Biodiversity and the economic response to COVID-19: Ensuring a green and resilient recovery

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This Policy Brief focuses on the vital role of biodiversity for human life and the importance of integrating biodiversity considerations into the recovery from the COVID-19 crisis. The Brief first outlines how biodiversity loss is a key driver of emerging infectious diseases and poses a variety of other growing risks to businesses, society and the global economy. Investing in the conservation, sustainable use and restoration of biodiversity can help to address these risks, while providing jobs, business opportunities and other benefits to society. The Brief then examines how governments are factoring biodiversity into their stimulus measures and recovery plans in practice, highlighting both concerning trends and best practices. The Brief concludes with policy recommendations on how governments can better integrate biodiversity into their COVID-19 stimulus measures and broader recovery efforts.

Key messages

- Biodiversity underpins current and future human health, well-being and economic prosperity. Yet it is being destroyed at an unprecedented and accelerating rate, with 25% of all plant and animal species now threatened with extinction. It is therefore critical that countries integrate biodiversity considerations into their COVID-19 response and economic recovery plans.
- Protecting biodiversity is vital for avoiding the next pandemic. Close to three-quarters of emerging infectious diseases in humans come from other animals. Land-use change and wildlife exploitation increase infectious disease risk by bringing people and domestic animals in close proximity to pathogen-carrying wildlife, and by disrupting the ecological processes that keep diseases in check.
- The economy and human well-being also depend on biodiversity for food, clean water, flood protection, erosion control, inspiration for innovation and much more. Over half the world's global domestic product is moderately or highly dependent on biodiversity. The ongoing decline of biodiversity therefore poses important risks to society. Investing in biodiversity as part of the COVID-19 policy response can help to minimise these risks, while providing immediate jobs and economic stimulus.
- While government and business leaders have acknowledged the importance of a "green recovery", the focus has been predominantly on climate change. Yet biodiversity loss and climate change are challenges of a similar magnitude and urgency, and are fundamentally interlinked. They must be addressed together as part of a broader green and inclusive recovery.
- A number of countries have integrated biodiversity measures in their COVID-19 policy response. Examples of biodiversity measures include changes to regulation on wildlife trade to protect human health, and job programmes focussed on ecosystem restoration, sustainable forest management and invasive species control.
- Despite some good practice examples, many countries have weakened environmental regulations or introduced stimulus measures that threaten to drive further biodiversity loss. Analyses suggest that the volume of potentially harmful spending committed as part of the economic recovery from the COVID-19 crisis outweighs the volume of spending beneficial to biodiversity.
- Governments can take the following steps to integrate biodiversity considerations into the COVID-19 recovery plans, and drive the transformative changes needed to halt and then reverse biodiversity loss:
  - Ensure that COVID-19 economic recovery measures do not compromise biodiversity
    - Maintain and strengthen regulations on land-use, wildlife trade and pollution
    - Attach environmental conditionality to bailouts to drive sustainability improvements
    - Screen *(ex ante)* and monitor *(ex post)* stimulus measures for their biodiversity impacts
  - Scale up investment in biodiversity conservation, sustainable use and restoration
    - Set biodiversity spending targets for COVID-19 stimulus measures and recovery plans
    - Promote jobs in biodiversity conservation, sustainable use and restoration
    - Engage businesses and the finance sector for a biodiversity-positive recovery
  - Put a price on biodiversity loss
    - Reform subsidies harmful to biodiversity
    - Scale up economic incentives for biodiversity
  - Foster cross-sectoral and international collaboration

- Adopt and strengthen the One Health approach
- Support developing countries to safeguard their biodiversity
- Develop, adopt and implement an ambitious post-2020 global biodiversity framework.

Introduction

The COVID-19 pandemic has led to widespread human and economic losses. The global death toll surpassed 950 000 in September 2020, and continues to rise (Johns Hopkins, 2020[1]). Government-imposed lockdowns and other public health measures to protect citizens from the virus have led to an economic downturn of a gravity unseen since the 1930s depression. The OECD Economic Outlook Interim Report (September 2020) projects that global GDP will decline by 4.5% in 2020, followed by a gradual recovery with considerable heterogeneity across countries (OECD, 2020[2]). Unemployment is estimated to reach 9.4% by the end of 2020 in OECD countries and remain at 7.7% in 2021 (OECD, 2020[3]).

Many governments are currently developing or implementing stimulus measures and recovery plans to create jobs and drive economic recovery. Globally, stimulus measures announced to date are in the order of USD 10 trillion. A key challenge for governments is to ensure that the measures they introduce effectively address immediate social and economic needs, while promoting longer-term resilience, human health, well-being and sustainability. With this in mind, government and business leaders across the globe have called for a green and inclusive recovery to COVID-19. However, the focus of this rhetoric and the green stimulus measures introduced to date has largely been limited to climate change, with much less attention given to biodiversity. Biodiversity loss and climate change are challenges of a similar magnitude and urgency, and are fundamentally interlinked. They must be addressed together as part of broader efforts to achieve a green and inclusive recovery.

The world is facing its sixth mass extinction event, with one million plant and animal species now threatened with extinction due to changes in land and sea-use, overexploitation, climate change, pollution and invasive alien species (Diaz et al., 2019[4]). Since 1970, populations of mammals, birds, reptiles, amphibians and fish have declined on average by 68% and vast areas of ecosystems have been degraded (WWF, 2020[5]). Human destruction of biodiversity is one of the leading drivers of infectious disease outbreaks (Loh et al., 2015[6]). It also poses a significant risk to supply chains, businesses and the global economy. Investing in activities that protect and restore biodiversity would provide immediate jobs, while also reducing the risk of future crises and improving the resilience and long-term viability of businesses and the economy.

This policy brief first outlines why biodiversity is a critical element of the COVID-19 response, highlighting the linkages between biodiversity loss and infectious diseases, and the importance of biodiversity for the economy. Next, it examines the extent to which stimulus measures and broader policy responses address biodiversity. Finally, it provides recommendations on how biodiversity can be better integrated into policy responses to ensure a biodiversity-positive recovery.

