FINANCING NATURE:

Closing the Global Biodiversity Financing Gap

Full Report

保尔森基金会
PAULSON INSTITUTE

The Nature Conservancy

Cornell Atkinson Center for Sustainability

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DISCLAIMER

The authors would like to thank the Technical Advisory Group members, contributing authors, and reviewers for their valuable contributions that strengthened the report. The content and positions expressed are, however, those of the authors and do not necessarily reflect the perspectives of those who provided input, nor the organizations to which they are affiliated.

SUGGESTED CITATION:

Deutz, A., Heal, G. M., Niu, R., Swanson, E., Townshend, T., Zhu, L., Delmar, A., Meghji, A., Sethi, S. A., and Tobin-de la Puente, J. 2020. Financing Nature: Closing the global biodiversity financing gap. The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability.

GRAPHIC DESIGN:

Jonathan Tsao

PHOTO CREDITS:

Cover (*trees/waterfall*): © Ken Geiger/TNC; Page 1 (*redwoods*): © Patrick McDonald/TNC Photo Contest 2018 Page 26 © Tyler Schiffman/TNC Photo Contest 2019; Page 42: © Carlton Ward Jr.; Page 48 © Jennifer Adler; Page 116: Junqiu Huang/TNC Photo Contest 2019; Page 121, 173: © Jianmin Wang; Page 227: © Harvey Locke

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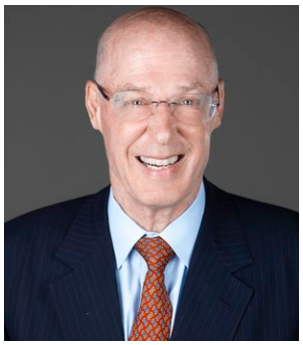
Acknowledgments

The authors are grateful to the many individuals, in addition to the members of the Technical Advisory Group, who contributed to this report as reviewers, advisors, supporters, communicators, or sources of information, including Katie Baildon, Divina Baratta, Kristin Gomez, Sara Levin Stevenson, Alan Martínez, Bianca Shead, and Eve Wang. The Paulson Institute authors would like to thank Henry M. Paulson Jr. for his leadership and vision, Deborah Lehr for her inspiration and guidance, and Tom Lovejoy and Larry Linden for their wise counsel. The Nature Conservancy authors would like to thank Jennifer Morris for her support and vision. The Cornell University authors are grateful to the leadership and staff of the Cornell Atkinson Center for Sustainability for logistical, financial, and communications support.

Contents

FOREWORD

The world is in the midst of one of the most dramatic extinction episodes in history.



HENRY M. PAULSON JR.
Chairman, Paulson Institute

The signs of biodiversity loss are everywhere. Tropical forests, our greatest stores of biodiversity and carbon, are in retreat. Coastal wetlands, vital to migratory birds and fisheries and also a significant global stock of carbon, are deteriorating worldwide. Although extinction is a natural phenomenon, scientists estimate that our planet is now losing species at 1,000 times the natural rate of one to five per year. If we continue on the trajectory we're on, we face a future where 30–50 % of all species may be lost by the middle of the 21st century.

Climate change is exacerbating this loss, causing coral reef bleaching, rampant growth of insect disease in forests, and severe expected loss of Arctic species. And it is a vicious circle—biodiversity loss also aggravates climate change. In the Amazon, hydrological changes caused by deforestation may permanently dry out millions of acres of rainforest and alter the entire Amazon climate. The resulting economic cost will be staggering.

If there's one lesson I've learned throughout all my years as a conservationist, it's that nature needs advocates. But advocates, for their part, need a clear and compelling economic case that can be broadly supported by the public and championed by political leaders. Today, the case for action has never been clearer.

Biodiversity loss doesn't just mean the loss of plants and animals. It poses enormous risks to human prosperity and well-being. Science is only beginning to understand and quantify the magnitude of this impact. The worldwide loss of pollinators—including bees, butterflies, moths, and other insects—well underway due to our excessive use of pesticides, would lead to an estimated drop in annual agricultural output of around US$ 217 billion. Associated with this loss are the risks of famine and social unrest, potentially more serious but harder to quantify.

The destruction of natural environments also brings people and wildlife into contact in a way that presents public health risks through the spread of zoonotic diseases. It may be no coincidence that we have seen multiple outbreaks of zoonoses during this time of rapid biodiversity loss,

including SARS, Ebola, MERS, and SARS-CoV-2, the virus responsible for the COVID-19 pandemic and its devastating impact across the world. However, these examples are the tip of the iceberg. Given the complexity and interdependencies of nature, there are many unknown risks.

Our political and economic systems and financial markets have not done enough to properly account for the services nature provides. For example, recent research has argued for a value as high as US$ 600 per ton of CO_2 captured, which would imply a value for forests in their role as carbon sinks alone of well over US$ 100 trillion. Yet valuing forests on carbon alone is akin to valuing a computer chip for its silicon. What we do have is an idea of the scale of our economic reliance on nature. The World Economic Forum estimates that US$ 44 trillion of global GDP—around half—is highly or moderately dependent on nature.

In short, although we will never be able to calculate the full value of nature, we know enough to know that its destruction presents profound risks to human societies and, as with any serious risk we face, the rational response is to hedge. In the case of biodiversity loss, this means taking comprehensive, worldwide effort to appropriately value, protect, and restore nature. The most cost-effective policies are those that would prevent ongoing destruction of biodiversity for short-term economic gains, while eroding and threatening the long-term prosperity and well-being of current and future generations.

...a healthy planet is good for business; it's far cheaper to prevent environmental damage than to clean it up afterward.

I've always believed that a healthy planet is good for business; it's far cheaper to prevent environmental damage than to clean it up afterward. For much of my career, this was a lonely position in the corporate world. But in recent years, something has changed. I've seen a new sense of urgency around nature conservation issues, a rapidly growing interest in the field of green and sustainable finance, and a renewed sense that collective effort can make a difference. Hopefully, investing in nature will move into the mainstream of the financial world soon enough to arrest the alarming decline of our biodiversity.

Ultimately, this will require a transformational shift in the way markets value nature. This shift needs to be reflected across governments, academia, the private sector, NGOs, media, and, most importantly, the public. In the meantime, to tackle the risks of biodiversity loss, it is important to identify and implement financing and policy mechanisms that can rapidly mobilize substantial amounts of capital for nature protection and conservation.

While government must play a leading role, we know that governments alone cannot deliver the financing needed to protect our biodiversity. The private sector is often touted—with good reason—as the great hope for

conservation because the financial resources it could bring to bear far exceed those of governments and philanthropy. Unquestionably, many CEOs in the private sector would like to protect nature. Some donate personal funds to conservation NGOs, and the organizations they run may make token investments and operating decisions to protect or restore biodiversity if they don't impact profitability. However, they won't deploy capital for conservation or environmental projects that don't promise economic returns. The distinction is important. Philanthropy is a way to distribute profits. Investing is a way that private sector generates profit. Deliberately investing at a loss isn't a realistic business model. That is why, to realize the potential of private sector investment in nature protection and conservation, governments must put in place policy measures—such as tax breaks, de-risking guarantees, and regulatory requirements—that induce the private sector to invest.

Philanthropy is a way to distribute profits. Investing is a way that private sector generates profit.

This report, a collaborative effort between the Paulson Institute, The Nature Conservancy, and Cornell University, makes a broad economic case for protecting and conserving nature and explores and highlights nine policy and financing mechanisms that, if implemented, will either secure new funding for biodiversity conservation or, through the reform of harmful subsidies, significantly reduce the need for future spending.

As governments prepare to agree on a "new deal for nature" at the 15th Conference of the Parties to the UN Convention on Biological Diversity, we offer this report as a contribution to help guide the negotiations, particularly around financial resource mobilization, and to national governments as they consider the domestic policies and measures required to implement the Post-2020 Biodiversity Framework and put their economies on a more sustainable path. It should be noted that investment in biodiversity will also contribute to reaching climate change goals given that nature-based solutions are among the most cost-effective climate mitigation strategies.

The economic case for protecting nature is compelling. However, we should keep in mind that there is an overwhelming case for preserving nature for its own sake. Nature is the greatest source of beauty, inspiration, innovation, and intellectual interest—indeed of everything that is good about life. In that sense, it is priceless.

Executive Summary

Human activities are causing unprecedented and accelerating global loss of biodiversity. Widespread land conversion for infrastructure, agriculture and other development, and overexploitation of natural resources are being driven by political leaders' prioritization of short-term economic gains and the inability of our economic systems and financial markets to appropriately value and protect our natural capital.

To slow and stop the global loss of biodiversity, we must fundamentally rethink our relationship with nature and transform our economic models and market systems. The policy and economic actions needed to achieve this require considerable political will, broad public support, and substantial investment. This will not happen overnight and, in the short to medium term, there is an urgent need to scale up finance for nature.

The *Financing Nature* report addresses two important challenges.

First, the report lays out the broad **economic case for protecting nature**, including an examination of the many known economic and social values of biodiversity, while recognizing that the complexities and interdependencies of nature mean that attempted economic valuations will almost certainly be partial and underestimates. Biodiversity loss presents serious known and unknown risks to human prosperity. The report further examines the underlying market failures that hasten global biodiversity loss and indicates a number of policy interventions and changes needed to halt biodiversity loss.

Second, the report focuses on a critical element related to protecting biodiversity, namely the **biodiversity financing gap** between the current total annual capital flows toward global biodiversity conservation and the total amount of funds *needed* to sustainably manage biodiversity and maintain ecosystems integrity. Having gauged this biodiversity financing gap, the report identifies a set of **nine financial and policy mechanisms** that, if implemented and scaled up, can collectively close this gap.

The report goes into detail about the enabling conditions for the implementation and scaling of each of these mechanisms, and it makes detailed recommendations for policy makers, business leaders, and other stakeholders. It makes clear that all governments—from the biodiversity rich nations that may have limited economic means to the established donor countries—must take immediate actions to stem the loss of biodiversity.

The immediate intent of this report is to inform the work of national delegations and other negotiators in developing the resource mobilization strategy for the Post-2020 Biodiversity Framework that will be agreed to at the 15th Conference of the Parties (COP15) of the UN Convention on Biological Diversity (CBD) in 2021. The longer-term intent is to help political leaders, country finance ministries, international institutions, and representatives of companies, NGOs, and private philanthropy to better understand the economic case for biodiversity conservation and to accelerate the transformation of national economic models to those that appropriately value nature.

Given the magnitude of the biodiversity financing gap identified by this report, coupled with estimates of the relatively limited amount of funding that will be available in coming years from traditional sources such as governmental budgets, official development assistance (ODA),

and philanthropy, it is critical that the biodiversity targets to be agreed to at COP15 incorporate a broad spectrum of nontraditional mechanisms. Catalyzing private sector capital must be a priority, given that it constitutes the largest available source of financing. However, the report makes clear that the potential for private capital to support biodiversity conservation will only be realized if appropriate governmental policies, regulations, and incentives are in place.

A detailed description of the methodologies used in this report, including data sources and assumptions, can be found in Appendix A of the full report.

Central Insights

The report provides four central insights:

1. **Closing the gap relies heavily upon government actions.** Governments need to do more to protect natural capital and put in place a combination of policy reforms to reduce negative impacts on biodiversity, such as **reforming harmful agricultural subsidies** and reducing investment risk by public and private investors. Governments must also **develop new financial innovations to increase available funding for conservation**, promoting green investments, and supporting development of nature-based climate solutions, natural infrastructure and biodiversity offsets.
2. **The private sector can play a pivotal role, but governments need to pave the way. Governments need to put in place the right regulatory environment, smart incentives and market structures to catalyze financial flows from the private sector into biodiversity conservation.**
3. **The only way to stop global biodiversity loss is to ensure that nature is appropriately valued in all economies.** This will require bold political leadership and transformative policies, mechanisms and incentives that discourage harmful actions and encourage large-scale finance for nature.
4. **The gap between the amount currently spent on biodiversity conservation and what is needed is large, but it can be closed.** As of 2019, current spending on biodiversity conservation is between $124 and $143 billion per year, against a total estimated biodiversity protection need of between $722 and $967 billion per year. This leaves a current biodiversity financing gap of between US$ 598 billion and US$ 824 billion per year.

The following text box provides six **overarching recommended actions** derived from the analysis underlying this report. Additionally, there is a set of specific recommendations for each of the nine financial and policy mechanisms described in this report. These are described briefly at the end of this executive summary and in more detail in Chapter 6 of the full report.

Overarching Recommendations

The key finding of this report is that governments must undertake catalytic policy reforms to unleash biodiversity funding. These six recommended actions will accelerate the of each of the nine financing mechanisms described in the report and materially contribute to closing the biodiversity financing implementation gap.

Recommended Action 1: Countries must take *immediate policy actions* to protect their natural capital and expand biodiversity conservation financing. This report identifies nine mechanisms with the highest promise for resource generation and harm-prevention, including prioritizing rural economic support that subsidizes farmers to provide ecosystem services, avoiding major infrastructure development impacts on critical habitats, and investing in nature-based climate solutions.

Recommended Action 2: Government and philanthropic donors should use their funds strategically to support countries to implement the financing mechanisms identified in this report and to catalyze subsequent public and private sector investment. This report calls for a doubling of foreign aid for biodiversity with the incremental resources being devoted to biodiversity-rich countries and toward implementation of these mechanisms.

Recommended Action 3: National and subnational governments should strengthen their regulatory and financial enabling conditions to significantly accelerate private sector actions and finance for biodiversity conservation. Governments should set policies and take actions to de-risk and incentivize private sector investment, build in-country support for sustainable commodity production, and ensure needed legal conditions including land tenure.

Recommended Action 4: Private sector actors should implement the recommendations from the sections on sustainable supply chains, harmful subsidy reform, natural infrastructure, biodiversity offsets, nature-based solutions and carbon markets, green investment, and investment risk management to both increase their opportunities to invest in biodiversity and minimize their biodiversity-related financial risks. In addition, major companies should adopt science-based targets for biodiversity within their operations and investments consistent with the 2050 vision of the UN Convention on Biodiversity.

Recommended Action 5: Governments and international agencies should improve tracking and reporting on biodiversity finance. Some of the best data collection and analysis that are available are spread across the OECD, UNDP's BIOFIN initiative and the CBD Secretariat. Additional public funding should be secured to support these institutions to enhance global finance data collection and build capacity of governments to collect and share data.

Recommended Action 6: In the context of the UN Convention on Biological Diversity negotiations, Parties should agree to develop and implement National Biodiversity Finance Plans (NBFPs) to guide the implementation of their national efforts toward the CBD's new Global Biodiversity Framework. The NBFPs should address opportunities to mobilize resources at all levels—local, national, and global—as well as from all sources—public, private, and philanthropic. To achieve this outcome, this report recommends the following Resource Mobilization targets for the Global Biodiversity Framework by 2030:

- *Global target:* Financial flows to investments that generate measurable and auditable improvements in the status of biodiversity increase globally to fully close the biodiversity financing gap by 2030 (est. US$ 598–824 billion annually);
- *Process target:* 100 % of Parties immediately develop National Biodiversity Finance Plans (NBFPs) and fully implement them by 2030;
- *National targets:* Each Party mobilizes 100 % of the necessary resources identified in their NBFPs to fully and effectively implement their National Biodiversity Strategies and Plans (NBSAPs); and
- *Global target:* International public funding for biodiversity at least doubles by 2030 and at least covers the costs, where needed, for developing countries to develop NBSAPs and NBFPs.

The Economic Case for Protecting Biodiversity

Viewed through a traditional economic lens, our planet's biodiversity and **natural systems are essentially a capital stock** (similar to financial, built, or human capital) that provides a flow of services to people. These "ecosystem services" include fertile soil and pollination that make food production possible, forests and watersheds that sequester carbon and purify water, and genetic diversity on which much of modern pharmacology and agriculture depend, among many others.

While it would seem possible to view biodiversity and natural systems as fundamental to human survival and economic prosperity, the tendency of political systems is to prioritize immediate economic gains while threatening the prosperity and well-being of current and future generations. The tendency of current economic models and financial markets is to view natural systems simply as assets available for immediate use or, worse, abuse and destruction. Such a view leads to the overuse and abuse of nature for short-term gains and without regard for the full value of the assets lost or the long-term costs to society of their loss.

Natural capital is complex and difficult to measure. Financial markets do not recognize the value of natural capital unless it has a defined cash flow or asset value that can be measured by current economic systems. **As a result, the full value or costs of using, or destroying, natural systems are poorly understood.** In contrast to other forms of capital, natural capital does not depreciate. Instead, it is to a certain extent self-regenerative. However, once ecosystem degradation reaches a tipping point, the self-regenerative properties of natural capital are lost, and ecosystem collapse may be irreversible.

Despite weaknesses in the models and tools to measure the value of natural capital, there are several studies that hint at its potential full value. Recently, researchers have estimated that approximately US$ 44 trillion of global GDP is dependent on nature and its services.[a] For example, the worldwide loss of all pollinators would lead to a drop in annual agricultural output of about US$ 217 billion.[b] Recent climate research has argued for a value as high as US$ 600 per ton of CO_2 captured, which would imply a value for forests in their role as carbon sinks alone of more than US$ 100 trillion.[c] As many as one third of the pharmaceuticals in use today were originally found in plants and other natural sources or were derived from substances occurring naturally.[d]

While these estimates demonstrate a potentially huge value of biodiversity to society, a major challenge lies in the fact that, **for every contribution of nature that can be measured and imputed a dollar value, there are many more that cannot.** In other words, when assessing the cost of biodiversity loss, there are "partly-known unknowns" and "unknown unknowns." Given this lack of exact knowledge, any estimate of the economic cost of biodiversity loss, even when based on a worst-case scenario, likely understates the cost of such losses.

The current failure of our financial markets and economic models and institutions to correctly value biodiversity lies at the intersection of several market failures. To start, many of the benefits of biodiversity are public goods that are non-excludable and non-rivalrous in nature, which means that markets will likely undervalue them. In addition, the benefits from biodiversity conservation and costs from biodiversity loss impact third parties in the form of external benefits and costs, which are another standard

[a] C. Herweijer et al. (2020), *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*, World Economic Forum, http://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf.

[b] Helmholtz Association of German Research Centres (2008, September 15), Economic Value of Insect Pollination Worldwide Estimated at U.S. $217 Billion. *ScienceDaily*. Retrieved March 1, 2011, from http://www.sciencedaily.com/releases/2008/09/080915122725.htm.

[c] Umberto Llavador, John Romer, and Joaquim Silvestre, *Sustainability for a Warming World* (Harvard University Press, 2015).

[d] D. J. Newman and G. M. Cragg, Natural products as sources of new drugs over the 30 years from 1981 to 2010. *J Nat Prod*. 2012;75(3):311–335. doi:10.1021/np200906s

market failure where actors who conserve biodiversity are not adequately rewarded financially and perpetrators of biodiversity damage are not financially penalized. Finally, market failures in biodiversity are compounded by the lack of well-defined property rights of environmental goods and services, and as a result no one has any financial interest in, or can derive direct financial benefit from, conserving them or ensuring that they are allocated to their highest-value use.

