and disaster risk reduction[7] (Eco-DRR) – also called nature-based solutions – have emerged based on the recognition that biodiverse ecosystems are more climate-resilient than degraded ones and can deliver greater flows of ecosystem services. If well planned, EbA and Eco-DRR can be cost-effective and provide multiple benefits beyond adaptation and disaster risk reduction, including species habitat, climate mitigation, and amenity values:

- *Canada*: investment in wetland conservation in the Smith Creek Drainage Basin in Saskatchewan is estimated to deliver over a ten-year period CAD 7.70 (Canadian dollars) (in flood control, nutrient removal, recreation and carbon sequestration) for every dollar invested in wetland conservation, and CAD 3.22 for every dollar invested in 25% restoration of lost wetlands (Pattison-Williams et al., 2018[38]).
- *Fiji*: Lami Town faces potential losses from flooding, estimated at FJD 31 million (Fijian dollar). A cost-benefit analysis was conducted to inform the choice between four adaptation scenarios. The benefit-to-cost ratios were highest for EbA, but engineering approaches were assumed to have higher damage avoidance (Table 3.3. Cost-benefit analysis for Lami Town). The analysis points to the potential role of hybrid approaches.

Table 3.3. Cost-benefit analysis for Lami Town

	Benefit-to-cost ratio	Assumed damage avoidance
Ecosystem-based adaptation only	19.50	10-25%
Ecosystem-based adaptation emphasis	15.00	25%
Engineering emphasis	8.00	25%
Engineering only	9.00	25-50%

Source: (Rao et al., 2013[39]).

- *United States*: an assessment of the value of coastal wetlands in the Northeastern United States found that wetlands prevented USD 625 million of flood damage from Superstorm Sandy in 2012 and lowered flood damage by 11% on average. A more localised study in the region estimated that properties located behind marshes in Barnegat Bay, New Jersey, suffered 16% less annual flood damage than properties that had lost their marshes (Narayan et al., 2017[40]).

3.3. Reflecting the true value of biodiversity in national decision-making

Countries are taking steps to gain a better understanding of their economic dependence on biodiversity and ecosystem services at a national and local level.[8] Notable initiatives include national ecosystem assessments (NEAs) to map, assess and in some cases economically value ecosystem services. NEAs build on and complement the MEA, the TEEB and IPBES assessments. For example, the first comprehensive assessment of ecosystem services in the United Kingdom was delivered in response to a UK House of Commons recommendation following the MEA. With the adoption in 2011 of the EU Biodiversity Strategy to 2020, EU Member States committed to "map and assess the state of ecosystems and their services", and integrate "these values into accounting and reporting systems at EU and national level by 2020" (European Union, 2011[41]).

Evidence shows that NEAs can – and are already – informing policy. NEAs conducted in Japan and the United Kingdom, for example, have been mentioned in documents setting out future policy or biodiversity strategies, and in legal documents pertaining to the conservation and sustainable use of biodiversity (Wilson et al., 2014[42]). The sharing of experiences on NEAs (e.g. objectives, scope, design and policy application) could help refine future NEAs and their utility in policy making (Wilson et al., 2014[42]; Schröter et al., 2016[43]).

Another major initiative underway is natural capital accounting, which seeks to overcome two limitations of traditional national accounting approaches and the use of GDP as an indicator of economic performance (OECD, forthcoming[44]). First, GDP focuses narrowly on current income and production, ignoring the underlying assets essential to long-term economic performance. Second, national accounting does a poor job of capturing stocks and flows of natural capital. To address this limitation, the United Nations developed a System of Integrated Environmental and Economic Accounting (SEEA) as a complement to its System of National Accounts. The SEEA is currently being revised to reflect lessons learned from practical experimentation and testing in countries, as well as advances in science and environmental economics. The revised version is due in 2021.

A number of countries have made progress on integrating natural-resource stocks and flows into their national accounts. Most have focused on compiling accounts for natural resources linked to priority sectors, e.g. timber, water and minerals, rather than establishing comprehensive economy-wide environmental economic accounts. However, several countries are experimenting with integrating non-market ecosystem services, which are more difficult to value. The World Bank initiative on Wealth Accounting and the Valuation of Ecosystem Services, and the UN-led Natural Capital Accounting and Valuation of Ecosystem

Services, funded by the European Union, are supporting these efforts. Establishing natural capital accounts is an important first step, but further efforts are needed to better link accounts to policy decisions.

Natural capital accounting, NEAs and wider efforts to value ecosystem services are increasing the economic visibility of biodiversity and ecosystem services, and helping policy makers improve the cost-effectiveness and efficiency of policies and projects. Governments have used ecosystem valuation to determine environmental externality costs to optimally priced taxes, determine compensation payments for natural-resource damage, and inform cost-benefit analyses for policies and projects (OECD, 2012[45]). Nevertheless, governments could make better use of policies to internalise the costs of biodiversity loss in private decision-making (Chapters 4, 7 and 8).

Even when decision makers have information on the values of ecosystem services and integrate them in their policy appraisals, political-economy factors, such as competitiveness concerns and vested interests, may prevent markets and governments from achieving efficient outcomes. Drawing on case studies, OECD (2017[46]) provides insights on how these challenges can be overcome, e.g. through broad stakeholder engagement, a solid and clearly communicated foundation of evidence (reiterating the role of NEAs), and targeted measures to address potential impacts on competitiveness and income distribution (Chapter 8).

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Notes

[1] For a discussion of valuation techniques, recent progress in valuation and limitations, see: (OECD, 2018[47]).

[2] Non-excludable: It is difficult to exclude other people from benefitting from e.g. flood protection provided by wetlands, or the aesthetic value of forests. Non-rival: one person benefitting from flood protection by wetlands does not reduce the flood protection benefits obtained by another person.

[3] For example, the National Cancer Institute repository contains only c. 60,000.

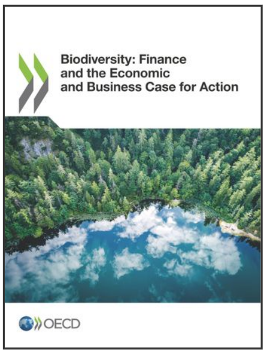
[4] Economic damages per tonne of carbon were valued at USD 41 (2007 US dollars).

[5] One-third of this could be achieved at low cost (less than or equal to USD 10 per tonne of carbon dioxide equivalent).

[6] Defined as "The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change. EbA aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change" (SCBD, 2009[48])

[7] Defined as "Sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development" (Estrella and Saalismaa, 2013[49])

[8] For an overview of ecosystem assessments, see the IPBES catalogue (IPBES, 2019[50]).



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