Why biodiversity should be factored into the COVID-19 response

Safeguarding biodiversity is vital for avoiding the next pandemic

Biodiversity[1] and human infectious diseases are intricately linked. Zoonoses – diseases transmitted from other animal species to humans – account for approximately 60% of all infectious diseases and 75% of emerging infectious diseases in humans (Taylor, Latham and Woolhouse, 2001[7]). In addition to COVID-19, examples of emerging zoonotic diseases that have caused human health crises include Ebola, avian influenza, sudden acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and Human Immunodeficiency Virus (HIV).

Human pressure on biodiversity increases the risk of infectious disease. Land-use change resulting from agricultural expansion, logging, infrastructure development and other human activities is the most common driver of infectious disease emergence, accounting for approximately one third of all emerging disease events (Loh et al., 2015[6]). Wildlife exploitation (capture, hunting and trade) for human subsistence, recreation, medicine and ornamentation is another important driver (UNEP and ILRI, 2020[8]). Scientists suspect that the SARS-COV-2 virus causing COVID-19 originated in bats and passed to humans via an intermediary host (possibly a species of pangolin) found in live-animal markets (MacKenzie and Smith, 2020[9]; Wong et al., 2020[10]; Zhang, Wu and Zhang, 2020[11]). The emergence of SARS in 2003 followed a similar pathway, but with traded masked palm civets as the intermediary host (Shi and Hu, 2008[12]).

Land-use change and wildlife exploitation increase disease risk by bringing people and domestic animal populations in close proximity to pathogen-carrying wildlife. Human pressure on ecosystems can also alter infectious disease dynamics by disrupting the species composition, function and structure of ecosystems (Karesh et al., 2012[13]; Keesing et al., 2010[14]; Halliday and Rohr, 2019[15])(Table 1). For example, when an ecosystem is disturbed its species diversity may decline while the abundance of "generalist" or "opportunistic" species increases. As these species tend to be effective zoonotic hosts[2], this can result in higher disease prevalence (Gibb et al., 2020[16]). In the case of multi-host pathogens higher species diversity may dilute pathogen transmission events, owing to the larger number of poor-quality hosts (i.e. the dilution effect) (Ostfeld and Keesing, 2012[17]). A recent study found that in areas under significant human use (e.g. agricultural and urban systems), wildlife hosts of human pathogens account for a greater share of total species abundance (21–144% higher) and species richness (18–72% higher) than in nearby undisturbed ecosystems (Gibb et al., 2020[16]). Box 1 presents recent examples illustrating how human pressure on biodiversity can influence the emergence, incidence or distribution of infectious diseases.

[1] According to Article 2 of the Convention on Biological Diversity, biodiversity or "biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD, 1992[106]).

[2] Generalist and opportunistic species (e.g. many rodent species) may be effective zoonotic hosts due to their fast life histories and high population densities (Johnson et al., 2012[107]).

Table 1. Possible mechanisms linking changes in biodiversity to infectious disease in humans

Level of diversity	Aspect of biodiversity undergoing change due to human pressure	Possible mechanism leading to human health effect
Genetic	Gene frequencies within populations of pathogens or hosts	Change in pathogen virulence or host resistance
Microbial	Composition of microbial communities in the external environment or within the host	Change in pathogen virulence in host immune response and allergic sensitization; expansion of range through human transport
Vector Species (living organisms that can transmit infectious pathogens between humans, or from animals to humans)	Abundance, diversity, composition and geographic range of vectors	Change in host-vector contact rates; change in contact between infected vectors and humans; expansion of range
Host Species	Diversity, composition and range of host species	Change in host-pathogen contact rates; change in competent host-vector contact rates; change in pathogen prevalence; expansion of range
Community (interacting species, including predators, prey/food, competitors)	Host density and contact with pathogen, host susceptibility to infection	Change in pathogen prevalence; change in human-pathogen contact rates
Ecosystem	Structure, complexity and diversity of vegetation; physical and chemical properties (e.g. climatic conditions)	Change in vector abundance and composition; change in host composition and distribution; change in host-pathogen contact rates; change in vector-host contact rates; change in infected vector-human contact rates; change in host-human contact rates

Source: Adapted from Pongsiri et al. (2009), Biodiversity Loss Affects Global Disease Ecology, *BioScience*, Vol 59 No. 11, pp 945-954 (2009[19])

Box 1. Examples of links between biodiversity and infectious disease emergence, incidence or distribution

Lyme disease – Host species diversity has a strong effect on the risk of human infection from Lyme disease in the United States. Blood-feeding ticks transmit the pathogen that causes Lyme disease, *Borrelia burgdorferi* among host species, including humans. However, host species differ in their probability of transmitting the infection. White-footed mice feed and infect large numbers of ticks, whereas most other hosts feed but do not infect ticks. White-footed mice tend to reach higher abundances in degraded and fragmented forests where species diversity is low. Infection prevalence in ticks is much higher in these areas, than in areas with high vertebrate diversity.

*Malaria** – Malaria is an acute febrile illness caused by the protozoan parasite *Plasmodium,* which is transmitted between people through the bites of infected female *Anopheles* mosquitoes. Changes in forest canopy structure can influence the density and diversity of *Anopheles* mosquitoes. In the Peruvian Amazon, for example, deforested sites have a higher density of malaria vectors and higher human biting rate, leading to increased infection risk for humans. Similar links have been drawn between malaria incidence and deforestation in the Brazilian Amazon, Asia and Africa.

Nipah virus – The outbreak of Nipah virus in Malaysia in 1998-1999 resulted in 265 cases of acute encephalitis with 105 deaths, and significant economic losses due to the near collapse of the pig-farming industry. Fruit bats (*Pteropus sp.*) are a natural reservoir of the virus. Evidence suggests that a loss of natural food resources due to deforestation may have increased the dependence of fruit bats on cultivated orchards and fruit trees close to intensive pig farms. The saliva and excrement of bats transmitted the Nipah virus to pigs, which acted as an amplifier host for human infection. In Australia, the emergence and subsequent outbreaks of Hendra virus, which is of the same genus as Nipah virus, have also been linked to land-use changes that reduce feeding and roosting sites for fruit bats.

Schistosomiasis – Schistosomiasis is a parasitic disease that affects over 200 million people worldwide. It infects humans through skin contact with the free-swimming larval stage of trematodes (blood flukes). In Malawi, overfishing of predatory fish has been linked to increased numbers of freshwater snails, which are intermediate hosts of trematodes, and the subsequent spread of schistosomiasis. Agrochemical pollution of water bodies can also lead to increases in freshwater snail abundance, thereby increasing the number of trematodes and the associated risk of schistosomiasis transmission.