Another comparison that can be made is in our understanding of the science and economics of climate change. Climate change science is far more advanced than the science of biodiversity loss, but climate change scientists nevertheless have greatly underestimated the rate and impact of warming, in part due to the challenge of incorporating the impacts of negative feedback loops in the warming process, such as accelerating glacial melt or methane releases from thawing permafrost. Likewise, **while our global economic models and systems do a reasonably good job tracking markets and finance in normal times, these same systems often fail in times of economic crisis.** These models and systems are unable to value our planet's deeply intertwined, dynamic, and complex climate, ecological, and human interrelationships.

A critical lesson is that we cannot rely on economic models, market forces, or the private sector alone to solve the problem of unprecedented global biodiversity loss. **Instead, policy intervention is essential.** Aside from the time-tested laws and policies that create protected areas and shelter endangered species, a host of policy instruments and mechanisms must be implemented to capture and derive economic benefits from nature in a sustainable manner or through a market-based approach, such as ecotourism, biodiversity-friendly products, and payment for ecosystem services. In addition, reforming agricultural and fishery subsidies harmful to biodiversity and promoting sustainable farming and fishing practices through well-designed policies will also help mitigate the impact of agriculture and fisheries, two of the largest drivers of global biodiversity loss.

Overall, a fundamental shift in the way markets, and economics more broadly, value and protect nature is imperative. Countries must implement new financing and policy mechanisms that more fully value natural capital, reduce harmful practices that destroy biodiversity, and rapidly mobilize substantial amounts of capital for biodiversity conservation.

Current Global Biodiversity Conservation Financing, Biodiversity Conservation Funding Needs, and the Biodiversity Financing Gap

Although the ultimate aim must be to appropriately value nature in our economic models, in the near-term there is an urgent need to scale up investment in biodiversity. This report determines that, in 2019, the total global annual flow of funds toward biodiversity protection amounted to approximately US$ 124–143 billion per year against an estimated annual need of US$ 722–967 billion to halt the decline in global biodiversity between now and 2030. Taken together, these figures reveal a Biodiversity Financing Gap of US$ 598–824 billion per year.

Significantly, this report shows that annual governmental expenditures on activities harmful to biodiversity in the form of agricultural, forestry, and fisheries subsidies—US$ 274–542 billion per year in 2019—are two to four times higher than annual capital flows toward biodiversity conservation.

Although this report addresses harmful subsidies from agriculture, forestry, and fisheries, it does not address the impacts of fossil fuel subsidies due to their indirect nature. This does not mean that fossil fuel subsidies are unimportant; the potential impacts of these subsidies on biodiversity, resulting from widespread conversion

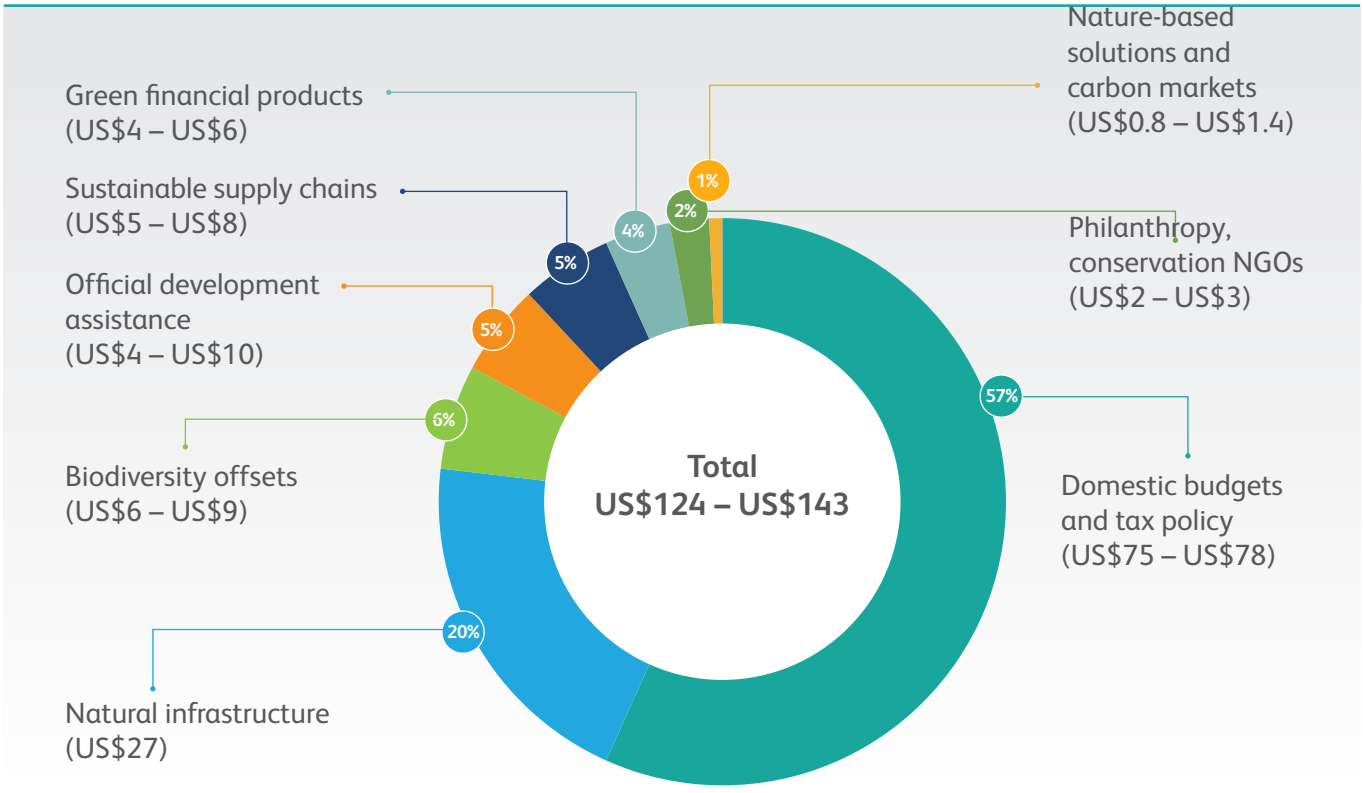
of natural vegetation for energy development and transmission and from increases in atmospheric and ocean temperatures associated with fossil fuel use, are highly likely to exacerbate and accelerate global biodiversity loss in addition to driving human-induced climate change.

Current Global Biodiversity Conservation Financing

The estimate of current global biodiversity conservation financing of US$ 124–143 billion per year is broadly consistent with other recently published estimates. For example, in early 2020 the OECD estimated[e] global biodiversity finance at US$ 78–91 billion per year based on available 2015–2017 data. In addition, BIOFIN estimates[f] that global annual public investment in biodiversity has increased from around US$ 100 billion in 2008 to about US$ 140 billion in 2017, with an average of US$ 123 billion deployed annually over this period. This report builds on the OECD's findings on public domestic, international public, and private mechanisms by providing a complementary assessment for private and public-private biodiversity finance.

Figures 1 and 2 break down the sources of financial flows into biodiversity conservation and show the scale of harmful subsidies in 2019. The categories and numbers were drawn from a pool of more than 160 biodiversity finance mechanisms in the BIOFIN Catalogue of Finance Solutions.[g] Some of these mechanisms

FIGURE 1. Global biodiversity conservation financing in 2019: Summary of financial flows into biodiversity conservation. *(in 2019 US$ billions per year)*

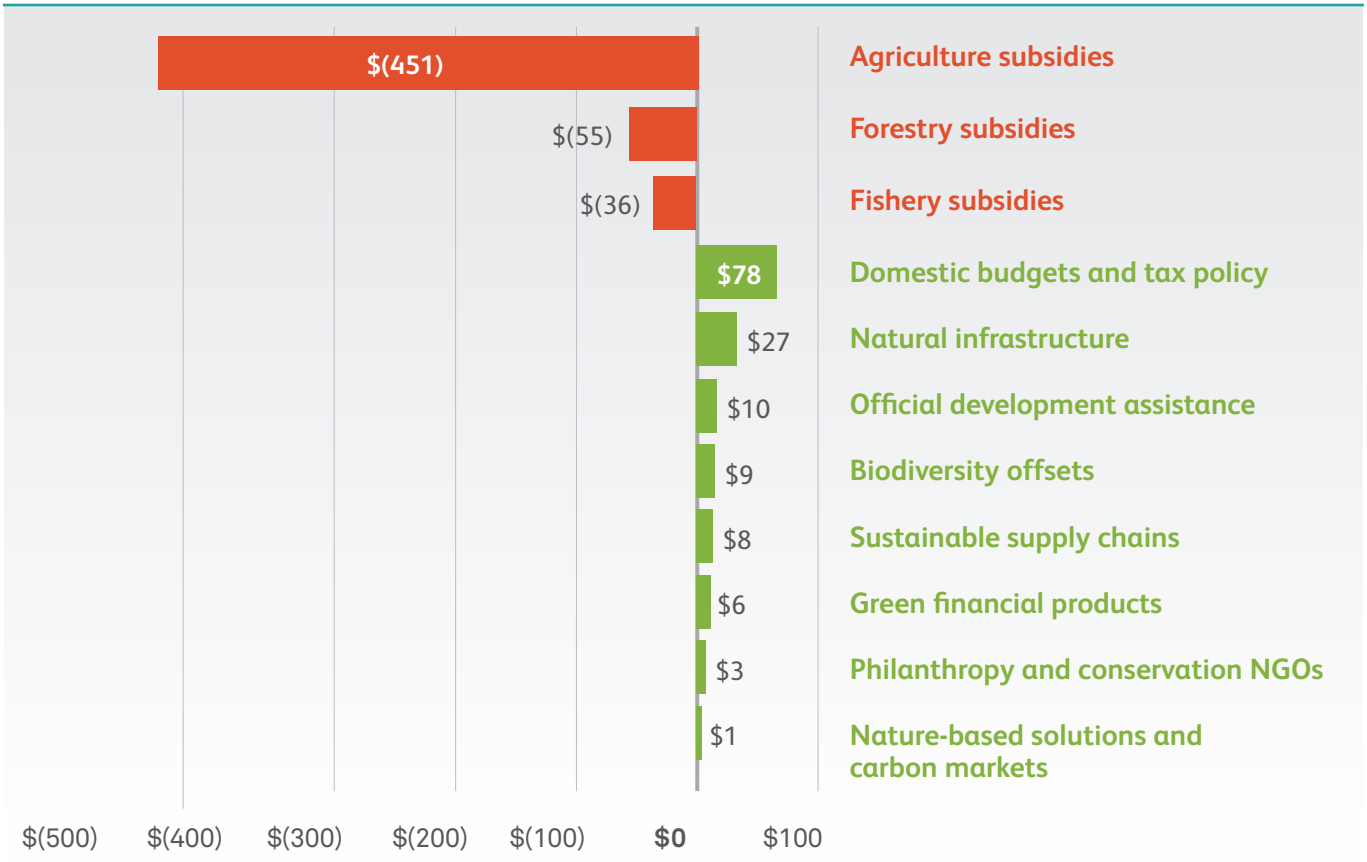


[e] OECD, 2020, *A Comprehensive Overview of Global Biodiversity Finance*. Final report prepared by the Organization for Economic Cooperation and Development (OECD), available at https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf.

[f] A. Seidl, K. Mulungu, M. Arlaud, O. van den Heuvel, and M. Riva, *Pennies for Pangolins: A global estimate of public biodiversity investments* (United Nations Development Programme, forthcoming 2020).

[g] UNDP BIOFIN, BIOFIN Catalogue of Finance Solutions, available at: https://www.biodiversityfinance.net/finance-solutions.

FIGURE 2. Harmful subsidies and global financial flows towards biodiversity conservation.
(upper estimates, in 2019 US$ billion per year)



Note: The estimates of agricultural, forestry, and fisheries harmful subsidies correspond to OECD's "potential biodiversity harmful" category of production subsidies. This graph excludes the estimated additional US$ 395–478 billion in fossil fuel production subsidies.[i]

were not incorporated into the current global biodiversity finance estimate, as they do not generate significant financial flows for biodiversity conservation or because the annual funding data have not been tracked or collected by the range of clearinghouses for economic information consulted and analyzed for this report. As such, Figure 1 represents a close approximation of the total annual public and private expenditures globally for biodiversity protection and conservation. The estimates of harmful subsidies used in Figure 2 correspond to OECD's "most harmful" category of subsidies.[h] Note again that this report excludes fossil fuel subsidies.

Biodiversity Conservation Funding Needs

For the purposes of projecting future annual funding needs for biodiversity protection, natural and human landscapes were divided into three broad categories of protected areas, productive landscapes, and urban environments, and the costs were estimated for their sustainable management:

1. **Protected areas:** This report incorporates the proposed global target for increasing both terrestrial and marine protected areas to reach 30 % by 2030, consistent with proposals by several conservation NGOs and

[h] OECD, 2020, *A Comprehensive Overview of Global Biodiversity Finance*. Final report prepared by the Organization for Economic Cooperation and Development (OECD), available at: https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf.

[i] OECD, 2020, Rising fossil fuel support poses a threat to building a healthier and climate-safe future, available at https://www.oecd.org/fossil-fuels/.

many governments, in anticipation of the new set of global biodiversity targets to be negotiated at the CBD COP15. Waldron et al. (2020)[j] propose a suite of six scenarios for protecting biodiversity. The lower estimate for future needs has been taken as a scenario that allows for a compromise between biodiversity protection and productive landscapes, thereby aligning with the category described in this chapter of productive landscapes and seascapes. The upper estimate is that of the scenario that prioritizes broader ecosystem integrity and viability.[k] The range of these cost estimates is US$ 149–192 billion per year.

2. **Sustainable management of productive landscapes and seascapes:** The costs in 2030 of sustainably managing the world's most productive landscapes and seascapes for the protection of biodiversity and key ecosystems were estimated as follows:
   a. Transitioning the agricultural sector to conservation agriculture practices in croplands by 2030 is estimated at US$ 315–420 billion per year.
   b. Transitioning global rangelands to sustainable rangeland management practices by 2030 is estimated at US$ 81 billion per year.
   c. Transitioning the forestry sector to sustainable forest management practices is estimated to be US$ 19–32 billion per year.
   d. Transitioning the global fisheries sector to sustainable fisheries practices is estimated at US$ 23–47 billion per year.
   e. Minimizing and mitigating the biodiversity impact of invasive species is estimated at US$ 36–84 billion per year.
   f. Restoring degraded coastal ecosystems (mangroves, seagrasses, and saltmarshes) that provide multiple, vital benefits for coastal communities is estimated at US$ 27–37 billion per year.
3. **Urban areas and areas of high human impact:** Urban expansion will result in the conversion of some 290,000 km^2 of natural habitats by 2030 and has the potential to degrade 40 % of strictly protected areas globally expected to be within a short distance of urban areas, if this expansion is not managed or mitigated for these impacts. The cost to protect biodiversity in the peripheries of cities is estimated at US$ 14.1–543 million per year. The impact of polluted water from urban environments on water quality and subsequently on biodiversity in marine and riverine ecosystems downstream of cities stems from untreated sewage. The cost of safeguarding biodiversity against the impact of polluted water from urban environments is estimated at US$ 73 billion per year.[l]

Aggregating these figures leads to a global biodiversity funding need of US$ 722–967 billion annually by 2030, shown in Figure 3, representing approximately 0.7–1.0 % of global GDP in 2019.

These estimates, while sobering, should be viewed as initial approximations of what is needed for biodiversity conservation. Estimates of this nature are not precise as they are affected by the limited biodiversity finance data available and inconsistencies between reporting frameworks.[m]

[j] A. Waldron et al., 2020, *Protecting 30% of the planet for nature: Costs, benefits and economic implications*, available at https://www.conservation.cam.ac.uk/files/waldron_report_30_by_30_publish.pdf

[k] The 2020 Waldron et al. paper uses a set of six scenarios to estimate a range of spending required to develop and manage biodiversity protected areas. This report establishes a range for protected area financing needs using two scenarios that dovetail with other estimates of future biodiversity needs, such as productive landscapes and seascapes.

[l] G. Hutton and M. Varughese, 2016, *The costs of meeting the 2030 sustainable development goal targets on drinking water, sanitation, and hygiene*. The World Bank., available at https://www.worldbank.org/en/topic/water/publication/the-costs-of-meeting-the-2030-sustainable-development-goal-targets-on-drinking-water-sanitation-and-hygiene.

[m] OECD, 2020, *A Comprehensive Overview of Global Biodiversity Finance*, Final report prepared by the Organization for Economic Cooperation and Development (OECD), available at: https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf.

FIGURE 3. Global biodiversity conservation funding needs. *(in US$ billions per year)*

The Biodiversity Financing Gap

When the estimates of global biodiversity funding needs (US$ 722–967 billion annually) are compared to the existing flows of biodiversity financing (US$ 124–143 billion), a global **Biodiversity Financing Gap** can be estimated in the range of US$ 598–824 billion per year. This means that current levels of funding cover only 16–19 % of the overall need to halt biodiversity loss. Figure 4 demonstrates the annual financing gap by comparing the average amounts of upper estimates of current funding and future need. The average gap is US$ 711 billion per year.

These estimates of future needs and the biodiversity financing gap, although reasonable, are not exact, and thus ranges are used to show the variability in the estimates. As such, these estimates should be considered indicative of the scale of the need and represent a reasonable and ambitious target for which to plan and aim.

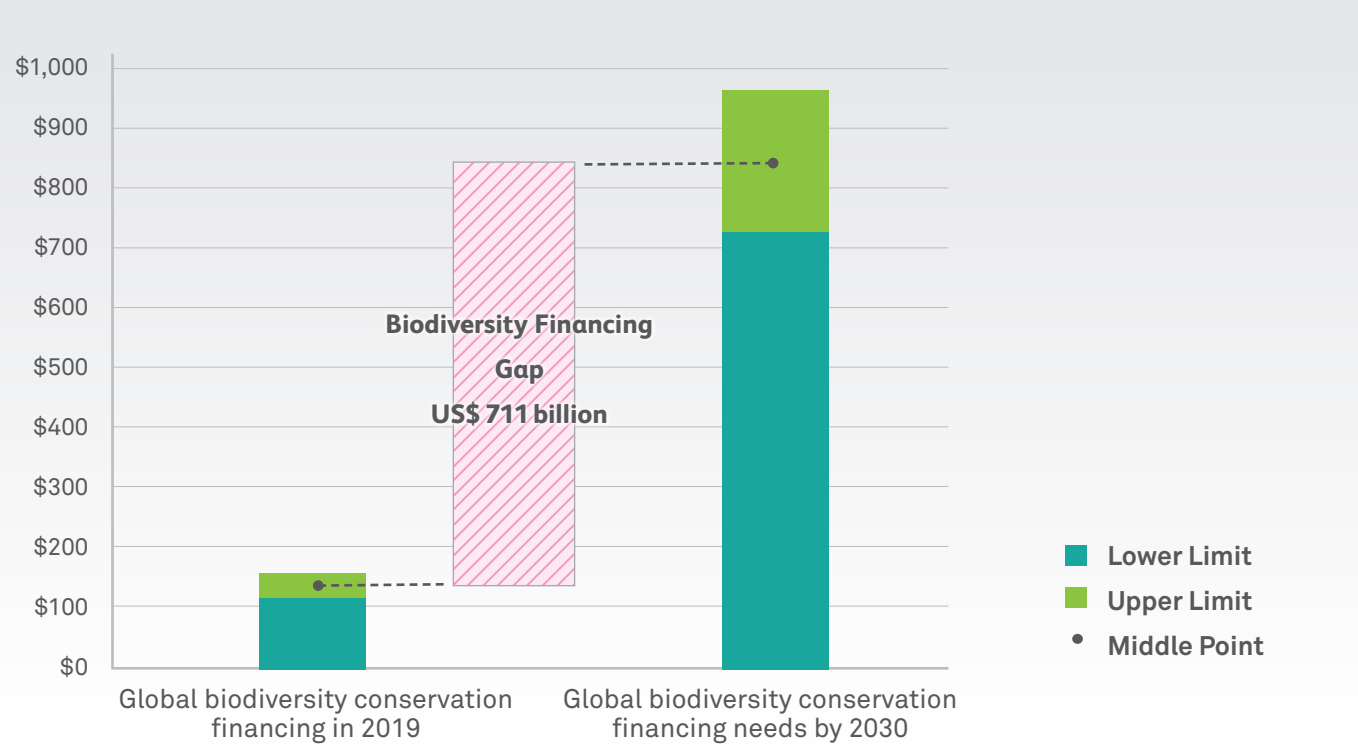
Closing the Biodiversity Financing Gap

The report outlines a set of nine financial and policy mechanisms that, if scaled through appropriate public policies and private sector action, have the potential to collectively make a substantial contribution to closing the global biodiversity financing gap over the next decade.