West Nile virus – West Nile virus can cause neurological disease and death in people. First emerging in Uganda in 1937, West Nile virus is now common in Africa, Europe, the Middle East, North America and West Africa. Birds are the natural reservoir of the West Nile virus, and mosquitos the vector that carries the pathogen to humans. In the United States, areas with high avian diversity are associated with lower rates of mosquito infection and incidence of human disease. This may be due to the presence of alternative, less competent host species, which provide a dilutive effect – mosquitos have a higher probability of feeding on a less competent host of the pathogen.

Note: *Malaria is not generally considered a zoonotic disease, as the four main parasites that cause it are specific to humans: *P. falciparum, P. malariae, P. ovale* and *P. vivax*. It is, however, transmitted by a vector species and its incidence is therefore affected by human interaction with biodiversity. Furthermore, humans occasionally become infected with Plasmodium species that normally infect animals, such as *P. knowlesi*

Source: (LoGiudice et al., 2003[20]) (Allan, Keesing and Ostfeld, 2003[21]) (Brownstein et al., 2005[22]) (Yomiko Vittor et al., 2006[23]) (Olson et al., 2010[24]) (Hahn et al., 2014[25]) (Singh and Daneshvar, 2013[26]) (Patz and Olson, 2006[27]) (Looi and Chua, 2007[28]) (Bing Chua, Hui Chua and Wen Wang, 2002[29]) (Epstein et al., 2006[30]) (UNEP and ILRI, 2020[8]) (Stauffer et al., 2007[31]) (Stauffer and Madsen, 2012[32]) (Becker et al., 2020[33]) (R., Jr. and Madse, 2012[34]) (UNEP and ILRI, 2020[8]) (Allan et al., 2009[35]) (Ezenwa et al., 2006[36])

The scale of land-use change and wildlife exploitation is immense. Humans have significantly altered three-quarters of the world's terrestrial ecosystems, and dedicated more than a third of land area to crop or livestock production. The area and quality of natural forests, wetlands and other ecosystems are declining rapidly. In 2018 alone, an area of forest the size of the United Kingdom was destroyed globally (NYDF Assessment Partners, 2019[37]). Meanwhile, an estimated 24% of the world's more than 31 500 terrestrial bird, mammal, amphibian, and squamate (scaled) reptile species are traded globally (legally or illegally) (Scheffers et al., 2019[38]). The number of individual animals traded is substantial: in 2019 alone an estimated 195 000 pangolins[3] were trafficked for their scales (May, 2017[39]). Illegal wildlife trade is now one of the five most lucrative illegal businesses, worth an estimated USD 5-23 billion per year (May, 2017[39]). The extent of local bushmeat consumption is also considerable. A survey of nearly 8 000 rural households in 24 countries across Africa, Latin America and Asia found that 39% of households harvested wild meat and almost all households consumed it (Nielsen et al., 2018[40]).

These pressures on biodiversity are expected to grow, increasing the risk of another pandemic. The projected rise in world population to 9.7 billion people by 2050, the consequent increase in food demand and the growing demand for bioenergy may put increasing pressure on land (OECD, 2020[41]). According to a projection by the Netherlands Environmental Assessment Agency (PBL) (PBL, 2017[41]), the area of land under agriculture could increase from 35% today to 39% by 2050, assuming that current trends in population, economic development and technology continue (changes in agricultural productivity would affect these results). Wildlife trade has increased over the past decades. While ongoing efforts to regulate wildlife trade and address illegal trade may help to curb further growth, the increasing rarity of species could drive both higher demand and higher prices for wildlife (Harris et al., 2017[43]) (Courchamp et al., 2006[44]). Furthermore, it is estimated that between 405 and 4 064 species currently not traded have traits that make them at risk of being traded in the future (Scheffers et al., 2019[38]).

The cost of investing in ecological measures that can help prevent a pandemic is much lower than the cost of a pandemic. A study released during the COVID-19 pandemic estimates that spending of USD 260 billion per year over ten years on measures such as combatting deforestation, improving management of global wildlife trade, ending the wild meat trade in China and improving disease surveillance in wild and domestic animals, would substantially reduce the risk of another pandemic. This investment is equivalent to 2% of the authors' estimated cost of the COVID-19 pandemic (Dobson et al., 2020[45]).

Protecting biodiversity promotes societal and economic resilience4

Integrating biodiversity considerations into the COVID-19 recovery is not only important for avoiding future pandemics; it is also vital to economic resilience and human well-being. Biodiversity underpins the ecosystem services upon which economic activity and lives depend: the provision of food, fresh water, medicine, timber and fuelwood; regulation of climate and protection from extreme weather events; primary production, soil formation and nutrient cycling; and many others. It is an important source of jobs and an inspiration for innovation through biomimicry (Kennedy and Marting, 2016[46]). The total economic value to society of biodiversity and ecosystem services (including priced and non-priced goods and services) is estimated to be as much as USD 140 trillion per year (Costanza et al.,

[3] All eight species of pangolin are threatened with extinction; three are critically endangered (IUCN, 2019[108]).

[4] For a more in-depth discussion of the economic case for protecting biodiversity see chapter 3 of OECD's report on Biodiversity: Finance and the Business and Economic Case for Action (OECD, 2019[49]).

2014[47]). An analysis of 163 industry sectors and their supply chains found that USD 44 trillion of global value added (over half of the world's GDP) is moderately or highly dependent on nature and its services (WEF, 2020[48]).

Despite these dependencies, economic activities continue to have a significant negative impact on biodiversity. This in turn undermines ecosystem resilience and the provision of ecosystem services, posing increasing risks to supply chains, to businesses and investors, and to the global economy (OECD, 2019[49]). These risks include reduced productivity (e.g. reduced agricultural productivity due to declines in populations of pollinators and soil fertility), increased scarcity and costs of inputs (e.g. reduced availability of clean water) and increased exposure to hazards (e.g. coastal floods).[5] Owing to tipping points and feedback loops, biodiversity loss and its associated risks are non-linear, and could climb exponentially. According to the 2020 Global Risks Report, global experts and decision makers perceive biodiversity loss to be among the five greatest risks facing society (WEF, 2020[50]). It is also intertwined with other prominent risks to society, such as climate change (Box 2).

Box 2. Links between biodiversity loss and climate change

Marine and terrestrial ecosystems are natural sinks for anthropogenic carbon emissions, with a gross sequestration of 5.6 gigatonnes of carbon per year (more than half of global anthropogenic emissions). However, biodiversity loss is reducing the natural capacity of ecosystems to store carbon, worsening climate change. Deforestation alone accounts for an estimated 10% of anthropogenic greenhouse gas emissions.

In turn, climate change is one of the primary drivers (and the fastest-growing driver) of biodiversity loss. Climate change has already resulted in shifts in species distribution, disrupted species interactions, and led to mismatches in the timing of migration, breeding and food supply. These and other effects have contributed to population declines. Climate trends and extremes are pushing marine and terrestrial ecosystems closer to thresholds and tipping points. Crossing these could lead to abrupt, fundamental and irreversible changes to the structure and function of ecosystems, with potentially catastrophic implications for biodiversity and climate change.

Source: (Diaz et al., 2019[4]) (BirdLife International and The National Audubon Society, 2015[51]) (Harris et al., 2018[52])

Beyond sound risk management, integrating biodiversity into the COVID-19 recovery would offer economic and business opportunities. For example, it is estimated that the number of jobs created per USD 1 million invested in biodiversity restoration in the United States ranges from 7 for county-level wetland restoration to 40 for national-level forest, land and watershed restoration (BenDor et al., 2015[53]). Restoring 15% of degraded ecosystems in the European Union would create an estimated 20 000 to 70 000 full-time jobs (Eftec et al., 2017[54]). For businesses, opportunities come in the form of cost savings, new market opportunities (e.g. ecotourism, certified sustainable products), increased market share, and new businesses (e.g. ecosystem restoration). "Nature-positive" business opportunities could add up to USD 10.1 trillion in annual business value and 395 million jobs by 2030 (WEF, 2020[48]).

[5] Individual companies may face additional risks such as regulatory and liability risks, reputational risks and market risks due to changing consumer preferences. See chapter 4 of OECD's report on Biodiversity: Finance and the Business and Economic Case for Action (OECD, 2019[49]).

How biodiversity is being factored into the COVID-19 recovery

Countries have introduced a range of policy measures to counter the impacts of the COVID-19 pandemic. While containing the virus and minimising its immediate impacts on human lives continues to be a priority, many countries are also rolling out complementary measures to address the social and economic fallout of the pandemic. COVID-19 response measures to date span monetary policy (e.g. lowering or freezing of interest rates), regulatory policy (e.g. permitting and reporting requirements), fiscal policy (e.g. tax relief, subsidies, grants and loans) and other measures such as skills training. Globally, fiscal measures announced have already surpassed USD 10 trillion (Reuters, 2020[55]), and this figure is expected to grow as more countries announce their recovery packages. While it is too soon to say conclusively what the net biodiversity impact of the COVID-19 recovery will be, this section provides an indication of current trends and highlights examples of how governments are integrating biodiversity into their stimulus packages and broader policy response to COVID-19.[6]

On balance the COVID-19 policy response may be more harmful to biodiversity than it is beneficial[7]

While some countries have taken steps to integrate measures beneficial to biodiversity in their policy packages, analyses to date suggest that spending on harmful activities may outweigh spending on beneficial ones. According to Vivid Economics' Green Stimulus Index, 17 major economies (OECD and G20 countries)[8] have announced economic stimulus packages that will direct approximately USD 3.5 trillion to sectors that can have a significant impact on nature – agriculture, energy, industry, transport and waste. In 14 out of the 17 economies, the volume of finance flowing to these sectors that is potentially harmful to biodiversity (e.g. bailouts for polluting companies without environmental conditions) outweighs financial flows to these sectors that is potentially beneficial (e.g. investments in ecosystem restoration). Of those countries assessed, France, Germany and the United Kingdom are the only three where potentially beneficial flows outweigh potentially harmful flows to these sectors (Vivid Economics, 2020[56]). The G20 Energy Policy Tracker also indicates that harmful flows relating to energy outweigh beneficial flows. Since the beginning of the pandemic, the G20 has committed at least USD 382 billion to supporting different energy types. More than half of this (USD 206 billion) is directed to fossil fuels (IISD et al., 2020[57]).

Perhaps the clearest example of a biodiversity-harmful response measure to date is the loosening of environmental regulation. Since the COVID-19 pandemic struck, some governments have weakened land-use policies, waste collection requirements, air and agricultural pollution standards, project permitting processes (including environmental

[6] For an analysis of COVID-19 and environment more generally (i.e. climate change, waste management, water and air pollution etc.) see OECD's policy brief on Making the Green Recovery Work For Jobs, Income and Growth.

[7] Examples in this section span OECD and non-OECD countries. Information presented is based primarily on an OECD Preliminary Country-by-Country Analysis of COVID-19 Policy Measures and their Environmental Implications (unpublished); OECD's biodiversity and COVID-19 survey completed by Estonia, Mexico, United Kingdom and United States (unpublished); OECD (2020) Agricultural Policy Monitoring and Evaluation; Vivid Economics' Green Stimulus Index; Conservation International's Conservation Rollbacks Tracker; IISD et al.'s G20 Energy Policy Tracker; and IMF's Database of Fiscal Measures in Response to the COVID-19 Pandemic.

[8] Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, South Africa, South Korea, Spain, Russia, United Kingdom, United States of America.

impact assessment rules), and environmental monitoring and reporting requirements. Not all of these regulatory changes are permanent; however, even temporary changes could lead to an increase in biodiversity-harmful activities and set a dangerous precedent for rolling back hard-fought-for environmental regulations. In addition to weakening existing environmental regulation, some countries have postponed the entry-into-force of forthcoming environmental regulations.