Analysis and selection of the nine financial and policy mechanisms is based on the UNDP BIOFIN Catalogue of Finance Solutions and screened mechanisms against the following three criteria:

- The mechanism is currently in use at a significant scale (more than US$ 0.5 billion per year);
- The mechanism, if scaled, has the potential to deliver substantial amounts of new funding on a consistent basis (more than US$ 5 billion per year and a potential compound annual growth rate of at least 2.5 %); and

FIGURE 4. Global biodiversity conservation financing compared to global biodiversity conservation needs. *(US$ billions)*



Note: Using midpoints of the current estimates and future needs, current global biodiversity conservation financing (left graph) may need to increase by a factor of 5–7X to meet the estimated global need for biodiversity conservation (right graph).

- The mechanism has a realistic policy and/or market pathway to scaling in order to meet its potential.

The nine mechanisms address the closing of the biodiversity financing gap in one of two ways. Two of the nine decrease the overall need for funding to be spent on biodiversity conservation. The remaining seven increase funding flows into biodiversity conservation.

Table 1 shows the current and potential future scale of financing flowing through these mechanisms to support biodiversity conservation. The estimates are expressed in ranges, reflecting the degree of uncertainty.

The analysis underlying this report yielded a numerical value for eight of the nine mechanisms, which collectively have the potential to contribute US$ 446–633 billion per year by 2030 toward meeting the estimated US$ 722–967 billion annual funding needs for global biodiversity conservation over the next decade. It was not possible to determine either current or future estimated numbers for the category of Investment Risk Management. Nonetheless, the report includes this category as it reflects a critical area of biodiversity impact and needs attention in the CBD Resource Mobilization Strategy as mainstreaming biodiversity in the financial sector will be critical to the success of the Global Biodiversity Framework.

These estimates, and the resource mobilization challenge they represent by 2030, may appear inordinately large. However, the financial resources that will be needed to close the biodiversity financing gap are comparable in magnitude to the capital committed to global

TABLE 1 Estimated Positive and Negative Flows to Biodiversity Conservation. *(in 2019 US$)*

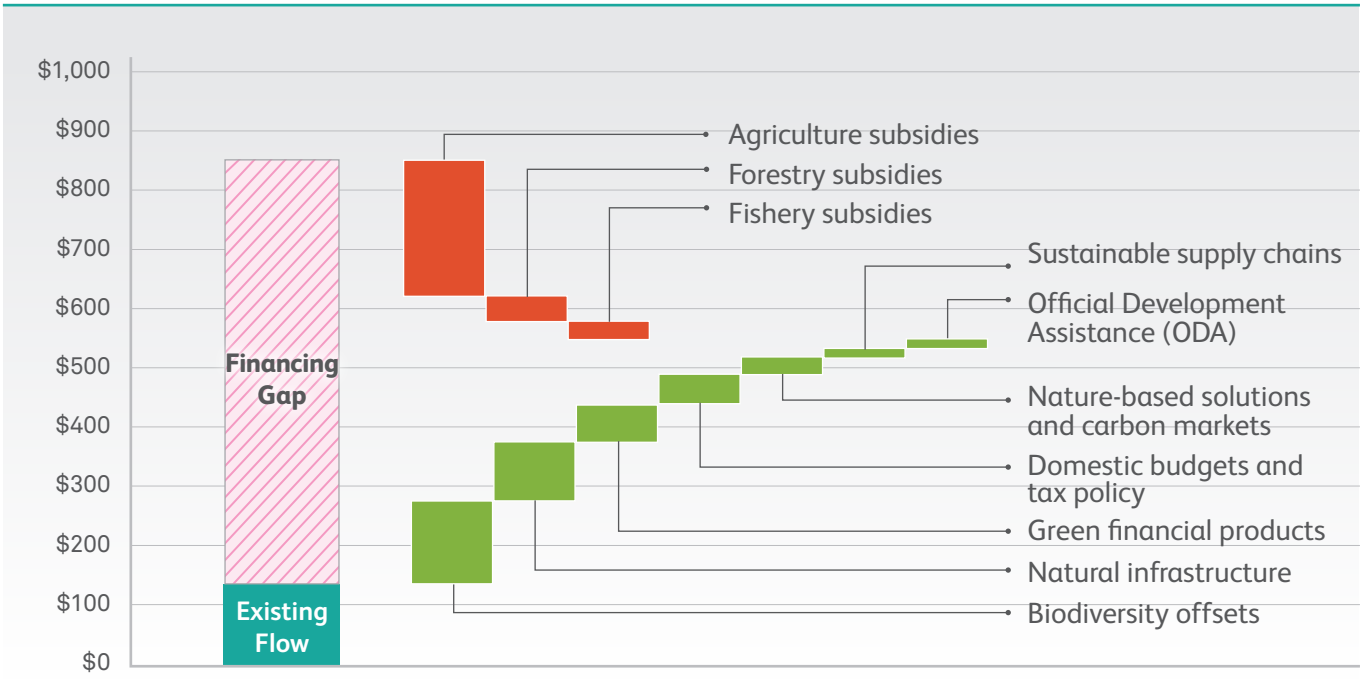
Financial and Policy Mechanisms	2019 *US$ billion / year*	2030 *US$ billion / year*
A. Mechanisms that decrease the overall need for funding to be spent on biodiversity conservation		
Harmful subsidy reform (agriculture, fisheries, and forestry sectors)	(542.0) – (273.9)	(268.1) – 0*
Investment risk management	N/A	
B. Mechanisms that increase capital flows into biodiversity conservation		
Biodiversity offsets	6.3 – 9.2	162.0 – 168.0
Domestic budgets and tax policy	74.6 – 77.7	102.9 – 155.4
Natural infrastructure	26.9	104.7 – 138.6
Green financial products	3.8 – 6.3	30.9 – 92.5
Nature-based solutions and carbon markets	0.8 – 1.4	24.9 – 39.9
Official development assistance (ODA)	4.0 – 9.7	8.0 – 19.4
Sustainable supply chains	5.5 – 8.2	12.3 – 18.7
Philanthropy and conservation NGOs	1.7 – 3.5	Not Estimated**
Total Positive Financial Flows	**123.6 – 142.9**	**445.7 – 632.5**

Note: All figures in this table are reported in 2019 US$.

* Assumes a global subsidies reform scenario that phases out by 2030 the most harmful subsidies as described by OECD (2020)[n].

** While future flows for philanthropy and conservation NGOs are seen as highly catalytic for mobilizing private sector financial flows, it was determined that they did not pass the threshold for inclusion in this report as a main mechanism for scaling up to close the biodiversity financing gap.

FIGURE 5. Estimate of growth in financing resulting from scaling up proposed mechanisms by 2030. *(in 2019 US$ billion per year)*



[n] OECD, 2020, *Rising fossil fuel support poses a threat to building a healthier and climate-safe future*, available at: https://www.oecd.org/fossil-fuels/.

climate-related investments of US$ 579 billion in 2017–2018, as estimated by Buchner and colleagues in 2019.[o] For context, this amount is less than the world spends on soft drinks in a year.[p]

Even when factoring in the maximum estimate of increased funding flows toward biodiversity conservation of US$ 446–633 billion per year, the 2030 global biodiversity financing gap will not be closed unless there are significant efforts to scale up the reform of subsidies harmful to biodiversity and improve investment risk management practices by the financial sector. These harmful subsidies were due to be eliminated, phased out, or reformed by 2020 under target three of the Aichi Biodiversity Targets agreed to in 2010, but little progress has been made. To continue to delay meaningful action on reducing harmful subsidies will cause extensive damage to biodiversity and dilute the effectiveness of conservation efforts. Under a 2030 scenario in which subsidies harmful to biodiversity have not been reformed, the remaining global biodiversity financing gap will be US$ 210–239 billion per year (Figure 5).

Each of the financial and policy mechanisms recommended for closing the biodiversity financing gap are summarized below and are described in greater detail in Chapter 5 of the full report. The following brief descriptions include the estimated positive or negative funding flows into biodiversity conservation for each mechanism and the recommended actions needed to implement and scale up each mechanism.

1. Harmful Subsidy Reform

2019 Estimated Harmful Flow: US$ 273.9–542.0 billion per year[q]
2030 Potential Harmful Flow: US$ 0–268.1 billion per year (assuming most harmful subsidies reform scenario)

Subsidies are fiscal policy tools used by governments that aim to benefit a specific population or sector through production support, income support, or reduced costs of inputs. Subsidies deemed harmful to biodiversity are those that induce production or consumption activities that exacerbate biodiversity loss, particularly important within the agriculture, fisheries, and forestry sectors. Some of these damaging activities include deforestation, overexploitation of fish stocks, and pollution from excessive fertilizer use. Agricultural subsidies that focus solely on increasing crop output have led to actions that are degrading natural resources and biodiversity. This report does not take a position on whether subsidies are inherently positive or negative for the economy or for the functioning of markets. Instead, this report focuses on proposing pathways that allow governments to reform existing production subsidies and deliver them in a manner that has a net positive effect on biodiversity rather than damaging biodiversity, while at the same time meeting the government's other social and economic objectives.

Recommendations

- Governments should develop and implement new fiscal policies or increase the effectiveness of existing ones that increase domestic spending on biodiversity conservation and disincentivize activities that are harmful to biodiversity. Such policies should be designed and supported by, and embedded within, multiple departments of government—particularly finance, environment, and natural resource ministries and other government agencies.
- National and subnational governments must improve the efficiency, effectiveness, tracking, and reporting on the deployment of revenues raised for biodiversity conservation.

[o] CPI, 2019, Global Landscape of Climate Finance 2019 [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London, available at https://www.climatepolicyinitiative.org/wp-content/uploads/2019/11/2019-Global-Landscape-of-Climate-Finance.pdf.

[p] Statista, 2020, available at https://www.statista.com/outlook/20020000/100/soft-drinks/worldwide?currency=usd [accessed 11 August 2020].

[q] Flows denoted as positive as they are listed as harmful to biodiversity.

- International finance institutions (such as the World Bank, IMF, and others) should increase financial support for biodiversity and lend their support to countries' efforts to establish taxes and fees whose revenue is allocated to conservation activities.

2. Investment Risk Management

As described in a previous section and in the full report, this report does not provide either current or future estimates in this area due to the lack of available data.

Investment risk management as described in this report involves actions taken by financial institutions to understand and manage the risks to biodiversity from their investments. The report reviews a range of both mandatory and voluntary investment risk management practices, many of which are becoming more established in mainstream investing. These include a number of screening tools and standards that investors are adopting that enable them to review risks and make informed decisions to avoid investments that may have negative impacts on biodiversity, or to invest in areas that have positive biodiversity impacts. Given the enormous scale of global capital markets and the trillions of dollars invested in infrastructure, energy, transportation, extractives, and other potentially damaging projects, the mainstreaming of these biodiversity-related risk management practices in conventional financial markets presents an enormous opportunity to prevent negative impacts to biodiversity.

Recommendations

- Financial institutions should take a lead role in understanding and avoiding harm to biodiversity from the deployment of private investment capital. They should recognize the reputation, regulatory compliance, and investor demand risks from continuing to operate under the status quo, as well as the potential revenue opportunities from proactive biodiversity risk management. They should manage these risks through systemic changes to internal structures, incentives, policies, and metrics to ensure that biodiversity conservation is integrated into all investments.
- Financial institutions should disclose the biodiversity impacts of their investments via appropriate disclosure frameworks and require the same of companies in their investment portfolio.
- Financial institutions should build their capacity to assess how investment decisions can lead to biodiversity loss and manage the associated biodiversity risks.
- Financial regulators and fiduciaries should adopt a broader understanding of fiduciary duty that is not narrowly limited to maximizing short-term financial returns, but that also accounts for the positive and negative collateral effects of investments on those to whom a fiduciary duty is owed. A revised understanding should allow for consideration of nonfinancial benefits to clients, including the value of biodiversity, as proper components of the fiduciary's analysis of the merits of competing investment choices.
- Governments should develop and implement policies and legislation that require financial institutions to implement and report on biodiversity risk disclosure frameworks.
- International organizations, financial institutions, and NGOs (including academia) should develop metrics, methodologies, and platforms for sharing data on the impacts of investments on biodiversity.

3. Biodiversity Offsets

2019 Estimated Flow: US$ 6.3–9.2 billion per year
2030 Potential Flow: US$ 162.0–168.0 billion per year

Biodiversity offsets are the last option in the mitigation hierarchy (avoid, minimize, restore, and offset), a biodiversity protection policy mandated by governments to compensate

for unavoidable damage to biodiversity by a development project when the cause of damage proves difficult or impossible to eliminate. The CBD has adopted a decision calling for the universal application of the mitigation hierarchy and biodiversity offsets.[18] Offsets should be implemented once development projects have done their utmost to avoid and minimize adverse environmental impacts. Given the rapid expansion of urban centers and the associated development of infrastructure, biodiversity offsets are a way for biodiversity to receive increased financing and protection. Under an offset policy, any biodiversity lost to development must be compensated for such that there is a net gain or, at least, no net loss of biodiversity. Currently, 42 countries have biodiversity offset policies in place, but there is evidence of enforcement from fewer than 20 % of these countries. Estimates for scaling up biodiversity offsets in this report are based on both full implementation of existing policies by these 42 countries and expanded application of offset policies in countries based on an analysis of anticipated development impacts globally by 2030.

Recommendations

- Governments with existing biodiversity offset and mitigation hierarchy policies should strengthen enforcement using supporting tools such as regulation, planning processes, and legislation. Governments without existing policies should immediately develop, implement, and enforce them to, first, avoid and minimize impacts to critical natural habitat and, second, implement biodiversity offsets to achieve no net biodiversity loss or, where possible, net gain.
- National and subnational governments should conduct (and make public to authorities, developers, and communities) spatial landscape planning to identify areas of critical habitat, made publicly available, to influence development planning processes and underpin the effective application of the mitigation hierarchy.
- National and subnational governments should require project developers to conduct long-term monitoring and reporting on biodiversity offsets to ensure they are achieving the desired outcomes.
- Financial institutions should strengthen the implementation of biodiversity-related performance standards within their investments and mandate that projects they invest in should demonstrate, via reporting and verification, no net loss of biodiversity or, where possible, net gain. Investments should be designed to allow adequate funding for long-term monitoring of the offset after the development has been completed.

4. Domestic Budgets and Tax Policy

2019 Estimated Flow: US$ 74.6–77.7 billion per year
2030 Potential Flow: US$ 103.0–155.4 billion per year

Governmental budgets are currently the main source of financing for biodiversity conservation, representing 54–60 % of total funding recorded and presented in this report. However, while prioritizing government budget expenditure for biodiversity, raising revenue from taxation may be insufficient to close the biodiversity financing gap in 2030. This report describes several categories of special taxes, fees, levies, and other innovative fiscal measures that both national and subnational governments can impose to either increase revenue to fund biodiversity protection or to incentivize or disincentivize activities that benefit or degrade biodiversity. To ensure that these additional revenues are devoted directly to biodiversity conservation (and not just diverted to the general budget), the report further recommends that governments restrict or "earmark" these funds to the biodiversity conservation uses for which they were created.

Recommendations

- Governments should develop and implement new fiscal policies or increase the effectiveness of existing ones that increase domestic spending on biodiversity conservation and disincentivize activities that are harmful to biodiversity. Such policies should be designed and supported by, and embedded within, multiple departments of government—particularly finance, environment, and natural resource ministries and other government agencies.
- National and subnational governments must improve the efficiency, effectiveness, tracking, and reporting on the deployment of revenues raised for biodiversity conservation.
- International finance institutions (such as the World Bank, IMF, and others) should increase financial support for biodiversity and lend their support to countries' efforts to establish taxes and fees whose revenue is allocated to conservation activities.

5. Natural Infrastructure

2019 Estimated Flow: US$ 26.9 billion per year
2030 Potential Flow: US$ 104.7–138.6 billion per year

The protection of natural infrastructure serves a dual purpose. First, it maintains healthy ecosystems for the long term; second, it delivers ecosystem services to human populations, supporting livelihoods and communities. In this report, natural infrastructure investments are described through the lens of watershed protection programs. In recent years, urbanization and the resulting increase in demand for resources from cities have elevated the importance of water supply and watershed protection, while the growing risk from extreme weather events and sea-level rise has highlighted the importance of coastal protection. Natural infrastructure funding is almost entirely provided by public entities through grants and contracts for watershed protection, but there are emerging areas that include both public and private sector investment, including user-driven watershed investments, water quality offset trading, and others. Additionally, there is growing evidence that the relative costs of protecting and managing natural water supplies and flood control can be cheaper than traditional engineering approaches.

Recommendations

- National, subnational, and local governments should require the evaluation of natural infrastructure alternatives in all infrastructure projects and, where feasible and cost-effective, they should require its use in public and private development projects through contracts and concessions, procurement processes, and regulation.
- Private sector corporations operationally dependent on water should, along with national and subnational governments, participate in developing, financing, implementing, and maintaining natural infrastructure for the watersheds they operate in.
- Insurance companies and financial institutions should incorporate the benefits of ecosystem services provided by natural infrastructure in their risk modelling. The results should be factored into decisions about capital costs and be reflected in premiums that incentivize the use of natural infrastructure in line with risk modelling as well as international and national standards and processes.
- International organizations, such as research institutions, NGOs, and standard setting bodies, should develop robust evidence on the costs and performance of different forms of natural infrastructure. This should be carried out in tandem with the process of developing international standards, tools, metrics, and data collection processes for natural infrastructure.
- Entities engaged in curriculum development, professional certification, and continuing

education of engineers, planners, and other professionals should require appropriate training that builds awareness and capacity of how to assess both the cost effectiveness and the environmental benefits of designing, developing, and maintaining natural infrastructure projects to meet human needs.