Some fiscal policies introduced in response to COVID-19 may be harmful to biodiversity. The extent and nature of their impact will depend in part on the biodiversity footprint of the business/sector receiving the support (which can differ from one country to the next), the volume of the stimulus and the design of the measure. A common example of a potentially harmful fiscal measure introduced to date is the issuance of loans, grants and guarantees without any environmental conditions, to bailout companies that have a heavy biodiversity footprint (e.g. airline and coal companies). Some countries have introduced subsidies potentially harmful to biodiversity (e.g. for fertiliser purchase), and temporarily waived or reduced biodiversity-relevant taxes (e.g. on oil/gas exploration and production), charges (e.g. on commercial operators in conservation areas) and fees (e.g. licencing fees for mining; protected area entrance fees). While waiving protected area entrance fees during the COVID-19 pandemic may be justifiable from a human health and well-being perspective, it is likely to have negative budgetary implications for biodiversity conservation.

Good practice examples illustrate how countries can integrate biodiversity into their COVID-19 response and recovery plans

Despite the concerning trends outlined above, a number of good practice examples exist that demonstrate how countries can integrate biodiversity into their recovery plans. In response to COVID-19, some countries are introducing regulatory measures that promote the conservation, sustainable use and restoration of biodiversity. China and Viet Nam, for example, have introduced measures to regulate wildlife trade in order to reduce the associated human health risks. China issued a notification in January 2020 that temporarily requires captive wildlife facilities to quarantine, and prohibits trade of wildlife in any form. Subsequent decisions in February by the Standing Committee of the National People's Congress permanently prohibit commercial breeding and trade in most terrestrial wild animal species for the purposes of consumption as food (People's Republic of China, 2020[58]).[9] Viet Nam presented a new Prime Minister's Directive that outlines responsibilities for eight national-level ministries to strengthen the implementation and enforcement of wildlife policies (Tatarski, 2020[59]).

A number of countries have introduced fiscal measures to address unemployment and boost economic activity, while also supporting biodiversity. Selected examples are:

- Canada - Canada is spending CAD 1.7 billion (USD 1.3 billion) to clean up orphaned or inactive oil and gas wells, with the aim of providing thousands of jobs and achieving lasting environmental benefits (Government of Canada, 2020[60]).
- Finland - The Finnish government adopted a package of economic recovery measures amounting to EUR 5.5 billion (USD 6.4 billion). This includes EUR 53 million (USD 62 million) for projects involving green areas, water services and forest conservation and an additional EUR 13.1 million

[9] The planned revision of China's Wildlife Protection Law this year may provide an opportunity to further strengthen regulations and address remaining legislative gaps and loopholes (e.g. trade in threatened species is currently still permitted if it is for traditional medicine and decorative purpose).

(USD 15.2 million) to rehabilitate nature sites and develop nature tourism (Government of Finland, 2020[61]).

- India - As part of the INR 20 trillion (USD 0.27 trillion) recovery package, the Indian government is channelling INR 60 billion (USD 0.8 billion) through its Compensatory Afforestation Fund Management and Planning Authority to provide jobs for tribal communities in forest management, wildlife protection and other related activities (BFSI News, 2020[62]).
- New Zealand - As part of its NZD 50 billion (USD 33 billion) Response and Recovery Fund (New Zealand Treasury, 2020[63]), the New Zealand government has launched a NZD 1.3 billion (USD 0.9 billion) “jobs for nature” programme. The programme aims to provide up to 11 000 jobs controlling invasive species (e.g. wilding pines, wallabies and stoats), and protecting and restoring habitat on private and public conservation land (New Zealand Ministry for the Environment, 2020[64]).
- Sweden - Sweden has committed SEK 150 million (USD 16 million) to subsidise employment in nature conservation and forest management roles. In addition to mitigating unemployment linked to COVID-19, this work is intended to increase access to outdoor life and recreation, and reduce the spread of European spruce bark beetle and other pests (Sweden Ministry of Enterprise and Innovation, 2020[65]).
- United Kingdom - The UK has launched a GBP 40 million (USD 51 million) "green recovery challenge fund", designed to help charities and local authorities to protect 2 000 jobs and create an additional 3 000 short- and long-term jobs in tree planting, habitat restoration and green space creation. The programme intends to provide a pipeline of shovel-ready nature projects that protect species, provide recreational opportunities and help combat climate change among other things (UK Government, 2020[66]).

Fiscal measures to support environment-related R&D during and after the pandemic also provide scope to support biodiversity. For example, Austria has committed EUR 350 million (USD 407 million) to fund research projects that help enhance climate adaption of forests, including measures to protect and enhance biodiversity and increase natural forest protected areas. UK Research and Innovation (UKRI) has launched a call for project proposals focussed on the social, economic and environmental impacts of the COVID-19 outbreak (UKRI, 2020[67]), and France’s National Research Agency has launched a new call “RA-COVID-19” for short-term research covering a broad range of issues an integrated systemic and unified approach to public animal and environmental health (ANR, 2020[68]).

Policy recommendations for integrating biodiversity into the COVID-19 recovery

Countries’ responses to the COVID-19 pandemic have weighty implications for society today and for generations to come. Smart policies can help drive the transformative changes needed to protect and restore biodiversity, thereby ensuring longer-term resilience, human health and well-being. Poorly construed policies will entrench or exacerbate the key drivers of biodiversity loss – changes in land and sea use, overexploitation, climate change, pollution and invasive alien species – thereby driving up risks to society. While some countries have taken measures to integrate biodiversity into COVID-19 stimulus packages and recovery plans, much more could be done. This section presents 4 action areas and 11 specific actions to guide policy makers as they plan the recovery from the pandemic.

1. Ensure that economic recovery does not compromise biodiversity

Maintain or strengthen regulation on land use, wildlife trade and pollution

The loosening of environmental regulation – temporarily or permanently – may be politically expedient, but it is very likely to exacerbate biodiversity loss and therefore be costly in the long-term. While the unravelling economic crisis may provide an impetus to improve the efficiency of cumbersome permitting and reporting processes, it is vital that any changes made do not weaken (*de jure* or *de facto*) their environmental stringency. To avoid future pandemics and other crises, maintaining or stepping-up regulations on land-use change, wildlife trade and polluting activities is critical. Furthermore, by shining a light on the links between human health and biodiversity, the COVID-19 pandemic may have provided a political window of opportunity to tighten regulation. The regulatory changes on wildlife trade in China and Viet Nam are testimony to this. However, it will be important that such regulatory measures are carefully designed and implemented to avoid driving wildlife trade underground and to minimise and address any negative impacts on the livelihoods of vulnerable communities (Roe et al., 2020[69]).

It is equally important to ensure that environmental regulations are effectively enforced. The COVID-19 pandemic and associated lockdown measures have led to reports of increased illegal logging and wildlife poaching in countries in Africa, Asia, and South America due in part to curtailed monitoring and enforcement efforts (and in part to a loss of rural livelihoods) (IUCN, 2020[70]; Waithaka, 2020[71]). Governments face the challenge of ensuring that environmental monitoring and enforcement continues to be financed and conducted during and after the COVID-19 pandemic (while respecting social distancing, travel restrictions and other health measures). In addition to being vital for safeguarding biodiversity and ecosystem services, increased efforts to monitor and deter illegal extraction of natural resources (e.g. timber and wildlife) may provide an important short-term economic stimulus by creating jobs (Strand and Toman, 2010[72]).

Attach environmental conditionality to bailouts to drive sustainability improvements

A significant share of public spending committed as part of COVID-19 response and recovery plans is dedicated to sectors that are associated with a heavy biodiversity footprint, such as agriculture, energy and industry. On the one hand, public spending on these sectors in the absence of environmental considerations risks entrenching or exacerbating pre-COVID-19 unsustainable practices and trajectories, driving further biodiversity loss. This is particularly the case in countries where biodiversity-relevant policies are already weak or poorly enforced. On the other hand, public spending could be an opportunity to pull these sectors onto a more sustainable trajectory.

To safeguard biodiversity and help drive improvements in environmental sustainability, it is imperative that governments keep longer-term policy goals in mind when designing and allocating loans, grants, tax relief and other support for companies. Preferential treatment could be provided to industries or companies that have a neutral or positive impact on biodiversity, or support could be made conditional on companies making commitments to reduce their biodiversity footprint. Some countries have already applied climate conditionality to their stimulus measures. For example, the Austrian government's bailout of Austrian Airlines is conditional on the company taking action to reduce their greenhouse gas emissions. To receive support from Canada's Large Employer Emergency Financing Facility (LEEFF), companies must commit to disclosing yearly climate-related reports (Government of Canada, 2020[73]).

Screen and monitor stimulus measures for their biodiversity impacts

Given the large scale of stimulus packages announced, spending decisions could have considerable implications for biodiversity. It is therefore prudent to screen measures for potential biodiversity impacts (positive and negative), prior to their implementation. This would help governments to evaluate the "greenness" of their economic recovery programmes, and to re-consider measures that could potentially have a significant negative impact on biodiversity.

Monitoring and evaluating the effects of implemented measures is also important. Understanding whether stimulus measures have achieved their macroeconomic, employment and environmental objectives, and whether they have had unintended consequences, would allow for adjustments over time and inform the design of future stimulus packages. Despite the importance of screening, monitoring and evaluating stimulus measures, a review by OECD found that very few ex-ante and ex-post assessments of green stimulus packages were conducted following the 2007-2008 Global Financial Crisis (OECD, 2020[74]). To complement countries' efforts to monitor COVID-19 stimulus measures, the OECD has established a COVID-19 Green Recovery platform, which includes a list of 13 headline environmental indicators covering a number of environmental issues including biodiversity (OECD, 2020[75]).

To effectively screen, monitor and evaluate stimulus measures, countries could also draw on green budgeting initiatives and the EU Sustainable Taxonomy. Green budgeting is about assessing and improving the alignment of budgetary processes and fiscal policies with biodiversity and other environmental objectives. Examples of green budgeting initiatives include OECD's Paris Collaborative on Green Budgeting, launched in 2017 (OECD, 2020[76]), and France's development of a green budgeting methodology in 2019 *(Green Budgeting: proposition de méthode pour une budgetisation environnementale)* (Waysand et al., 2019[77]). The EU Sustainable Taxonomy is a framework under which an economic activity can be considered environmentally sustainable under European financial legislation (Martini, 2020[78]). An economic activity is eligible if it "substantially contributes" to at least one of the six environmental objectives[10] while doing "no significant harm" to any of the other objectives. The principles, tools and approaches of these initiatives could be employed and further developed to ensure that COVID-19 recovery spending is consistent with biodiversity objectives.

2. Scale up investment in biodiversity conservation, sustainable use and restoration

Set biodiversity spending targets for COVID-19 stimulus measures and recovery plans

Governments could set green targets (or requirements) for their COVID-19 stimulus packages to ensure they support biodiversity and other environmental objectives. For example, the EU requires 30% of the pandemic recovery package the Next Generation European Union (NGEU) and interlinked Multiannual Financial Framework (MFF) to be earmarked for climate protection (i.e. EUR 550 billion over 2021-27), which may also benefit biodiversity by addressing one of the key drivers of biodiversity loss. Similar spending targets could be envisioned for biodiversity. Austria's COVID-19 response includes EUR 200 million in funding for municipalities to co-finance climate resilience

[10] The six objectives are 1. Climate change mitigation, 2. Climate change adaptation, 3. Sustainable use and protection of water and marine resources, 4. Transition to a circular economy, waste prevention and recycling, 5. Pollution prevention and control, 6. Protection of healthy ecosystems. The biodiversity/ecosystem criteria is due to be developed by the end of 2021.

projects, and requires 20% of this to support nature-based solutions. It is important, however, that efforts to increase the volume of biodiversity-positive stimulus measures are accompanied by efforts to reduce the volume of stimulus flowing to biodiversity-harmful activities.

Promote jobs in biodiversity conservation, sustainable use and restoration

Investing in biodiversity creates immediate job opportunities, while safeguarding the natural capital that underpins the economy, human health and well-being. Activities such as ecosystem restoration, reforestation, invasive alien species management and environmental monitoring and enforcement tend to be labour intensive and quick to implement, because worker-training requirements are relatively low and projects often have minimal planning and procurement requirements (Hepburn et al., 2020[79]).

In addition to providing immediate jobs, investment in biodiversity can provide a short and long-term economic multiplier effect. For example, ecosystem restoration in the United States provides direct employment for 126 000 workers and generates USD 9.5 billion in economic output annually, while creating a further 95 000 indirect jobs and USD 15 billion in household spending (BenDor et al., 2015[53]). Furthermore, conservation, restoration and improved management of forests, grasslands, wetlands and agricultural lands could deliver 23.8 gigatonnes of cumulative carbon dioxide 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 CO2 by 2030[11] [12] (Griscom et al., 2017[80]).