6. Green Financial Products

2019 Estimated Flow: US$ 3.8–6.3 billion per year
2030 Potential Flow: US$ 30.9–92.5 billion per year

Green financial products are a collection of financial instruments, primarily debt and equity, that facilitate the flow of investment capital into companies and projects that can have a positive impact on biodiversity. This report discusses a range of green financial products that can channel financing toward green investments that produce environmental benefits. The report discusses the role of green bonds, sustainability-linked loans, and private equity funds in supporting biodiversity. The report also notes emerging and innovative new developments in green finance such as environmental impact bonds, insurance products, and the growing roles that governments are playing through finance facilities and specific efforts to incentivize increased private investment.

Recommendations

- Governments should work with private investment organizations to develop, implement, and enforce clear guidance, incentives, penalties, and disclosure requirements that enable and encourage investments that protect biodiversity. Governments can do this through two pathways: first, by creating opportunities for new markets using policies, structures, and regulation; second, through incentivizing flows of additional, new investment of private capital.
- National and regional governments should leverage their ability to raise capital from private markets, via issuance of green debt, as a way to increase the amount of upfront capital available for investment in biodiversity conservation.
- Investment organizations and private finance institutions should develop and enforce internal policies establishing internal performance metrics that incentivize the structuring, offering, and use of financial products with explicit benefits to biodiversity.
- Governments and private financial institutions should, as a means to catalyze the flow of capital to biodiversity, develop and implement industry standards and mechanisms that ensure accountability, transparency, and verification for financial transactions that are meant to positively impact biodiversity.
- Multilateral development banks, development finance institutions, and private foundations should provide early-stage, concessionary, or risk mitigating financing that catalyzes the development of projects and that complements local conservation efforts.

7. Nature-Based Solutions and Carbon Markets

2019 Estimated Flow: US$ 0.8–1.4 billion per year
2030 Potential Flow: US$ 24.9–40.0 billion per year

As countries move toward development of new programs to support delivery of their national climate goals (specifically through their Nationally Determined Contributions, or NDCs), there is a growing emphasis on the protection and restoration of forests and other biodiversity-rich ecosystems in what are called Nature-Based Solutions (NBS) and Natural Climate Solutions (NCS). Indeed, recent science indicates that NCS can provide up to a third of the cost-effective, near-term mitigation potential needed by 2030 to stay below 1.5 degrees Celsius of warming. The report describes several pathways countries might take to develop one or more NBS/NCS strategies as part of meeting their NDC goals, and it provides estimates of the amount of funding these efforts could generate that will

have direct biodiversity benefits. Additionally, a number of countries are developing national (or, in some countries, subnational or jurisdictional) policies that use carbon pricing as part of their overall climate strategies. These policies typically take the form of direct carbon taxes or the creation of a regulated cap-and-trade program in which greenhouse gas emitters are capped and regulated through programs that allow the creation and trading of carbon credits. The active trading of these credits (which are issued in metric tons of carbon dioxide equivalent [tCO_2e]) enables creation of a robust carbon market. When countries allow the creation of carbon offsets from forest practices or other natural and land-based projects, the sale of these credits can create an important source of funding for forest and biodiversity conservation.

Recommendations

- National governments should include one or more nature-based solution (NBS) strategies, such as reforestation, within the next round of Nationally Determined Contributions (NDCs) commitments under the Paris Agreement.
- Governments with existing carbon markets should allow the use of offsets from agriculture, forests, and other land uses. Governments without existing carbon markets should enact new carbon pricing programs that include carbon taxes, cap-and-trade programs, or other climate policies that price carbon emissions and allow for the use of carbon offsets from agriculture, forests, and other land use practices.
- Governments of forest-rich and biodiversity-rich countries should enact policies to increase implementation and scalability of national and jurisdictional REDD+ programs, including the opportunity to nest existing REDD+ projects to maximize scale.
- The governments and standard-setting bodies that govern both compliance (cap-and-trade) and voluntary carbon markets should require the use of, and adherence to, standards that include biodiversity and social safeguards for all forestry and land use projects, and for NBS. These bodies should also improve the transparency and quantifiability of biodiversity within all existing and new standards that apply to forests and natural systems.

8. Official Development Assistance (ODA)

2019 Estimated Flow: US$ 4.0–9.7 billion per year
2030 Potential Flow: US$ 8.0–19.4 billion per year

Official development assistance (ODA) is broadly defined as aid, either disbursed by countries directly or through multilateral institutions, designed to support and promote the economic development and welfare of developing countries. It includes concessional finance, grants, and the provision of technical assistance. In the context of the Convention on Biological Diversity (CBD), the 2010 Aichi Targets called for a "substantial increase" in resources available from all sources to support the implementation of the Convention. In 2012, the Parties adopted a decision calling on donor countries to double foreign aid flows for biodiversity by 2015 relative to 2010 levels, and at least maintain them at that level through 2020. That target has essentially been met by donor countries. The report recommends that ODA funding to biodiversity-rich countries double again between 2020 and 2030, with the new funding primarily targeted to supporting country efforts to develop National Biodiversity Finance Plans and implement the nationally appropriate suite of mechanisms described in this report to ensure that each country meets its biodiversity finance needs.

Recommendations

- Foreign aid donors should recommit to double ODA flows again by the year 2030 relative to 2019 levels to support the implementation of the post-2020 Global Biodiversity Framework. Provision of ODA should include biodiversity

conservation as criteria, alongside existing ones such as economic development, in prioritizing countries that receive ODA flows.

- Donor governments should better deploy the increased aid to focus on the in-country enabling conditions to unlock other mechanisms discussed in this report, including the development of National Biodiversity Strategies and Action Plans (NBSAPs) and National Biodiversity Finance Plans.
- Bilateral and multilateral aid agencies should strengthen their efforts at mainstreaming biodiversity across their grant and lending portfolios.
- Bilateral donors and multilateral development banks should require reporting of results from biodiversity projects, as well as be more accountable for their application of IFC Performance Standard 6, especially with respect to the application of the mitigation hierarchy and biodiversity offsets.

9. Sustainable Supply Chains

2019 Estimated Flow: US$ 5.5–8.2 billion per year
2030 Potential Flow: US$ 12.3–18.7 billion per year

Supply chain sustainability relates to the management of environmental, social, and governance aspects of the movement of goods and services along supply chains, from producers to consumers. The historical impact of global supply chains on biodiversity has been largely negative, driven by land use change and unsustainable agricultural, forest, fisheries, and other practices associated with commodities. However, a shift toward more responsible supply chain management practices offers an opportunity to avoid harm and positively affect biodiversity, including significant corporate pledges to get deforestation out of supply chains over the last few years. This report explores a range of options to reduce negative supply chain impacts on biodiversity, including improved corporate policies and internal standards, the use of third-party sustainability standards and certifications, and direct corporate funding of sustainability improvements within their supply chains including in producer countries. The report also examines options to achieve positive impact, such as sustainable jurisdiction/landscape-level sourcing initiatives and conservation-focused management of naturally sourced ingredients. Although the report puts forth some estimates on current and projected future funding for sustainability, much of the financing on sustainable supply chains is by companies and by nature is not publicly available information. As such, the amount spent by companies on increasing sustainability of supply chains might be higher than estimated here.

Recommendation

- All actors engaged in supply chains should collaborate to foster the green transformation of supply chains, with an immediate focus on soy, palm oil, cattle, and forest products, including developing and implementing production standards and improving the means of tracking products and impacts from producer to consumer.
- Governments in supplier (exporting) countries should improve the land use planning and enforce legislation and measures to reduce deforestation and conversion of other natural ecosystems. Governments should also provide both financial and technical support, including agricultural extension services, and facilitate market access for compliant producers to incentivize the sustainable production of commodities.
- Governments in buyer (importing) countries should leverage their market and diplomatic powers to encourage exporting country governments to enforce sustainable practices.
- Consumers should, with support from governments and companies, educate themselves about the environmental impact of their consumption behavior and subsequently use their spending power to

demand greater transparency and improved practices, such as deforestation-free products, via increased use of ecolabels and certification systems by companies and brands to support biodiversity-positive practices in supply chains.

- Large buyers with significant influence in supply chains should develop and implement green procurement policies and standards; work within the supply chain to monitor, track, and verify biodiversity impacts to assure that primary producers are adhering to the required sustainability standards; and work with governments to incentivize, support, and require local producers and intermediaries in the supply chain, who operate at a more local or jurisdictional scale, to transition away from unsustainable practices toward those that support biodiversity.
- Countries should increase efforts through the international architecture, specifically the WTO, to develop green trade agreements that facilitate and incentivize increased trade in commodities produced without conversion of natural habitats.

Conclusion

This report highlights the risks associated with biodiversity loss, makes a compelling case for appropriately valuing nature in our economies, and delivers a specific contribution to the negotiations on a resource mobilization strategy as part of the Post-2020 Global Biodiversity Framework under the UN CBD process. It focuses foremost on the need for all countries to take increased actions to adopt environmental and economic policies aimed at protecting biodiversity and reducing harmful practices. The report further highlights the potential for the private sector to make a major contribution to financing nature conservation but is clear that this potential will only be realized if governments create the conditions that make that investment profitable.

The analyses underlying this report are based on best available data but recognize that, due to the complexities and interconnectedness of nature, the scale of the risks we face due to biodiversity loss are impossible to fully measure, and any valuations of natural capital are likely to be underestimates. Thus, the range of financial estimates presented in this report are imperfect. However, these uncertainties should not be an excuse for inaction. The case for protecting biodiversity, its urgency, and the policies and mechanisms needed are sufficiently clear; the sooner governments begin to take out the insurance policy of filling the biodiversity financing gap and appropriately valuing nature, the cheaper the premium will be.

CHAPTER 1

Introduction

This report responds to the accelerating pace and cost of global biodiversity loss. It builds the case that the irreversibility of this dramatic loss, and the high social, economic, and environmental costs likely to result, must compel governments, civil society, and the private sector to quickly and effectively deploy as many policy and financial mechanisms as feasible to slow, halt, and reverse this loss.

In this context, this report addresses two important challenges. First, the report lays out the broad economic case for protecting nature. It presents a range of the many known economic and social values of biodiversity, but it also discusses the complexities and interdependencies of nature and the challenge in attempting monetary valuations of nature that are often partial or underestimates. The report further examines the underlying market and financial system failures that hasten global biodiversity loss and presents a number of needed policy interventions and changes in financial and economic systems.

Second, the report focuses on a critical economic element related to protecting biodiversity, namely the biodiversity financing gap between the total amount of funds currently spent annually on biodiversity protection globally and the total amount of funds needed to sustainably manage and protect biodiversity. The main body of the report details a set of nine financial and policy mechanisms that, if implemented and scaled up, can collectively close the gap.

Why This Report, and Why Now?

Addressing the above challenges is timely given that the international community is preparing to agree on the next set of 10-year biodiversity targets at the CBD COP15 in Kunming, China, in 2021. These are intended to replace the current Aichi Biodiversity Targets, which were agreed to in 2010 and expire in 2020. By all accounts, the Aichi Targets have had limited success and are proposed to be replaced by a more exact set of measurable targets and a supporting financial resource mobilization framework.

Our analysis indicates a material gap between what is currently spent and what is needed to be spent on biodiversity conservation. Further, the sheer size of this biodiversity financing gap emphasizes that the current main sources of biodiversity financing, if continued as usual, will not be sufficient to close the gap.

As such, the international community (including multilateral and bilateral aid agencies, investment institutions, and corporations) and, in particular, the national government delegations involved in CBD COP15 must understand and consider a broader range of financial and policy mechanisms to supplement and augment the traditional domestic and international public sources of biodiversity conservation funding. As part of finalizing the proposed resource mobilization framework, all countries will need to rethink conventional approaches to biodiversity financing and explore alternative mechanisms to meet their disparate resource needs for biodiversity conservation while, at the same time, protecting biodiversity to ensure the long-term sustainability of earth's ecosystems.

The report also targets finance ministries and other senior government officials to help them understand the economic case for biodiversity conservation, the economic value of their biodiversity stocks, and the potential magnitude of the economic costs of not addressing

biodiversity degradation. It also provides an understanding of the scalable policy and financial mechanisms available to increasing capital flows toward biodiversity conservation and/or reducing harm to biodiversity.

Finally, this report attempts to address the key challenge facing global biodiversity conservation: that governments who manage the world's richest stores of species and habitats must take action and develop policies for sustainable resource use through laws and regulations that protect their biodiversity through fiscal measures and policy incentives that encourage private sector engagement and investment.

However, these governments cannot be expected to act alone, at their expense, to protect what is a global public good. Thus, this report sets forth a range of financing mechanisms and economic policies designed to help biodiversity-rich countries secure new funding from private and international public sources as well as reduce the costs of in country biodiversity protection.

Use of Terms

As used in this report, biodiversity is the full complement of life forms on Earth, including organisms such as plants, animals, fungi, and micro-organisms in terrestrial, marine, and other aquatic environments, as well as the integrity of the ecosystems in which they live, as well as the genetic variability within species. The concept of biodiversity describes a hierarchy of ecological processes that combine to define the composition (which species are present), structure (how species assemble into distinct terrestrial, aquatic, and marine ecosystems), and function (provisioning of ecosystem services) of Earth's ecosystems. As used herein, the term nature is used interchangeably with the term biodiversity.

This report uses the term **biodiversity financing** to describe the deployment of funding from governments, the private sector, or philanthropy into activities that support the conservation and sustainable management of biodiversity.

The difference between what is spent on biodiversity and what needs to be spent on biodiversity to ensure long-term ecosystem integrity and sustainable management of biodiversity is referred to as the biodiversity financing gap.

Scope of This Report

This report explores the economic case for biodiversity conservation, considers what financial resources would be needed to reverse the global loss of biodiversity and ensure its protection, and explores how those resources might be enabled and scaled up. This report does not attempt to explain the causes of the loss of biodiversity or inventory the ecosystems that are being transformed or irreparably degraded. Furthermore, this report does not analyze or quantify the direct economic and nonmonetary benefits resulting from the conservation of biodiversity and ecosystem services. Many other recent publications have fully addressed these topics.

This report focuses on the economic rationale for investing in conservation, the associated costs of globally protecting biodiversity, and the proposed policy and financing mechanisms needed to achieve global biodiversity conservation. This report aims to bridge the languages of governments, biodiversity conservation organizations, and the financial sector to drive policy action and investments toward biodiversity protection. As such, the report does not aspire to be a scientific or technical report on biodiversity, species, and ecosystem conservation, nor is it an in-depth presentation about public and private finance, markets, or specific financial instruments. The underlying premise of the report is that by scaling up the mechanisms described in this report, countries that own and manage our planet's greatest biodiversity resources will be supported by other actors and can therefore more easily embark on a path toward financing better biodiversity outcomes.

In the determination of the nine financial mechanisms covered in this report, the authors evaluated more than 160 biodiversity financing mechanisms and instruments compiled by the United Nations Development Program (UNDP) Biodiversity Finance Initiative, as well as several other reports and databases addressing potential public and private sources of funding for biodiversity conservation. The various sources of data and details on the analysis and methodologies used in this report are outlined in Chapter 3, Chapter 4, and Appendix A.

In the course of narrowing the field to the final set of nine, certain topics emerged that are large, intractable threats to biodiversity but, due to the indirect potential of their impacts, were determined to be beyond the scope of this report. Two such topics that met this set of conditions and are not included in this report—but are nonetheless pressing threats to biodiversity—are:

1. The impacts of greenhouse emissions resulting from the use of fossil fuels, in particular, fossil fuel subsidies; and
2. The impacts of human population growth, shifts in economies, and the concomitant process of migration to urban and peri-urban areas.

The mechanisms proposed and described herein will not be the entire solution to the global decline of biodiversity. But these mechanisms, if supported, enacted, and enforced by governments and the private sector, may help countries secure the necessary financial resources and change economic practices to materially help protect and restore biodiversity. However, this will only happen if countries take actions to change current harmful practices, thereby reversing the downward trend in biodiversity loss.

Report Structure

In addition to this Introduction (Chapter 1), the report is organized as follows:

- Chapter 2 presents the overall economic case for biodiversity conservation and provides illustrations of some of the documented social and economic values of biodiversity as well as some of the underlying failures of traditional market and economic systems to appropriately value and protect biodiversity.
- Chapter 3 describes the current sources of financing for the conservation of global biodiversity (based on 2019 numbers).
- Chapter 4 examines the principal threats to biodiversity and presents estimates of what it would cost annually to protect and manage biodiversity sustainably in the next 10 years. The chapter also contrasts these estimates of need against the current spending shown in Chapter 3 and provides an overall estimate of the global biodiversity financing gap.
- Chapter 5 presents nine financial mechanisms and economic policies that hold the highest potential to make a material contribution to closing the biodiversity financing gap. These nine mechanisms are divided into two parts: the first includes two critical mechanisms that would reduce negative impacts on biodiversity and would, therefore, help close the biodiversity financing gap by reducing the total funding needed to conserve and manage biodiversity sustainably for the long term; the second includes seven mechanisms that can lead to an increase in capital flows for biodiversity conservation.
- Chapter 5 describes each of the nine mechanisms in detail, including the background and features of the mechanisms; their relevance to biodiversity conservation; their current and future financial potential for biodiversity conservation; the obstacles and enabling conditions needed for scaling up each mechanism; and actionable recommendations for implementing the mechanisms.
- Chapter 6 presents a set of overarching recommendations that, if implemented, would support the goal of reducing

biodiversity loss, independently of which, if any, of the mechanisms proposed in this report are used.

- Appendix A contains the detailed methodologies used to generate the original estimates presented in this report. These include sources of underlying information, assumptions made, a description of the calculations, and other related information.
- Appendix B contains a brief description of the analysis carried out to identify and mitigate areas of double counting in the financial estimates.

CHAPTER 2

The Economic Case for Protecting Biodiversity

Conserving biodiversity, the range of species on the planet, is crucial to human survival and prosperity. We are a part of biodiversity, and if biodiversity is destroyed, we may be a part of what is lost. Biodiversity is crucial to human well-being: we evolved in concert with it and are dependent on it in myriad ways, some obvious and some subtle.

A powerful illustration of the importance of biodiversity comes from a review of the habitability of Earth compared with our immediate neighbors in the solar system, Venus and Mars. Neither is remotely habitable: Venus way too hot, Mars too cold, Venus with a poisonous atmosphere and Mars with none. Why does Earth have a temperature that is just right for animals like us and an atmosphere that allows us to live? Because, unlike Venus and Mars, Earth is surrounded by the biosphere, the thin layer of atmosphere, oceans, and plant and animal life that extends from the surface of Earth to about 10,000 meters above it. The gaseous composition of the atmosphere ensures that Earth is at a temperature at which we can thrive, and it also provides the oxygen we need to function. This atmospheric composition arose as a result of the evolution of blue-green algae, and then much later plants, which by photosynthesis removed carbon dioxide from the atmosphere and replaced it with oxygen, thereby making our lives possible and stabilizing Earth's temperature. Without the natural world that surrounds us, we would not and, indeed, could not exist: it brought us into existence. Biodiversity is a key element of this natural world.

The importance of the natural world, the biosphere, is also emphasized by the extraordinary story of Biosphere 2. Looking like a collection of alien spaceships amid the sand and cacti of the Sonoran Desert in Arizona, Biosphere 2 is a set of sealed glass buildings enclosing a 3.15-acre ecosystem. Built at great expense and with the latest technologies, its two-year mission was to investigate the possibility of supporting human life in a self-contained system. Eight "biospherians" inhabited this complex, together with pollinating insects, and were to grow all of their own food in a system with a fixed volume of air and water, both of which were to be recycled and reused. Biosphere 2 was to replicate the functioning of the original biosphere in miniature.