Engage businesses and the finance sector for a biodiversity-positive recovery

Businesses and the finance sector have a critical role in delivering a recovery that is sustainable and green. Strategic spending by governments could help to mobilise private finance for biodiversity, for example by improving the risk-return profile of biodiversity projects to attract private finance, and by ensuring publicly procured goods and services come from companies that meet biodiversity criteria.

Further work is required to help businesses and investors measure their impacts and dependencies on biodiversity, and the risks and opportunities these entail. Businesses should integrate biodiversity considerations across all areas of business, e.g. strategy and governance, risk management, due diligence and disclosure. Financial markets must be transparent, and correctly value and account for biodiversity-related impacts and risks. The work of the newly established Taskforce on Nature-related Financial Disclosure could help to achieve this.

With companies redesigning operations and supply chains to address the crisis, now is also a good time to promote the uptake of responsible business conduct (RBC) standards and tools.[13] OECD's Guidelines for Multinational Enterprises (OECD, 2011[81]) and OECD Due Diligence Guidance for Responsible Business Conduct (OECD, 2018[82]) could help guide these efforts. Applying risk-based due diligence to identify and address adverse

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

[12] The permanence of these mitigation benefits will, however, depend on the effectiveness of broader efforts to mitigate climate change and manage the increasing risk of wildfires resulting from climate change. See OECD's conference report on Adapting to a Changing Climate in the Management of Wildfires.

[13] For a more in-depth discussion of COVID-19 and RBC, see OECD's policy brief on COVID-19 and Responsible Business Conduct.

impacts on biodiversity, would help companies' to build resilience to current and future supply chain disruptions, and enhance their ability to access finance. Work is underway at the OECD to strengthen the biodiversity component of RBC guidelines.

3. Put a price on biodiversity loss

Reform biodiversity-harmful subsidies

With increased government spending putting further pressure on already strained budgets, it is now as vital as ever that public expenditure is well targeted and efficient. Subsidising activities that undermine the integrity and resilience of ecosystems upon which future economic health depends, is a self-defeating policy. Prior to COVID-19, government expenditure on subsidies harmful to biodiversity was at least five times greater than total spending to protect biodiversity (OECD, 2020[83]). Support for fossil fuels in 77 economies (principally OECD and G20), was USD 478 billion in 2019. Agricultural support potentially most harmful to biodiversity[14] was on average USD 112 billion per year for the period 2017-2019, in OECD countries alone (OECD, 2020[84]). Such support is likely to drive further ecosystem degradation, thereby increasing the risk of future pandemics, climate-related disasters and disruption of commodity supply chains.

Instead of incentivising activities that harm biodiversity, governments should redirect subsidies to activities that deliver socio-economic outcomes and have a positive (or at least neutral) impact on biodiversity. For example, governments could provide targeted payments to promote biodiversity and other environmental public goods in agricultural systems; however only a handful of countries adopt these policies and they represent a small share of total support for agriculture (OECD, 2020[85]). Agri-environmental payments have the potential to deliver "win-win" outcomes for both environmental and economic performance, although evidence suggests that their success has been patchy and identifies significant room for improvement (OECD, 2013[86]) (DeBoe, 2020[87]). Similarly, re-directing fisheries support away from policies that incentivise more intensive fishing towards activities that improve the sustainability of fishing operations, could have significant benefits for the environment as well as for fishers' livelihoods (Martini and Innes, 2018[88]).[15] Budgetary support for innovation and the wider enabling environment could also play an important role in making agro-food systems more productive, sustainable and resilient, helping to reduce pressure on ecosystems. Yet only one-eighth of total agriculture support[16] goes to agricultural innovation systems, inspection and control systems, and rural infrastructure (OECD, 2020[85]).

Scale up economic incentives for biodiversity

The waiving or reduction of taxes, or deferral of tax payments, has been a key element of many countries' COVID-19 responses. While reductions in labour taxes to support struggling businesses and maintain jobs during this crisis may be sound policy, reducing biodiversity-relevant taxes is not. It favours polluting companies and facilitates the erosion

[14] Support to agricultural producers considered potentially most environmentally harmful consists of market price support; payments based on commodity output, without imposing environmental constraints on farming practices; and payments based on variable input use, without imposing environmental constraints on farming practices.

[15] For a more in-depth discussion of fisheries and COVID-19, see OECD's policy brief on Fisheries, Aquaculture and COVID-19: Issues and Policy Responses.

[16] Based on an analysis of 54 countries.

of biodiversity and ecosystem services upon which the economy, human health and well-being depend. Rather than reducing biodiversity-relevant taxes, countries should increase their application and ensure that their prices accurately reflect the cost of biodiversity loss. Introducing and ramping up taxes on activities that harm biodiversity would deliver dual benefits. Firstly, it would provide a clear economic signal to help drive the transformative changes needed to halt biodiversity loss. Secondly, the additional revenue could help offset increased government spending and reductions in other tax revenue (e.g. labour tax) resulting from the COVID-19 induced economic crisis.

Although biodiversity-related taxes were steadily increasing in number prior to COVID-19, they remain underutilised. A total of 206 biodiversity-relevant taxes were in force at the beginning of 2020, spanning 59 countries. While revenue from biodiversity-relevant taxes was USD 7.5 billion per year (average 2016-2018) in OECD countries, it is less than one percent of total revenue from environmentally-relevant taxes (OECD, 2020[89]), which in turn account for approximately five percent of all tax revenue (OECD, 2020[90]).

Revenue from biodiversity-relevant taxes and other environment-relevant taxes could be used to reduce budget deficits, or it could be re-directed towards green stimulus measures that improve the sustainability of agriculture and other land-use. Colombia and Costa Rica, for example, have implemented carbon taxes whose proceeds are earmarked for conservation activities, such as forest protection, reforestation, agroforestry and sustainable forest management (WEF, 2020[48]). While these schemes were in place prior to COVID-19, they provide pertinent examples of how governments could develop effective response packages that support livelihoods and benefit biodiversity, without increasing the fiscal burden.