Simply put, it failed: after 18 months the oxygen level fell from 21% to 14%, a level normal at 17,500 feet and barely sufficient for humans to function. All of the insect pollinators died, meaning that people had to transfer pollen with Q-tips from flower to flower in the hope of eventually getting a zucchini. Had they continued in Biosphere 2, the humans would not have been able to breathe or eat. Sophisticated though we may be, we can't replicate what the natural world provides for us, and so we can't survive without it.

Economic Framework

Economists recognize the importance of the natural world to the functioning of our societies and think of this in terms of capital stocks. A capital stock is an asset that provides a flow of services over time. An investment in equities

provides a flow of dividends; an investment in a house provides a flow of accommodation services; an investment in a computer provides a flow of digital services. These are examples of the most commonly recognized types of capital, financial capital (equities) and built capital (houses, computers). Other categories of assets also provide a flow of services over time; knowledge is one of the most important. If you train as a lawyer or accountant or a computer programmer, you can use the knowledge acquired to generate a flow of income over time. We call this human capital, capital embedded in human beings.

For our present purposes, another category, natural capital, is important. Natural capital refers to lands, waters, and the diversity of life that provide human societies with a flow of services over time. Norway has great lakes that provide huge amounts of electricity via hydroelectric power stations: these lakes and the hydrological systems that replenish them are natural capital. Upstream forests control the water flow into the lakes and reduce soil erosion, which would otherwise fill the lakes and reduce water flow. They are clearly equivalent in many ways to conventional power stations, so the designation as capital seems appropriate. Switzerland's mountains and alpine pastures are beautiful and provide excellent conditions for skiing. As a result, many tourists visit Switzerland, adding to the income of those who live there. These geographic features are a form of natural capital. The islands of the Caribbean provide a similar example: their climate and beaches mean that millions of North Americans visit during the winter, adding to the income of the islanders. Climate and geography again combine to form an asset with great value to the local population. The fertile soil of the American Midwest, together with its temperate climate and adequate water supplies, make it a remarkably productive area for growing a range of important food crops, so again a range of geographic and climatic conditions combine to provide a flow of services—food production—that have great economic value. Until only a few decades ago, the North Atlantic teemed with fish such as salmon and cod, providing food and a living for coastal communities, a valuable natural capital stock that has been sadly depleted in the last few decades.

The services that natural capital provides—food production in the cases of the American Midwest and North Atlantic—are called ecosystem services: natural capital is the machinery of nature, the infrastructure on which ecosystems run. We now have a picture of natural capital as an asset that supports a variety of ecosystems and, together, they generate a flow of services that we refer to as ecosystem services.[i]

Although articulated fully only in the last few decades, this perspective is not new. It can be traced back at least to President Theodore Roosevelt, who remarked to the US Congress in 1907 that "[t]he conservation of our natural resources and their proper use constitutes the fundamental problem which underlies almost every other problem of our national life." He then went on to remark, "The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value." Here is a clear precedent for seeing the living world around us as an asset integral to our well-being and that repays conservation. An important aspect of this environment-as-natural-capital paradigm is that societies invest in capital: they willingly cut back current consumption to enhance their capital stock. It may therefore make economic sense to invest in the environment. The future returns from an enhanced environment may more than compensate for the loss of current consumption.

In the financial sector, assets are generally valued at the expected present value of the services that they will provide. We can value natural

[i] For an extensive discussion of how to measure and model natural capital and use the idea in conservation projects, see the Natural Capital Project at naturalcapitalproject.stanford.edu.

capital in this way, too, though valuing the services that it will provide is more challenging than valuing the dividends of an equity. There are often no markets for the services that natural capital provides, so there are no prices to provide estimates of value. Nevertheless, researchers have developed techniques that can give answers and provide estimates of economic value.

Biodiversity is an integral part of natural capital, the living part. We generally take the word biodiversity to refer to the total variety of living organisms on the planet, from single-celled organisms to great apes. It is the total range of living things together with their genetic, cellular, and other biological characteristics that make them unique and different from each other and enable them to function in their diverse environments.

Biodiversity's Contributions

Soil

Soil deserves closer study. Soil is clearly an asset, particularly productive soils such as those of the American Midwest or of the Punjab in the Indian subcontinent. Both regions are often referred to as the breadbaskets of their countries. Soil is not just a collection of inorganic chemicals. It is a living community populated by a vast range of microorganisms. Even a handful may contain billions of living creatures. These are an important part of what makes the soil valuable. They interact with the roots of plants growing in the soil and support the chemical processes that make them grow. They are a living (but invisible) component of natural capital and a part of biodiversity. Frequent tilling of soil, and intensive use of fertilizers and pesticides, can kill these microorganisms and diminish soil fertility. Soil, then, is natural capital with both living and nonliving components, and though the living component is the less visible of the two it is arguably the more important. This is an iconic example of biodiversity: an element of the natural world that brings us our essential food, yet is invisible to most of us. Markets recognize the value of productive soils, and farmland in such regions trades for prices greatly in excess of those of less productive areas. In this case, markets are recognizing the value of biodiversity, though in most cases biodiversity's value is hard to capture in market transactions.

Crop Pollination

Pollinators are another example of a category of biodiversity that is crucial for us and is only slightly more visible than soil microbes. Plants generally need to be pollinated if they are to bear fruit, although some of the most widely used crop plants are wind-pollinated or have been bred to be self-pollinating. These includes wheat, corn, rice, and soybeans. Other crops, however, need pollinators—fruit, nuts, and vegetables typically need an insect or small animal to transfer pollen from one flower to another. In fact, about one third of the food that we eat (by weight), the tastiest and most nutritious third, would not be available without pollinators, generally bees and bats, with birds also important, particularly hummingbirds and sunbirds. The last few decades have seen a sharp decline in populations of these pollinators worldwide, particularly of insects and bats. Many newspapers and TV programs have reported on the evolving "insect apocalypse" and also on the US loss of about three billion birds over the same period. One driver of this loss is habitat destruction: clearing natural habitats for farming and residences. Another is the extensive use of pesticides: most plant pests are insects, so pesticides are insecticides and kill pollinating insects, too. Bat populations have been reduced to a fraction of their former levels by white nose syndrome, a fungal disease that is spreading around the world. It is one of the worst wildlife diseases of modern time and threatens the continued existence of bats in many regions. In some places, they have also been decimated by wind farms, as the blades of the turbines hit and kill bats. There also seems to have been

a collapse of bee populations beyond what could be attributed to habitat destruction and pesticide use, perhaps due to the global spread of mites that infest and kill bees. While the cause remains a mystery, this precipitous drop in pollinator populations has spelled trouble for farmers and initially led to sharp drops in fruit and vegetable yields.

This collapse of natural populations has led to the emergence of a rental market in pollinators: beekeepers rent hives of bees to farmers whose crops need pollination. The largest managed pollination event in the world is in Californian almond orchards, where nearly half (about one million hives) of the US honeybees are trucked to the almond orchards each spring. New York's apple crop requires about 30,000 hives; Maine's blueberry crop uses about 50,000 hives each year. Some of the domesticated rental bees have been affected by the infections that are killing bee populations, so even this commercial form of pollination does not have an assured future. The market here has replaced natural biodiversity by managed biodiversity.

What's the value of pollination services provided by biodiversity? To think about this, suppose we lost the pollinating insects, bird, and bats that currently bring us about one third of our food. There are two questions we can ask: What would be the cost of replacing them? And, if we didn't replace them, what would be the value of the food that we lost?

It's not clear that we could replace them. To date, in many places we have replaced wild pollinators by domesticated ones, bees bred for the purpose, and we are at some risk of losing these as well as the wild insect pollinators due to colony collapse disorder and pesticide use. If we did lose these vital resources, it's not clear that we could replace them, so if we lost pollinators we would probably lose food output too. How much food? German and French researchers recently estimated that worldwide the loss of all pollinators would lead to a drop in annual agricultural output of about US$ 217 billion, a truly huge sum.[1,2]

But vast as it is, this again may be an underestimate of the value of pollinators. They pollinate wild plants as well as crops, so their absence would have an impact on wild ecosystems, which in turn could have economic consequences. A subtler point is that even if we were to lose US$ 217 billion of food from the absence of pollinators, that missing food might actually be worth a lot more to us than its market value. Suppose, for example, that we lost an apple crop for which we currently pay US$ 1 million, and other fruits—peaches, grapes, oranges, lemons, etc.—worth another US$ 5 million. Is the total value of our loss US$ 6 million? Probably not, because it's likely that even though we actually paid US$ 6 million for what we lost, we would in fact have been willing to pay more for it. Demand for apples doesn't drop to zero if the price rises; people continue to buy them, though perhaps on a reduced scale. The economic value of the apples we have lost is not what we actually paid for them but the maximum we would have been willing to pay, which for foods is generally quite a lot more. There are many goods you might go without if their prices rise even a little, but food is not one of them. In fact, the French and German study cited above takes this point into account and estimates that the total willingness to pay for the food that we would lose were the pollinators to vanish would be more than US$ 500 billion annually. Using standard financial valuation techniques shows that an asset that produces a stream of services this great has a capital value of about US$ 14 trillion, about 75 % of the value of US national income. Think of this as a low estimate of the value of only a part of the earth's insect population.

Insects also pollinate nonfood crops; in fact, they pollinate mostly nonfood crops. In the United States, about 80 % of the total value of pollination services derive from the pollination of forage crops such as alfalfa, which is fed to cattle and

used to produce beef and dairy products. Absent pollinators, some of the beef and dairy products would be lost too. So even this huge number, US$ 500 billion, is on the low side. The bottom line is that pollinators may be small insects, but they loom large in terms of economic value.

A recent study confirmed the economic importance of bats in the United States.[3] In the last decade, white nose syndrome has laid waste to bat populations in parts of the northeastern United States. The eliminations of bats from some counties but not all acted like a controlled experiment and enabled researchers to prove that in counties where this has occurred, farmers have significantly increased their purchases of insecticides, showing that bats were making a real contribution to agriculture. The need to pay for insecticides reduces farm profits, and the increase in their use further harms pollinators and also lead to a statistically significant uptick in infant mortality. The conclusion: bats contribute to our welfare along many dimensions.

Forests

We have spoken of soil and of pollinators as examples of biodiversity and the contributions it makes to human well-being. Forests are another powerful illustration of the importance to us of living organisms. Forests, like watersheds, birds, and insects, are mundane but nevertheless play a fundamental role in managing the climate, both locally and globally. Trees manage the balance between carbon dioxide and oxygen in the atmosphere, regulating the amount of the principal greenhouse gas and ensuring that we can breathe. Not for nothing are they often referred to as the lungs of the earth. Using sunlight to generate electric currents, that is, using solar power, they split water molecules into hydrogen and oxygen and combine the hydrogen with carbon dioxide from the air to produce carbohydrates. Oxygen, which we and all other animals breathe, is a byproduct released into the air. Forests and the soil beneath them absorb about a quarter of all emissions of carbon dioxide. This reinforces a point that we noted above, that vegetation is responsible for the earth being habitable by animals like us. In fact, preserving and growing forests is one of the most cost-effective ways of reducing the concentration of greenhouse gases in the atmosphere. Forests, incidentally, are not just collections of trees. Tropical forests, which are the most effective on the planet at capturing and storing CO_2, rely on species such as monkeys and birds for regeneration: these species eat the fruits of the trees and pass the seeds, spreading them around the forest and leading to the next generation of trees. And the tropical soils, as we noted before, are alive with millions of microorganisms.

Trees also affect the climate locally by evapotranspiration, a process by which they release water into the atmosphere. This is one of the reasons why rainforests have rain. A large forest releases so much water that it affects the climate locally and generates rain. We have known for a long time that clearing forests reduces humidity and rainfall, and a major concern in a country such as Brazil with huge forests and also vast agricultural areas is that deforestation will reduce rainfall and hence the productivity of the agricultural areas. In fact, some scientists believe that deforestation of the Amazon region would dry the climate as far north as the United States. This is not a small point, as there is evidence that the survival of the Amazon as a rainforest is at risk: rainforest ecosystems can only survive if they operate on a large enough scale, and deforestation may be pushing the Amazon to a point where it no longer has the size needed to be viable.

The climate-stabilizing role of forests has a readily measurable value. Forests capture and store carbon dioxide from the atmosphere; they carry out carbon capture and storage, generally abbreviated to CCS. CCS is the Holy Grail of climate policy: it provides a way to offset the emissions of greenhouse gases from the use of fossil fuels. Many research groups are spending hundreds of millions of dollars trying to develop

technologies for CCS, yet trees provide an efficient and proven one available at zero cost. The social cost of carbon is an estimate of the present value of the damages resulting from the release of one extra ton of CO_2 into the atmosphere. There is a range of estimates of this number, from about US$ 40 to several hundred. If we value the removal of a ton of CO_2 from the atmosphere at the social cost of carbon and conservatively take this to be at least US$ 35 per ton, then the CCS services of the world's forest are worth roughly US$ 262 billion per year, giving forests viewed as CCS assets a value of about US$ 9.5 trillion. This is a conservative estimate, and it would be easy to argue for a social cost of carbon considerably in excess of US$ 35. Recent research has argued for as much as US$ 600 per ton CO_2,[4] which would imply a value for forests in their CCS role of well over US$ 100 trillion.

Watersheds

Most of New York City's drinking water comes from a watershed in the Catskill Mountains, a range of hills about 3,000 feet high and about 100 miles north and west of the city. This watershed provides a well-documented example of natural systems as critical infrastructure. Watersheds don't just collect water and channel it in a particular direction; at their best they add two additional services. They smooth out the water flow and they purify the water. Rain falls unevenly, but rainwater has to be matched to a relatively constant demand for water. Soil in the watershed smooths out the flow of water, absorbing water at times of heavy rainfall and releasing this slowly over time. Soil not only acts to smooth the water flow from highly variable rainfall, but it also acts as a highly effective filter, removing many fine particles and other contaminants. Most large cities in the developed world have to pass their drinking water through a filtration plant so that it can be consumed safely, but New York doesn't. It has a special exemption from the US Environmental Protection Agency (EPA). The reason is simply that the Catskill watershed does an amazing job of cleaning the water as it flows through the soil. Back in the late 1990s, the quality of New York's water began to fall, and the EPA warned the city that unless this trend was reversed it would have to build a filtration plant, at a cost of US$ 8 billion (1995 dollars). Research showed that the reason the water quality was falling was that the Catskills watershed was being polluted by economic development in the area: sewage systems from summer homes for New York residents were leaking, and fertilizers and pesticides from arable farms were running into the watershed, as were animal wastes from livestock farms. All of these were reducing the effectiveness of the watershed soil as a filter. The city calculated that it would be less expensive to restore the functioning of the watershed than to build a filtration plant, and it tackled this by paying crop-growers in the area to use organic agriculture (no pesticides or fertilizers), paying livestock farmers to keep their animals back from the streams so that they would not pollute the water, improving the local sewage systems, and buying up undeveloped land or buying conservation easements on it. The city has to date invested around US$ 1.5 billion, a fraction of the anticipated cost of a new treatment plant. This investment in ecosystem restoration has worked well. Again, soil and the microorganisms in it turns out to be critically important.[5]

Genetic Resources: Food

Genetic variability provides a different example of the economic importance of biodiversity. This variability exists both between species and within species. The genes of mice differ from those of men, an example of interspecies genetic variation. The genes of Vladimir Putin also differ from those of Donald Trump, a case of intraspecific variation. Indeed, all individuals have different genomes, so we can use the genome as a unique personal identification device. Although all humans have different genomes, there are certain aspects of the genome we all have in common and that are different from those that

all mice have in common.

This genetic variation has economic value. Slight variations in the genomes of early grasses allowed our ancestors to selectively breed grasses to produce grains such as wheat; had the genomes of grasses been homogeneous, this would not have been possible. Similarly, slight variations in the genomes of aurochs (the predecessors of cattle) allowed early farmers to breed cattle. Again, this involved taking advantage of naturally occurring variations in the genetic details of aurochs and selectively breeding for desirable characteristics. Had the aurochs and grasses of antiquity been genetically homogeneous, we would today be much worse off. It's fair to say that most of our food comes to us courtesy of historical intraspecific genetic variation, which allowed our predecessors to breed the productive food animals and plants on which we depend today.

Today's within-species genetic variability has value too. It provides insurance against pests and diseases. The grassy stunt virus is a powerful illustration of this point. This virus is transmitted by an insect, the brown planthopper, which is common in southeast Asia, and infection by the virus can lead to the loss of as much as 50 % of a susceptible crop. Until the 1980s there was no known cure for grassy stunt infections of rice crops, and some Asian countries were losing as much as one third of their crops to the virus. The problem was eventually solved by the use of biodiversity. The International Rice Research Institute (IRRI) in the Philippines maintains a living library of rice strains and rice relatives, and it found that an early relative of current commercial rice varieties was resistant to the virus. Selective breeding allowed this resistance to be transferred to today's commercial varieties, some of which were then immune to the virus. Genetic diversity, a dimension of biodiversity, provided protection against a serious and growing threat to food supplies in a populous part of the world.

Genetic Resources: Medicines

It's not just our food supplies that depend on genetic diversity: many of our medicines come from this source too. Perhaps the most significant example is aspirin. We all know it as an effective painkiller with few side effects, and it can also reduce the risk of heart attacks and cancer. It is effective, easy to produce, and inexpensive—a rarity in today's pharmaceutical world. It's not a modern discovery: aspirin comes from the bark of willow trees, and the medicinal properties of willow bark have been known for centuries. Indeed, gorillas have been seen to eat willow bark when sick, showing that knowledge of aspirin's effectiveness crosses species boundaries. The German pharmaceutical company Bayer was the first to commercialize aspirin and to find a way of synthesizing the active ingredient so that willow bark was no longer needed. But without the willow bark, we probably would not have discovered this simple and safe painkiller.

Subsequently many more modern medicines have been derived from natural sources. In fact, according to some estimates as many as one third of the drugs in use today were originally found in plants or insects or other animals, or were derived from substances occurring naturally in these.[6] Bayer has another important drug derived from natural organisms: glucobay, a treatment for high blood glucose levels, which has generated more than US$ 4 billion in revenue for Bayer. Glucobay was initially derived from bacteria found in a lake in Kenya. Discoveries like this have led to the growth of "bioprospecting," searching for pharmacologically active molecules in natural settings. Through evolution and natural selection, plants and animals have come to contain pharmacologically active substances as defenses against their predators. These pharmacologically active molecules can in some cases be used as the basis for new drugs: in these cases, we are standing on the shoulders of evolution and natural selection and taking advantage of the centuries of work in refining

molecular specifications. Most bioprospecting occurs in the tropics, as these are the regions where many differing species interact closely and the chances of predation and so the needs for defenses are greatest. So-called biodiversity hotspots, regions where there are unusually large densities of different species of plants, insects, and birds, are seen as the most promising locations for bioprospecting. If such a region contained only one substance as valuable as aspirin or glucobay, its value as a source of knowledge would vastly exceed its values in other possible uses, such as felling the trees for lumber or clearing the land and using it for farming. It is perfectly possible that a biodiversity hotspot could contain the raw materials for several new pharmaceuticals, all as valuable as aspirin. The rosy periwinkle, a pretty flower that grows in Madagascar, was the source of two important drugs, vinblastine and vincristine. The former is used to treat childhood leukemia, and the latter to treat Hodgkin's disease. The loss of biodiversity means the loss of opportunities to discover new molecules of great value to humanity.

The famous Harvard biologist Ed Wilson suggests that we think of biodiversity as a library, as a vast source of information. In support of this vision, he makes the following interesting observation:[7]

> In a purely technical sense, each species of higher organism is richer in information than a Caravaggio painting, Bach fugue, or any other great work of art. Consider the typical case of the house mouse, Mus musculus. Each of its cells contains four strings of DNA, each of which comprises about a billion nucleotide pairs organized into a hundred thousand structural genes. If stretched out fully, the DNA would be roughly one meter long. But this molecule is invisible to the naked eye because it is only 20 angstroms in diameter. If we magnified it until its width equaled that of a wrapping string to make it plainly visible, the fully extended molecule would be 600 miles long. As we traveled along its length, we would encounter some 20 nucleotide pairs to the inch. The full information contained therein, if translated into ordinary-sized printed letters, would just about fill all 15 editions of the Encyclopedia Britannica published since 1768.

It is information of this type and on this scale that we are destroying when we lose biodiversity.

The recent outbreak of a novel coronavirus in China gives another topical illustration of the costs of biodiversity loss. This new disease is zoonotic—it has jumped from wild animals to humans, who have no established immunity to the virus. SARS, the coronavirus that circulated in China in 2003, is also zoonotic, as are Ebola, an extremely dangerous hemorrhagic disease now threatening populations in west Africa, and HIV, which has spread from Africa around the world. These diseases, which have probably been endemic in wild animal populations for centuries or more, spread to humans as a result of increasingly close contact between humans and their wild carriers, largely through hunting and consumption, which brings highly stressed or dead animals, exuding fluids, into close contact with each other and with their human consumers. A recent paper in Nature reviews the impact of biodiversity loss on the emergence and transmission of infectious diseases, and comments that "in recent years, a consistent picture has emerged—biodiversity loss tends to increase pathogen transmission and disease incidence," suggesting that the growth we are seeing in new diseases is connected to the loss of biodiversity.[8]

One more example of the value of genetic diversity: A key element of modern biotechnology is the polymerase chain reaction (PCR for short), which is used to amplify DNA specimens. This reaction is fundamental to many modern biotechnology processes, and it is fair to say that much of the modern biotech industry would not exist without it. This reaction requires an enzyme that is resistant to high temperatures, and no such enzyme was known until the bacterium

Thermus aquaticus was discovered in the Lower Geyser Basin of Yellowstone National Park. Again, we see a relatively rare naturally occurring microorganism playing a key role in an evolving modern technology. In fact, the polymerase chain reaction is central to the test currently being used for COVID-19,[9] so without an obscure bacterium from Yellowstone we would be severely handicapped in dealing with one of the worst pandemics of the last 100 years.

What all these examples establish is that biodiversity is a crucially important element in the natural infrastructure, the natural capital, that underpins our prosperity. Without biodiversity we cannot flourish. Our food comes from biodiversity. The plants and animals we eat owe their productive forms to genetic diversity that existed many years ago, the plants are pollinated by birds and insects, and current genetic diversity provides insurance against devastating infestations and infections. Much of this biodiversity is now threatened.

Biodiversity as an Asset

Biodiversity is an asset that provides a flow of services that are crucially important. Some of these services can be valued at least partly, as in the case of the carbon capture and storage services of forests, or the plant pollination service of insects, birds, and bats, or the bioprospecting services of biodiversity hotspots, or the insurance role of plant biodiversity. The numbers are approximations and are also partial estimates of biodiversity's economic contribution, because for every contribution that can be measured and converted into a dollar value, there are many that cannot. But there is no doubt from the few valuations we can conduct that biodiversity is a vastly important asset. We have a lower bound on its value that is measured in tens of trillions of dollars.

It is also worth noting that biodiversity is an asset that doesn't depreciate. Built capital does, as does human capital, but natural capital generally doesn't. A river that provides hydroelectric power today will still do so centuries from now; by then a conventional power station would have been replaced many times. Biodiversity will continue to provide all of its services as long as we need them, and as long as we allow it to by maintaining it intact.

One more important point about biodiversity is that its loss is often irreversible. Once a species is extinct, we can't re-create it, and everything associated with it, all the information implicit as described so graphically by E. O. Wilson, is gone forever. Forest loss can also be irreversible: one might think that a cleared forest can be replanted or allowed to regenerate, and that is true within limits, but if a large fraction of a tropical rainforest is destroyed, this leads to permanent changes in the soil and in the local weather patterns, and reforestation is no longer possible. Most assets can be replaced if lost or damaged, so this is a distinctive characteristic of biodiversity. It has ramifications: it is commonplace in economics that choices leading to irreversible changes need to meet higher standards of justification than others.[10] So a decision to destroy biodiversity, which we are making every day, needs to meet stricter cost-benefit standards than conventional economic decisions. In particular, such choices should not occur by default.

The Economic Value of Biodiversity

The earlier sections provide illustrations of cases in which we can assign at least a partial value to biodiversity. Pollinators as an asset are worth at least US$ 14 trillion, and tropical forests in their CCS role at least US$ 9.5 trillion, probably a great deal more. These numbers are strictly lower bounds; we have calculated them by valuing only some of the services these assets provide, hence the "at least" before the dollar values. The total values may be a large multiple of these numbers. There are estimates of the value of other aspects of biodiversity, again all partial in nature, all lower bounds.[11] Several researchers

have attempted to estimate the value of the genetic resources in biodiversity hot spots to pharmaceutical companies as bioprospecting resources, with a wide range of outcomes. Others have looked at the insurance role of biodiversity and asked what an insurance company would charge for such risk mitigation. All the resulting numbers are large, confirming that biodiversity has immense economic value, though all are partial and all have a large margin of error around them.

A crucial point that emerges from looking at cost-benefit studies of biodiversity conservation is that it is easy to underestimate the benefits, as they are often unknown or estimated only with large uncertainty. Because of the uncertainty about the exact value of the benefits of biodiversity conservation, studies sometimes omit them. But this is equivalent to setting them to zero, and whatever the benefits are, they are not zero. It is important to have some estimate of the value of conservation, even a rough one. The correct approach is to work out the possible range of values, from minimum to maximum values, and then evaluate conservation projects using all the values in the range and seeing how sensitive the overall picture is to the value assumed.

We have seen that a part of the value of biodiversity is in the tens of trillions of dollars, with the total value probably far higher than the numbers suggested in the cases reviewed above. The total value of biodiversity as an asset, and so the cost of biodiversity loss, is highly uncertain. It is also possible that there are costs to biodiversity loss of which we are currently unaware. For example, until the onset of HIV in the early 1980s, we were unaware of the potential for zoonotic diseases, yet we are now aware that these pose a major public health threat and that their emergence is related to biodiversity loss. There clearly could be other consequences of biodiversity loss that will loom large in the future but are as yet unknown.

In summary, there are costs to biodiversity loss that we can describe but about whose magnitude we are highly uncertain (although we have lower bounds), and there are potentially other costs about which we currently know nothing—there are partly known unknowns and unknown unknowns. This makes any formal cost-benefit analysis particularly challenging. We have some ideas about the costs of conserving biodiversity—the costs of parks, protected areas, etc.—but much more imprecise ideas about the benefits. In such a situation there is always a danger that the apparently robust and well-understood costs will outweigh the much less precise benefits. Such an outcome would be in violation of an emerging consensus among decision-theorists on how to make decisions when some of the outcomes cannot be described even in probabilistic terms.[12] An element in this consensus is that in such situations it is rational to focus on the worst outcomes that could occur, and place heavy emphasis on these. In the current context, this would mean developing detailed worst-case scenarios that could be associated with loss of biodiversity and then basing a cost-benefit analysis on these. If the cost of biodiversity loss is unknown, then rather than putting a zero in the cost-benefit equation, use a number based on a worst-case scenario.

The World Bank has for more than a decade run an initiative called WAVES, Wealth Accounting and Valuation of Ecosystem Services.[13] The central idea is that developing countries should incorporate the value of natural capital and ecosystem services into their development planning. The Bank, in partnership with a number of client countries, has developed and mainstreamed techniques for valuing certain types of natural capital and the services it provides so that these can be incorporated into national income accounts and their contributions to the national well-being considered in strategic economic decisions. This is an important development and one that should be encouraged in all countries and not just those in the WAVES partnership.

Market Failures and Biodiversity

Given the immense value of biodiversity to human societies, why do we allow it to be destroyed? Why do institutions such as the market not capture the value of biodiversity? Markets do a good job of valuing many things that are clearly much less important to us than biodiversity, so why don't they do this with biodiversity too?

Unfortunately, there are several quite compelling reasons why markets and other economic institutions fail to reflect the value of biodiversity. The key economic concept here is market failure: markets generally do a reasonable job of allocating value to resources, but there are certain cases, rehearsed in all standard economics texts,[14,15] where they fail dismally. Biodiversity occurs at the intersection of several of these market failures.

A good place to start in understanding this is with the idea of public goods. Most goods are private goods and their consumption by one person prevents their being consumed by anyone else. Public goods instead can be consumed simultaneously by many people: if they are provided for one, they are provided for all in a certain group. Cleaner air is a good example. If New York City cleans its air, then this is a good provided for all New Yorkers and not just for a specific few. Markets can't handle the efficient provision of public goods because you can't exclude from receiving them those who didn't pay for them, meaning that markets under-provide public goods relative to what is needed for economic efficiency. Many of the benefits of biodiversity are public goods. Pollination services are available for everyone—bees don't check whether the owner of an orchard has paid for their services. Forests suck CO_2 out of the atmosphere and in so doing benefit everyone, whether they paid for the forest or not. Drugs produced by bioprospecting can benefit everyone, whether they paid for the conservation of biodiversity or not. Knowledge is a classic public good, and as E. O. Wilson so sagely observed, knowledge is what in many cases we get from biodiversity.

Another way of thinking about this is in terms of external costs and benefits. Sometimes a transaction between a buyer and seller produces costs or benefits for a third party who is not directly involved in the transaction. Burning fossil fuels as a result of a transaction between an airline and an oil company leads to the emission of pollutants and greenhouse gases, which impose costs on many others not parties to the transaction. These are called external costs or benefits—costs in this case—and are another standard cause of market failure. Markets lead to inefficient outcomes when there are external costs or benefits. Biodiversity conservation leads to external benefits: conserving tropical forests leads to benefits that accrue to many people who are not involved in the conservation—in fact, to everyone in the world. As a result, the economic incentives to conserve these forests are far too small, and markets do not allocate enough resources to their conservation. Economically the situation is dire. In general, the owner of a tropical forest can generate a return from it only by destroying it, selling it for lumber or using the cleared land for farming. In either case the biodiversity is destroyed. The forest owner cannot monetize the carbon capture and storage carried out by the forest, nor generally can the owner capture the value that its biodiversity may have in bioprospecting. The failures are not inevitable: the global community could decide to compensate forest owners for the CCS services that their forests provide to us all, and indeed the 2015 Paris COP's endorsement of REDD+ in Article 5 set the scene for doing this. The Convention on Biological Diversity is also trying to make it easier to monetize the values of genetic diversity in a forest. As of yet, neither is sufficiently operational to provide a return to forest conservation and overcome the basic market failure. The same is true of conserving pollinator habitat.

A third dimension of market failure relevant to biodiversity is the lack of well-defined property rights: markets can only manage the purchase and sale of goods and services efficiently if the ownership of those commodities is clear, so that when there is a sale, there is no ambiguity about who sells and who buys, about who pays and who receives. For many environmental goods and services, this is not the case: no one person owns the atmosphere or the birds that fly in it or the oceans or the fish swimming in them. Indeed, most biodiversity is no one's property, so no one has any financial interest in conserving it or in ensuring that it is allocated to its highest-value use.

Policy Interventions to Benefit Biodiversity

The economic conclusion is that because biodiversity provides benefits that are sometimes public goods and sometimes external benefits, and because the ownership of biodiversity is generally unclear, the market will undervalue and underprovide biodiversity. We cannot rely on market forces to solve the problem of biodiversity loss, making policy intervention essential. This may take many forms, but all in essence have to overcome the underlying market failures linked to biodiversity.

The simplest forms of intervention are the establishment of protected areas, such as national parks, in which biodiversity is protected. In the oceans, the equivalent is the marine protected area (MPA). There is abundant evidence that if established on a sufficient scale and if well-managed, parks and MPAs can stabilize biodiversity and indeed reverse losses that have occurred. Both have costs: there is a political cost to declaring an area off limits to economic activity and a financial cost to managing the conserved area and ensuring that the habitat is protected. In the United States, the current system of national parks was established by Teddy Roosevelt, whose prescient comments about natural resources we noted earlier. There is evidence that MPAs will pay for themselves after somewhere between 5 and 10 years,[16] because they lead to large increases in fish populations and eventually these increased populations leak out of the MPA into the surrounding fishing grounds, increasing yields, so that in the long run the local fishers gain from the existence of the MPA. Similarly, in some cases it is possible to generate a cash return from the biodiversity conserved by a park through ecotourism. Conservation of charismatic animals in southern Africa has certainly led to an increase in tourism there, and this has provided close to commercial levels of returns on the investments in conservation,[17] but Africa's charismatic megafauna are unique in terms of their drawing power. On a smaller scale, Costa Rica and Panama have developed ornithological tourism based on the conservation of their tropical bird populations, providing some return to the costs of conservation.

Protected areas are an important weapon in the conservationist's armory, but they have limitations. They isolate populations, leading to inbreeding, and make it impossible for species to move in response to changing climate. Ideally, they should be connected by corridors along which species can migrate and through which genetic exchange can occur.

Ecotourism based on charismatic fauna is an example of a more general approach to monetizing a public good such as biodiversity, namely bundling it with private goods whose value it enhances. In the case of ecotourism, what is being sold is not the biodiversity on display but hotel rooms, campsites, and guiding services. No one would pay US$ 1,000 per night to camp in the Okavango Delta were it not for the lions, cheetahs, leopards, elephants, hippos, sitatunga, and many other species to be seen there. Biodiversity increases visitors' willingness to pay for spending time in the Okavango, and safari camp operators make their profits from this. This exemplifies a more general proposition, which is that the provision of a public good

(which cannot profitably be sold) may increase what consumers are willing to pay for a private good if its consumption is made more enjoyable or productive by the presence of the public good. Sellers of the private good therefore have an incentive to provide the public good too: they are able to sell it indirectly via its impact on the price of the private goods they sell. Under certain conditions this incentive is strong enough that the public good is provided at an economically efficient level.[18,19]

An example different from ecotourism is provided by housing development on Spring Island, a barrier island off the South Carolina coast.[20] Zoned for development, it was auctioned in 1990. The state, which hoped to conserve the island, was outbid by a developer. But the developer, instead of constructing the 5,500 homes permitted by the zoning, built 500 high-value homes and deeded the balance of the land to a conservation trust. This was not, he explained, charity: being embedded in a nature reserve increased the value of the 500 homes to the point where this was the more profitable strategy. The nature reserve, a public good, was enhancing the value of the private homes he was selling. A similar case occurred with a group of Montana hunters who had traditionally hunted on an area of land and grew concerned that its development would end their ability to hunt. They borrowed money to buy the land and finance construction of a small number luxury homes, and they placed a conservation easement on the remainder of the land, giving themselves the right to hunt. After this they sold houses they had built for more the than cost of buying the land and building the houses. Again, being embedded in a conserved area of great beauty enhanced the value of the homes. In all of these cases a public good is being sold with—bundled with—a private good and is enhancing the private good's value so much that the seller has an incentive to enhance the provision of the public good.

A less comprehensive form of bundling occurs when a company takes the trouble to have its products certified as in some way biodiversity-supportive. Examples are lumber that is certified by the Forest Stewardship Council or fish certified by the Marine Stewardship Council. A recent development in this field is the Roundtable on Sustainable Palm Oil: palm oil is widely used in processed foods, is grown largely in southeast Asia, and virgin tropical forest is frequently cleared to make space for oil plantations, at a great cost in terms of biodiversity loss. The roundtable results from pressure by western consumer and environmental groups on companies such as Nestlé, Procter and Gamble, and Unilever to stop using palm oil from growers who destroy rainforests.

A company whose products are certified as "sustainable" in one of these categories is telling consumers that it is contributing to biodiversity conservation, generally with the expectation that consumers will react positively to this and will therefore be predisposed to buy this product rather than the product of a competitor.[21]

In the United States, one of the most powerful regulatory tools for biodiversity conservation has been the Endangered Species Act (ESA), passed by Congress in 1973. Once a species is listed as "endangered," which requires a complex administrative process, the ESA makes it illegal to take any actions that reduce its survival chances. Wolves, eagles, the red cockaded woodpecker, and many other less charismatic species survive in the United States largely because of the ESA. Introduced by President Nixon, it has been systematically weakened by Congress and subsequent Republican presidents, but it still provides a valuable tool for the support of biodiversity. In its original form it prohibited any actions that threatened the survival of a listed species; it has been amended to allow such actions provided that the actor makes other provisions that more than compensate, which has led into complex and sometimes

controversial territory but has also led to the evolution of mitigation banking, a market-oriented approach to biodiversity conservation.[ii]

Other forms of policy intervention tackle more directly the market failures associated with biodiversity. Recall that one of these is the presence of external costs: many economic activities, such as farming and property development, have the side effect of destroying biodiversity habitat. A classic economic solution would be to discourage them by placing a tax on them. Put a "biodiversity conservation tax" on any activities that harm biodiversity, such as land clearance for development or for agriculture. Conversely, give a subsidy to those who help biodiversity. These would be directly addressing the external effects that are so often associated with biodiversity conservation or destruction.

A natural extension of the idea of subsidizing biodiversity conservation is the idea of payment for ecosystem services. The key point here is that owners of natural capital—in general, landowners—should be compensated for ecosystem services that originate on their land but benefit others. To give a concrete example, owners of land in the Catskills that is part of New York City's watershed would be compensated for the provision of clean drinkable water to the city: in effect, the city would buy such water from them. This would clearly give them an incentive to maintain the ecological functions of the watershed. In the same way, owners of land that supports pollinators would be paid the value of the pollination services, and forest owners would be paid for the carbon capture and storage roles of their forests, which, as we have seen, are of great economic value and could provide a healthy return to investments in forests. This is a policy one can imagine going into effect if the regions providing ecosystem services are owned by a single landowner or by a small number, but which could be difficult to implement if the region is the property of many small landowners, which was the case with the Catskills watershed. In this case, the coordination problem could prove overwhelming.