4. Foster cross-sectoral and international collaboration

Adopt and strengthen the One Health approach

Emerging zoonoses such as COVID-19, and other health threats such as antimicrobial resistance, are linked to the interaction between humans, domesticated animals, wildlife and ecosystems. One Health[17] has emerged as a holistic, interdisciplinary approach to address such complex challenges. While there is no universal definition, the One Health Commission defines it as “a collaborative, multi-sectoral, and trans-disciplinary approach – working at local, regional, national, and global levels – to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants and their shared environment” (One Health Commission, 2020[91]). The Manhattan Principles on One World, One Health adopted in 2004 delineate priorities for an international, interdisciplinary approach for combating threats to the health of life on Earth. The Food and Agriculture Organization of the United Nations (FAO), World Organisation for Animal Health (OIE) and World Health Organization (WHO) started collaborative work in 2010 to address risks at the human-animal-ecosystems interface and updated their joint 2008 tripartite guide on zoonoses and other One Health issues in 2019.

While there has been some success in applying the One Health approach (Weerasinghe, 2018[92]), efforts have largely focussed on building links between medical and veterinary disciplines, with less attention given to ecosystems (Barrett and Bouley, 2015[93]) (Cleaveland, Borner and Gislason, 2014[94]) (CBD, 2017[95]). Further integration of

[17] One Health is closely related to the concept of Ecohealth (IDRC, 2012[110]) (Roger et al., 2016[109]) and Planetary Health (Whitmee et al., 2015[112]). See Lerner et al. (2017) (Lerner and Berg, 2017[111]) for a comparison of these three concepts.

ecological, medical, veterinary, climate and broader economic perspectives is an important step in preventing future zoonotic outbreaks (Romanelli et al., 2014[96]). The Convention on Biological Diversity (CBD) provides guidance on how this can be achieved in its 2017 *Guidance on Integrating Biodiversity Considerations into One Health Approaches* (CBD, 2017[95]). Countries are invited to take further action to integrate biodiversity into the One Health approach by CBD Decision 14/4 Health and Biodiversity, which was adopted by the 14th Conference of the Parties to the CBD in 2018 (CBD, 2018[97]). The cost of investing in ecological measures that can help prevent a pandemic is much less than the cost of a pandemic (Dobson et al., 2020[45]).

Support developing countries to safeguard their biodiversity

Developing and emerging economies will be among the hardest hit socially and economically by the COVID-19 pandemic, with significant implications for biodiversity. Prior to the pandemic, many of these economies were already struggling to finance biodiversity, and were facing rising debt. Total external debt stocks of developing economies and economies in transition had more than doubled from USD 3.5 trillion in 2008 to USD 8.8 trillion in 2018, or from 22% of GDP to 29% (UNCTAD, 2019[98]). As of late 2019, 33 out of 69 countries analysed were classified "in debt distress" or at "high risk" (IMF and World Bank, 2019[99]). The COVID-19 pandemic is exacerbating the situation as countries increase spending to finance health measures, support households and firms, and invest in the recovery, while sources of domestic revenue (e.g. tax revenues) and international development finance wane.[18]

Official development assistance (ODA) has proven to be a key resource and countercyclical flow (i.e. counteracts fluctuations in the economy) in past crises (OECD, 2020[100]), and could be vital for ensuring the ongoing protection of biodiversity in some developing countries during and after the crisis. Many developing countries are highly dependent on ecotourism revenues for funding biodiversity protection, and these have all but dried up due to travel restrictions (Waithaka, 2020[71]; IUCN, 2020[70]). In the short-term, ODA could be used to help fill the gap where other finance has declined. For example, Germany's International Climate Initiative (IKI) is implementing a EUR 68 million Corona Response Package that will provide, among other things, financial support for the conservation of nature reserves in IKI partner countries to address the immediate impact of COVID-19 (Platform 2020 Redesign, 2020[101]). In the longer term, ODA could be used to scale up efforts to tackle deforestation and illegal wildlife trade, and to develop new funding models for biodiversity protection that are diversified and therefore more resilient to shocks such as COVID-19.

In the face of impending debt crises, sovereign debt restructuring and debt swaps could present an opportunity to reduce a country's debt, while also delivering on biodiversity objectives that provide domestic and global benefits. This could be achieved by lender countries offering lower interest rates and principal repayments in return for increasing biodiversity protection (Zadek, 2020[102]). Debt-for-nature swaps, a type of debt restructuring, have existed since the late 1980s. The US government's debt-for-nature swaps cancelled approximately USD 1.8 billion owed by 21 low- and middle-income nations, and generated USD 400 million for conservation. Debt-for-nature swaps carried out by all other high-income nations totalled USD 1 billion of debt cancelled and generated about USD 500 million for conservation (Sommer, Restivo and Shandra, 2019[103]). While

[18] For a focussed discussion on development finance and COVID-19 see OECD's policy brief The Impact of the Coronavirus (COVID-19) Crisis on Development Finance.

debt-for-nature swaps traditionally focused on terrestrial biodiversity, the first debt-for-nature swap with a marine conservation component was launched in 2016 by the Government of the Seychelles and Paris Club creditors, supported by The Nature Conservancy.

Develop, adopt and implement an ambitious post-2020 global biodiversity framework

The post-2020 global biodiversity framework was due to be adopted in 2020 at the 15th Conference of the Parties to the Convention on Biological Diversity (CBD COP15). However, owing to COVID-19, the conference has been postponed to 2021. The framework is intended to steer action on biodiversity by the public and private sector for the next decade, and bring about the transformative changes in national goals, policies and actions needed to avert biodiversity loss.

Countries will need to work together effectively and efficiently to establish a framework that is fit-for-purpose. This means having an effectively structured and operational framework containing specific, measurable and ambitious targets. Targets should be linked to indicators in order to track progress and enhance the effectiveness of policy interventions. OECD proposes that the framework has a set of headline indicators that are consistent and comparable across countries, and cover the state of biodiversity, the pressures on biodiversity and the actions needed to addresses these and underlying drivers. For further details see "The Post-2020 Biodiversity Framework: Targets, indicators and measurability implications at global and national level" (OECD, 2020[104]) and "OECD submission on the draft monitoring framework for the post-2020 global biodiversity framework" (OECD, 2020[105]).

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