In fact, payment for carbon capture and storage is one of the aims of Reducing Emissions from Deforestation and Degradation (REDD), a system aimed at reducing greenhouse gas emissions from cutting tropical forests by providing financial rewards to countries that reduce deforestation or increase forest cover. Although the explicit aim of this measure is to reduce climate change, if successful it also stabilizes biodiversity by conserving tropical forests. It is an attractive policy because it can tackle two of the world's major environmental problems at the same time. As mentioned, Article 5 of the 2015 Paris Agreement provides a basis for the implementation of REDD, and this could also be an important avenue for increasing funding for forest conservation.[22]

None of these policies will directly address the values of genetic diversity, as a source of new variants on existing species, as a source of new medicines, or as insurance against novel pathogens. It is possible that the Convention on Biological Diversity (CBD) could be strengthened to cope with some of these issues. The focus of the Nagoya Protocol to the CBD is bioprospecting, and this could provide a basis for a more determined approach to regulating bioprospecting. In the case of rice, the collection and conservation of rice relatives and predecessors has been managed by the International Rice Research Institute, mentioned in the context of the grassy stunt virus earlier: the IRRI is funded by the Ford and Rockefeller Foundations and the government of the Philippines. The CGIAR (formerly Consultative Group on International Agricultural Research) also performs some of these functions for a wider range of plants and is funded mainly by the aid agencies of western countries. All of these entities are clearly useful, but all need to be scaled up if

[ii] Unfortunately, much of the land clearance that matters for biodiversity loss occurs in developing countries, where the implementation of such a tax is challenging.

they are to have the resources needed to make an impact on the loss of biodiversity at a global level.

An important move that could greatly help preserve biodiversity is the development of an agricultural system that is less land-intensive and drives deforestation less. A major driver of deforestation is cattle ranching, so moving diets away from beef and toward plant-based foods could be a great gain for biodiversity, and for public health as well.[23] In this context the growth of vegan diets among millennials is a source of hope. Indeed, the emergence of companies such as Beyond Beef and Impossible Foods suggests that plant-based alternatives to meat are commercially viable and could reduce the pressure to clear land for ranching. Any policies that encourage the growth of plant-based diets could reduce biodiversity loss.

Conclusion and Next Steps

Biodiversity is an asset to humanity. It has been demonstrated to be a hugely valuable asset, providing a wide range of critically important services without which our societies would never have evolved as far as they have, and which still underpins our prosperity in myriad ways. It is an asset that never depreciates and whose loss is irreversible, so it behooves us to be particularly careful with it.

In this respect we are failing badly. Even though biodiversity is of critical economic importance, we cannot rely on markets to conserve it; it has characteristics of both public goods and external benefits, which means that much of its value escapes the market, and market-based decisions inherently lead to the destruction and loss of biodiversity. Policy interventions are thus essential if biodiversity is to survive.

Traditional government establishment of parks and protected areas, and the use by government of laws and regulatory systems to protect biodiversity such as the US Endangered Species Act, have all been effective in protecting biodiversity but in fairly limited ways. More recent experience with government programs to either pay for or compel private actors to make payments for ecosystem services are showing some potential, although experience with this to date is still limited.

The Convention on Biological Diversity is clearly a framework that could act as a building block in this area, and the approaching COP15 delineation of both measurable biodiversity targets and a supporting financial resource mobilization framework offers some immediate hope. The financial analysis and associated development of nine financing mechanisms and fiscal policies offered in the next chapters of this report, if taken up by the COP Parties and country signatories, could put in place strong policies and economic measures that when scaled up will have a lasting and measurable effect in protecting the planet's biodiversity.

CHAPTER 3

Updating the Estimate of Current Global Biodiversity Conservation Finance

Global Biodiversity Conservation Finance Sources[iii]

Biodiversity refers to the variety and variation in life on planet earth.[24] Yet, beyond a list of species distributed across the globe, biodiversity underpins a hierarchy of ecological processes[25] that combine to define the composition (which species are present), structure (how species assemble into distinct terrestrial, aquatic, and marine ecosystems), and function (provisioning of ecosystem services) of earth's ecosystems. To ensure the integrity of the global biosphere, biodiversity conservation requires financial resources and alignment of economic incentives to protect and manage all three levels of the ecological hierarchy. Investments are also required to maintain or restore environments that support communities of species and, in turn, maintain ecosystem composition, structure, and function.

In this report, biodiversity conservation finance is considered to encompass financial resources toward conservation, restoration, and sustainable use of biodiversity as well as investments into the biophysical systems supporting biodiversity.

Financial resources for biodiversity conservation derive from three overarching sectors: government funding (domestic public), official development assistance (ODA) (international public), and private capital. Biodiversity conservation financing has historically been dominated by the public sector, representing over 50 % of the available financial resources and implemented chiefly through domestic public budgets and fiscal policies to monitor and manage anthropogenic impacts on ecosystems, through the establishment of public protected areas (e.g., national parks or marine reserves), and through taxation to discourage ecologically damaging activities. Public sector financing is typically deployed within the country. However, official development assistance (ODA) in support of biodiversity conservation has also played an important role, particularly for developing economies.

Government funding remains crucial for biodiversity conservation; however, with the increasing pace and extent of ecosystem degradation and global climate change stressors, the portfolio of mechanisms for financing biodiversity conservation needs diversification. Innovation in biodiversity financing spans the public, philanthropic, and private sectors, with increasing efforts to align economic and business incentives to biodiversity-positive outcomes. Recent advances in public-private financing instruments to support biodiversity conservation include market-based approaches such as biodiversity offsets and the implementation of nature-based solutions funded through carbon markets, among others.

Government and philanthropic resources alone are not enough to address the global biodiversity conservation financing needs in the future, and thereby private and public-private investments are critical for the future of biodiversity conservation. Private sector biodiversity financing solutions are diverse and include green bonds, sustainability linked loans, environmental

[iii] All figures in this section are reported in 2019 US$ unless otherwise stated.

impact bonds, as well as direct incorporation of sustainability and biodiversity conservation measures into supply chains, among numerous other approaches detailed in the later chapters of this report. Similarly, new partnerships in the philanthropic and nongovernmental sector are emerging to link biodiversity conservation and private investments, for example, through the development of public-private ("blended") impact investing funds to support sustainable forestry, agriculture, or fishing practices.

It is important to state that while this report acknowledges the critical role of private capital to meet future biodiversity conservation funding needs, it also recognizes that increasing private capital flows alone is not sufficient. The effective delivery of private finance as well as the enabling conditions to incentivize and direct it toward positive biodiversity conservation outcomes is contingent on the work of governments, NGOs, and local communities. Only by aligning the efforts of these actors to establish appropriate enabling conditions can we hope to effectively deliver the necessary private financing flows to meet biodiversity conservation funding needs.

Estimating Current Global Biodiversity Conservation Finance

Estimates of the existing finance flows for biodiversity conservation remain critical to assess the funding gap for global biodiversity conservation. Since 2012, the figure of US$ 52 billion per year of financial flows related to biodiversity conservation first proposed by Global Canopy in the *Little Book of Financing Biodiversity*[26] has been widely used in biodiversity and conservation finance. This report provides a benchmark estimate of current capital flows by aggregating spending systematically across the public, philanthropic, and private sectors.

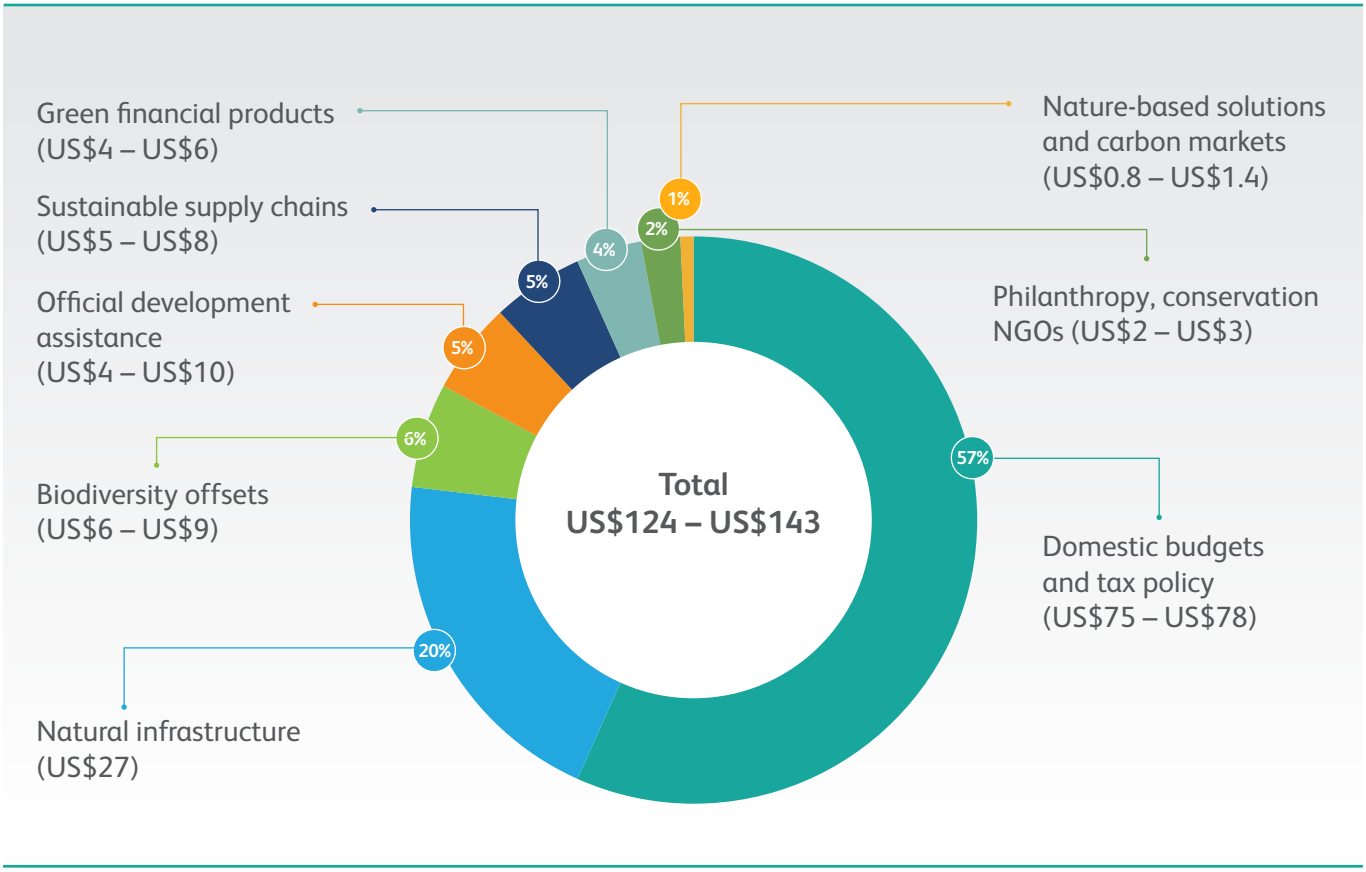
To generate an estimate of current global biodiversity finance, a range of clearinghouses for economic policy and financial information have been utilized, including data collected by the Organisation for Economic Cooperation and Development (OECD), the United Nations Development Program Biodiversity Finance Initiative (UNDP BIOFIN), Forest Trends' Ecosystem Marketplace, and Bloomberg New Energy Finance (NEF), among other organizations.

TABLE 3.1 Estimated Current Global Biodiversity Conservation Financing.

Mechanisms that increase positive financial flows into biodiversity conservation	Financial flows in 2019 *US$ billion / year*
Domestic budgets and tax policy	74.6–77.7
Natural infrastructure	26.9
Sustainable supply chains	5.5–8.2
Biodiversity offsets	6.3–9.2
Official development assistance (ODA)	4.0–9.7
Green financial products	3.8–6.3
Philanthropy, conservation NGOs	1.7–3.5
Nature-based solutions and carbon markets	0.8–1.4
Total positive financial flows into biodiversity conservation	123.6–142.9
Mechanisms that increase negative capital flows into biodiversity	
Harmful subsidies (agriculture, forestry, and fisheries sectors)	(542.0)–(273.9)

Note: Values are adjusted to 2019 US$. Detailed methodology is available in Appendix A.

FIGURE 3.1 Global biodiversity conservation financing in 2019: Summary of financial flows into biodiversity conservation. *(in 2019 US$ billions per year)*

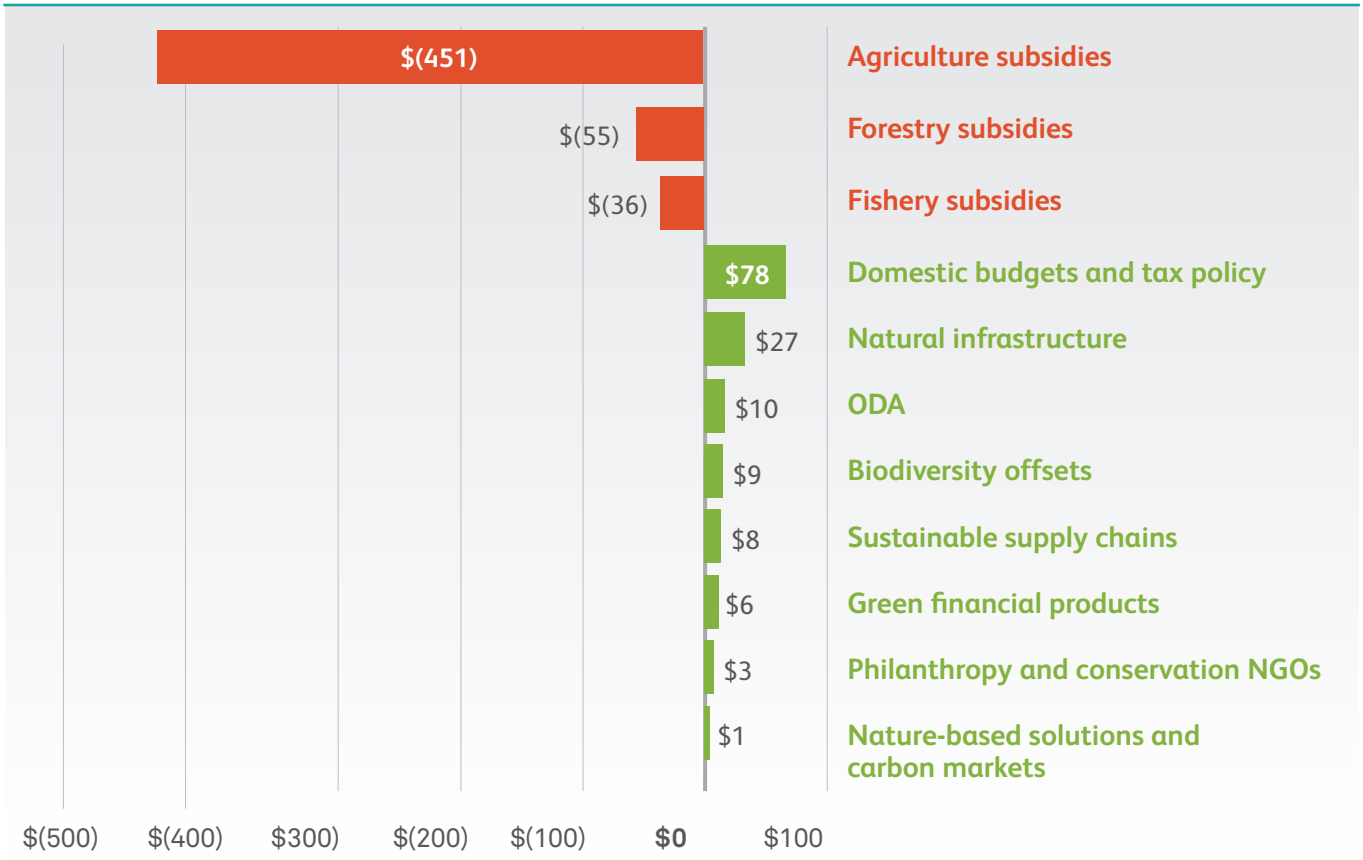


The existing annual financial flow toward biodiversity conservation is estimated at US$ 124–143 billion per year as of 2019 (Table 3.1 and Figure 3.1), corresponding to 0.12–0.14 % of global GDP in 2019. Presently, biodiversity conservation funding continues to be dominated by the public sector, with direct domestic government spending and fiscal policies alone representing 54–60 % of the total annual biodiversity conservation flows.

Global annual production subsidies from the agricultural, fisheries, and forestry sectors potentially harmful to biodiversity in 2019 were estimated to be US$ 274–542 billion; that is, at least four times larger than the total positive current financing flows into biodiversity conservation in 2019 (Figure 3.2). A key message from this report is that, in addition to scaling up biodiversity finance mechanisms, it will be critically important to accelerate the reform of subsidies harmful to biodiversity over the next 10 years.

Recent efforts have provided values for global biodiversity conservation financing using alternative data or methodologies that are presented here. In April 2020, the OECD's A Comprehensive Overview of Global Biodiversity Finance report estimated global biodiversity finance at US$ 78–91 billion per year based on available 2015–2017 data. The OECD estimate provides a detailed overview of public domestic and international public expenditures from OECD Creditor Reporting System (CRS), OECD Policy Instruments for the Environment (PINE), the Clearing-House Mechanism CBD portal, UNDP BIOFIN biodiversity expenditure reports, and the Classification Of the Functions Of Government (COFOG) datasets.[28] The 2020 UNDP BIOFIN

FIGURE 3.2 Harmful subsidies and global financial flows towards biodiversity conservation.
(upper estimates, in 2019 US$ billion per year)



Note: The estimates of agricultural, forestry, and fisheries harmful subsidies used correspond to OECD's "potentially biodiversity harmful" category of production subsidies. This graph excludes the estimated additional US$ 395–478 billion in fossil fuel production subsidies.[27] While fossil fuel subsidies are not addressed in this report, the potential indirect impacts of these subsidies on biodiversity resulting from increases in atmospheric and ocean temperatures associated with fossil fuel use may exacerbate biodiversity loss.

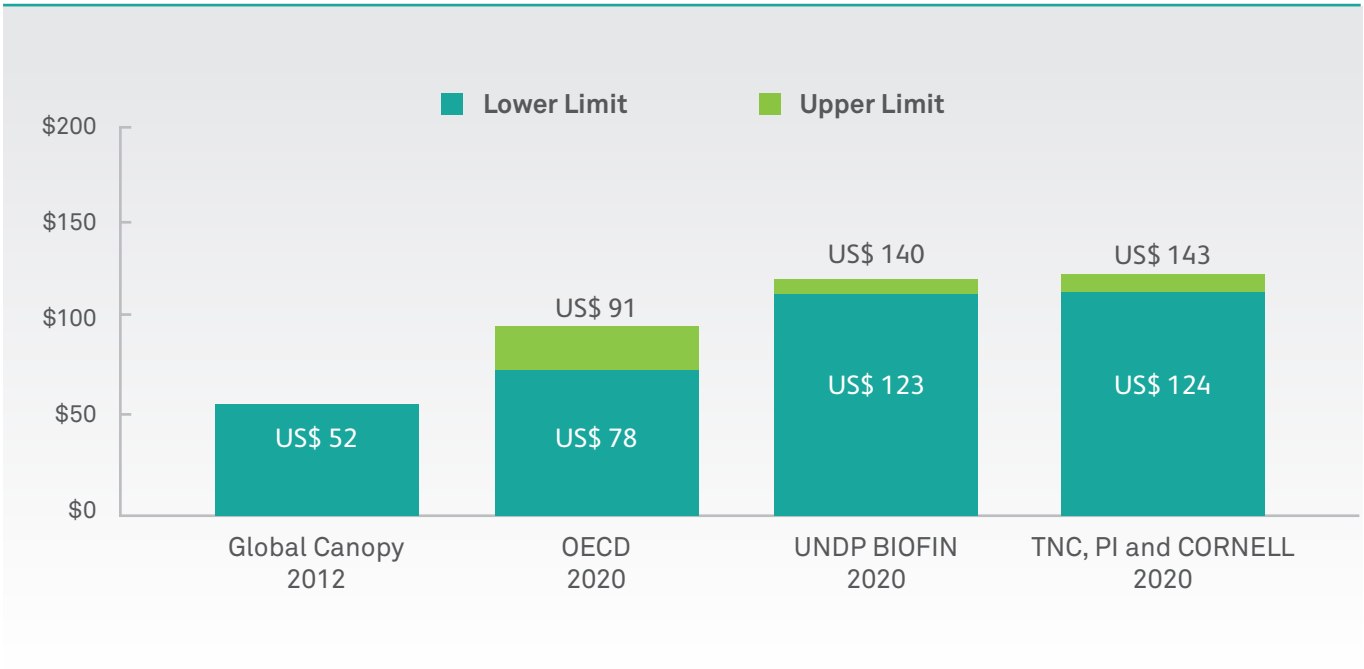
research on Pennies for Pangolins: A Global Estimate of Public Biodiversity Investments calculated that global annual public investment in biodiversity has increased from around US$ 100 billion in 2008 to about US$ 140 billion in 2017, with an average of US$ 123 billion invested annually (± 1 billion) over this period.[29] This UNDP BIOFIN estimate also focused on government spending and used a statistical model to project global spending based on a sample of 30 countries' biodiversity expenditures over 2008–2017.

Together, the existing global estimates of biodiversity conservation finance suggest some consistency in results across efforts (Figure 3.2); however, in recognition of the existing data gaps in private and public-private biodiversity finance, this report has attempted to build on biodiversity conservation finance estimates from these sources, thereby producing a global estimate that may be somewhat higher than alternative efforts. As such, numbers reported here build on the OECD's findings on public domestic, international public, and private mechanisms by providing a complementary assessment for private and public-private biodiversity finance. Therefore, the current global biodiversity conservation finance assessment

in this report includes first order estimates for biodiversity offsets, green financial products, sustainable supply chains, natural infrastructure, and nature-based solutions and carbon markets, using a range of academic sources and published industry market size reports. Details on the methodology describing public and private estimates, data sources, and assumptions can be found in Appendix A. It should also be noted that the figure estimated in this report is not directly comparable with the previous 2012 estimate of US$ 52 billion per year due to differences in methodology and comparable available datasets.

An important caveat in our analysis is that due to lack of quantitative breakdown of expenditure by mechanisms category in the public sector and comparable biodiversity expenditure reporting standards across countries, this report's estimate may include a portion of "double counted" flows. Namely, for some countries it was not possible to distinguish between public and private flows. For instance, some capital counted under private watershed investments in natural infrastructure may flow to government entities from those who benefit from ecosystem services provided by healthy watersheds and be incorporated into public sector domestic expenditures on biodiversity conservation. Therefore, caution may be warranted when evaluating these numbers, viewing these estimates as a potential upper limit to global biodiversity conservation finance flows. Details on which specific financial mechanisms have potential for double counting are presented in Appendix B.

FIGURE 3.3 Summary of global biodiversity financing estimates *(US$ billions per year)*



Note: The Global Canopy estimate is in 2012; The OECD estimate is in average 2015–2017; Other estimates are in 2019

CHAPTER 4

Estimated Financing Need for Global Biodiversity Conservation[iv]

As the scope and intensity of human impacts on earth's ecosystems continue to expand, the need to adequately finance global biodiversity conservation is more important now than ever before.[30,31] In this chapter, global resource needs for biodiversity conservation to ensure the long-term sustainability of earth's ecosystems are assessed and then compared with our estimates of current global biodiversity finance to identify a global biodiversity financing gap.

Several efforts have attempted to estimate the financial needs to meet global biodiversity outcomes (Table 4.1). Except for the US$ 150–440 billion estimates from the First High-Level Panel report in 2012,[32] which evaluated the financial resources needed to achieve the Aichi targets by 2020, previous estimates focused primarily on the financial needs to support protected area-based management to prevent biodiversity loss. This report recognizes that protected areas play a key role in preventing biodiversity loss; however, in isolation without further conservation measures they will not be sufficient to ensure the long-term sustainability of the earth's biosphere.

In this report, a holistic view of biodiversity conservation is adopted, which includes protection of existing biodiversity through protected areas, but which also considers mainstream biodiversity conservation investment needs to adequately manage and use "productive" land and seascapes to maintain biodiversity integrity that supports key ecosystem services for humanity, and to support green transformation by measures such as controlling water pollution and protecting biodiversity in urban areas. Therefore, in transitioning to a future where anthropogenic activities balance the capture of ecosystem services, to satisfy society's resource needs, with biodiversity conservation to ensure the long term health of the biosphere, the global biodiversity conservation funding needs are organized into three components:

A. Biodiversity conservation through terrestrial and marine protected areas,
B. Sustainably managing productive landscapes and seascapes (fisheries, croplands, rangelands, forests, critical coastal ecosystems, managing invasive species) to maintain ecosystem integrity that supports key ecosystem services for humanity, and
C. Biodiversity conservation in peri-urban areas and reducing water pollution.

The sum of future global biodiversity funding needs has been calculated as US$ 722–967 billion per year by 2030.

The estimates presented are made using available data and reasonable assumptions based on peer-reviewed academic research (detailed in Appendix A). They are not meant to be taken as precise targets but to demonstrate both the scale of the problem as well as benchmark milestones for where we, as a global society, need to be in 2030.

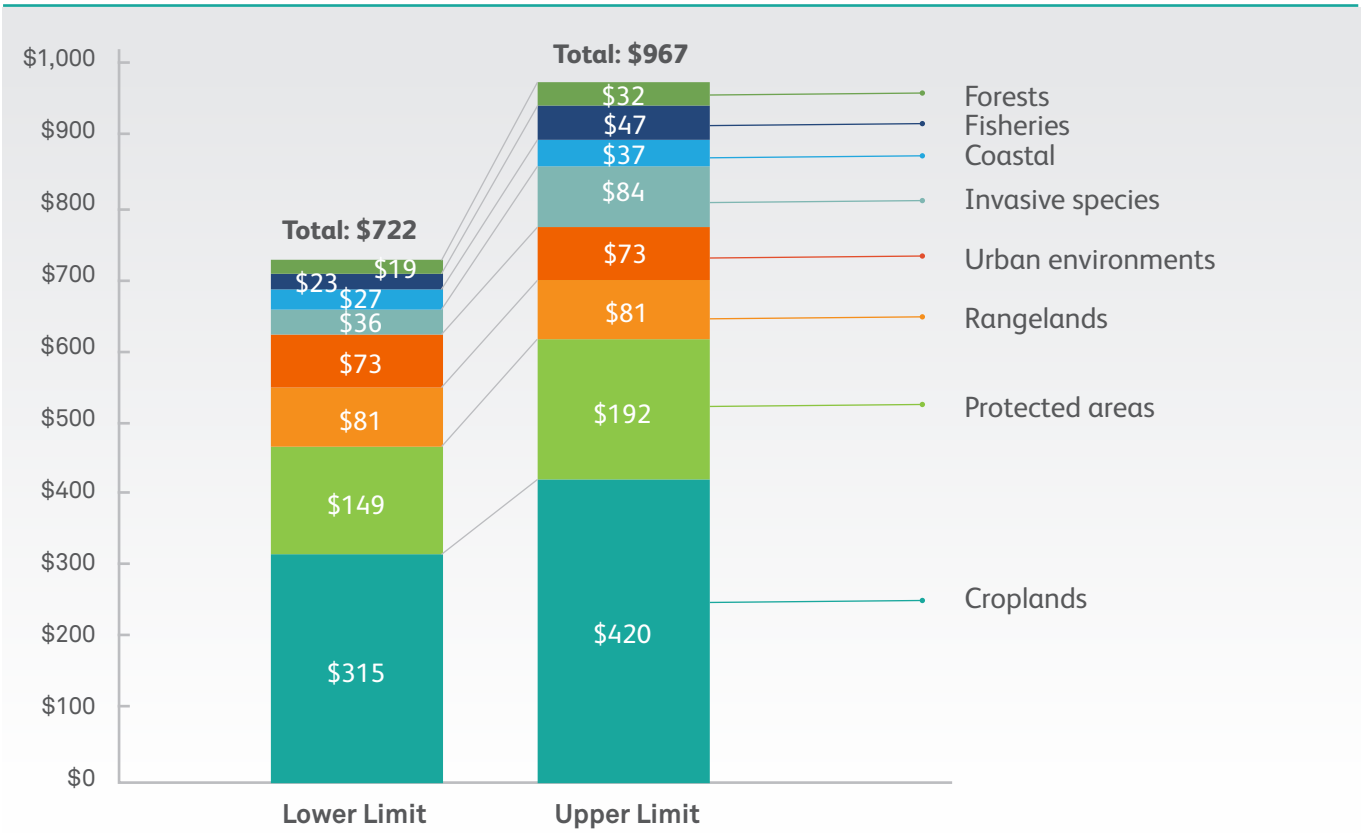
The estimates presented are also global estimates. It is inevitable that there will be

[iv] All figures in this section are reported in 2019 US$ unless otherwise stated.

TABLE 4.1 Summary of Key Literature on Biodiversity Funding Needs

Report Name	Notes
McCarthy, Donal P., et al. "Financial costs of meeting global biodiversity conservation targets: current spending and unmet needs." Science 338.6109 (2012): 946–949.	Estimated the financial cost of reducing the extinction risk for all species and of establishing and maintaining terrestrial protected areas. Estimated that at least US$ 71.6 billion annually is needed to conserve areas of particular importance for biodiversity, with about US$ 22.4 billion (29 %) of funding needs concentrated in low-income countries.
Report of the High-Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011–2020, CBD (2012).	Estimated the global costs of meeting the Aichi Biodiversity Targets in 2020 as US$ 150–440 billion per year, based on estimates of the resource requirements identified for each of the 20 Aichi Biodiversity Policy Targets. The report added that a variety of factors would affect the magnitude of the funding requirements. In particular, inter-linkages, policy coherence, institutional development, and synergies between targets and other goals mean that the approach, resourcing, and effectiveness of the delivery of any one target may influence the investment needs of another.
Waldron, Anthony, et al. "Reductions in global biodiversity loss predicted from conservation spending." Nature 551.7680 (2017): 364–367.	Developed a statistical model to calculate conservation spending to reduce biodiversity decline rates, which can also be used to predict countries' biodiversity conservation investments needed to reach targets under the Convention on Biological Diversity or the Sustainable Development Goals. Identified that US$ 14.4 billion of conservation investment between 1996 and 2008 reduced biodiversity loss across 109 countries by an average of 29 % per country.
Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Chapter 3 (2019).	Recognized that while financial resources have increased during the past 10 years, these were insufficient for the effective implementation of the 2020 Aichi targets. Summarized the direct and indirect drivers of global biodiversity loss and evaluated the limited performance of funding requirements for each of the 20 Aichi targets. Reviewed the estimates by the CBD (2016) and McCarthy et al. (2012) and highlights that the ~ US$ 71.6 billion per year needed to conserve protected areas needs to increase by at least an order of magnitude.
Roxburgh, T., Ellis, K., Johnson, J. A., Baldos, U. L., Hertel, T., Nootenboom, C., and Polasky, S. 2020. Global futures: Assessing the global economic impacts of environmental change to support policy-making. Summary report, January 2020.	Evaluates the potential consequences of nature's decline for 140 countries' trade and industrial sectors, based on assumptions regarding socioeconomic drivers, climate change emissions, sea-level rise, and changes in land-use and land-cover (LULC). The Natural Capital Project InVEST model is used to quantify how the supply of ecosystem services would be affected by 2050 under three scenarios: Business-as-Usual (BAU), Sustainable Pathway (SP), and Global Conservation (GC). The BAU and SP scenarios are largely based on the IPBES global assessment. The model covers six ecosystem services including pollination, coastal protection, water yield, timber production, fish production, and carbon sequestration. Under a BAU scenario, annual global GDP would be at least -0.67 % lower by 2050 (reduction of US$ 479 billion in annual GDP in US$ 2011 dollars). Under a CC scenario, in contrast, annual global GDP would be at least +0.02 % higher (increase of US$ 11.3 billion in annual GDP).
Estimation of Resources Needed for Implementing the Post-2020 Global Biodiversity Framework (GBF2020): Preliminary Second Report of the Panel of Experts on Resource Mobilization, Convention on Biological Diversity, (2020)	Estimated the funds needed for the implementation of the GBF2020. Develop a statistical model to estimate biodiversity expenditures and financial needs per country, based on information reported in the CBD Financial Reporting Framework, projecting three scenarios to estimate financial needs: Business-as-Usual (BAU), Sustainable Pathway (SP), and Global Conservation (GC) based on the WWF 2020 report. The BAU scenario resulted in US$ 150–300 billion annually, keeping the same level of carbon emissions, land use degradation, and GDP. The SP scenario resulted in US$ 136–222 billion annually. The GC scenario resulted in US$ 105–122 billion.

FIGURE 4.1 Global biodiversity conservation funding needs. *(in US$ billions per year)*



regional and inter-country heterogeneity in where these needs are most prevalent. For example, the needs to restore coastal ecosystems may not be relevant, in the domestic policy sense, to landlocked countries although they may wish to assist neighboring or other countries in meeting their coastal ecosystem financing needs to protect or improve marine ecosystem services.

A. Protected Areas

Protected areas preserve existing biodiversity by controlling or eliminating human impacts on swaths of terrestrial, aquatic, or marine habitats. Implementation of biodiversity conservation through protected areas requires resources, for example, the acquisition cost of land, as well as operating costs to monitor and manage enclosed areas. Waldron et al. (2020)[33] have estimated that the current global protected area network of 16 % of the land and 7.4 % of the ocean is only receiving US$ 24.3 billion annually—roughly one third of what it needs to be effectively managed, that is, US$ 67.6 billion per year. Protected areas in several countries suffer from funding deficits because governments allocate fewer financial resources than the minimum required for proper management, for example, 76.5 % of Brazil's federal protected areas have funding deficits.[34] In this report we align with the global target for increasing both terrestrial and marine protected areas to reach 30 % by 2030, consistent with proposals by the Campaign for Nature and other organizations, in anticipation of the new set of global biodiversity targets to be negotiated at the CBD COP15. Waldron et al. (2020) propose a suite of six scenarios for protecting biodiversity. The lower estimate for future needs has been taken as the scenario that allows for a compromise between biodiversity protection and productive landscapes, thereby aligning with the category described in this chapter of productive landscapes

and seascapes. The upper estimate is that of the scenario that prioritizes broader ecosystem integrity and viability.[v] The range of these cost estimates is **US$ 149–192 billion per year**.

B. Sustainable Management of Productive Landscapes and Seascapes

Outside protected areas and urban environments, a larger proportion of the Earth's surface operates as productive landscapes or seascapes that experience some level of modification associated with the capture of ecosystem services to support humanity, the so-called managed middle. These areas are dominated by agricultural landscapes and working forests on land and by coastal ecosystems and fisheries by sea.[35,36] Biodiversity plays a fundamental role in the sustainable provision of ecosystem services from the "managed middle," contributing to ecosystem composition, structure, and function that underpin the workings of the biosphere,[37] and while protected areas provide the strictest protection of biodiversity, working landscapes and seascapes can coexist with and promote biodiversity conservation.[38,39,40] Therefore, these extensive areas present important regions and opportunities for biodiversity conservation where the long-term benefits of transition to sustainability are higher than not doing so. To assess the financial need in the "managed middle," information on costs to manage cropland, rangeland, timber forests, fisheries, and critical coastal ecosystems with sustainability best practices were aggregated. The spread of invasive species represents a key global threat to biodiversity around the world, including protected areas and productive landscapes and seascapes, and therefore an estimate for annual spending to manage this threat has also been calculated. Finally, the impact of the illegal wildlife trade on biodiversity loss is understood to be high and increases the risks of zoonotic disease outbreaks such as COVID-19, and therefore illegal wildlife operations should be prevented; however, the global costs to curtail this market have not been estimated in this report.[vi]

B.1. Agricultural Lands—Cropland:

Approximately half of ice-free land on earth is under agricultural production (i.e., croplands, irrigated crop systems, rangelands, and pasture lands).[41] While intensive and industrial agriculture can lead to significant environmental degradation,[42,43,44] sustainable management of agricultural lands that reduces environmental impact per unit of food production can mitigate deleterious biodiversity impacts. In many cases, land under sustainable agriculture practices can also support high levels of biodiversity.[45] Furthermore, production costs under sustainable agriculture practices may not be significantly higher (or can even be less in the long run) than conventional agriculture and yields can be higher value, leading to long-term win-win outcomes for farmers, consumers, and ecosystems.[46,47]

Sustainable agriculture is defined as farming practices that follow three principles: (1) minimum soil disturbance, (2) crop rotation/ diversification, and (3) continuous soil cover.

[v] The 2020 Waldron et al. paper uses a set of six scenarios to estimate a range of spending required to develop and manage biodiversity protected areas. This report establishes a range for protected area financing needs using two scenarios that dovetail with other estimates of future biodiversity needs such as productive landscapes and seascapes.

[vi] **Illegal Wildlife Trade:** With estimated annual revenues between US$ 7 billion and US$ 23 billion, this is one of the largest illegal global markets alongside drugs and arms. The prevalence of this market can have huge detrimental impacts on national economies, significant public health impacts through the spread of zoonotic diseases, and threats to biodiversity through the collection of wildlife items, as well as through the transmission of invasive species, as part of the associated illegal trade flows. Dobson et al (2020) have estimated that the annual costs of preventing future pandemics from wildlife trade and deforestation are between US$ 22 billion and US$ 31 billion for financing monitoring wildlife trade, reducing animal disease spillovers, early detection and control, and ending wildlife meat trade in China, among other critical actions. Considering the potential co-benefits from reducing deforestation with sustainable agriculture and forestry production described in this report can reduce the net prevention costs of preventing future pandemics range to US$ 18–27 billion annually. However, only an estimated limited US$ 190 million international donors' commitments per year, between 2010 and 2016, has been tracked toward preventing illegal wildlife trade, with most support focused on Africa and Asia toward improving protected area management and law enforcement for preventing illegal wildlife trade. It has not been possible to estimate the total cost to eliminate this highly detrimental illegal trade flow, beyond the potential disease's containment. There needs to be a concerted public and private global effort to combat this as part of wider efforts to protect biodiversity as well as the livelihoods of those impacted by this trade.
Source: Dobson, A.P., Pimm, S.L., Hannah, L., Kaufman, L., Ahumada, J.A., Ando, A.W., Bernstein, A., Busch, J., Daszak, P., Engelmann, J., Kinnaird, M.F., Li, B.V., Loch-Temzelides, T., Lovejoy, T., Nowak, K., Roehrdanz, P.R., Vale, M.M., 2020. Ecology and economics for pandemic prevention. Science 369, 379. https://doi.org/10.1126/science.abc3189; FATF, 2020. Money Laundering and the Illegal Wildlife Trade, FATF, Paris, France. Available at: www.fatf-gafi.org/publications/methodandtrends/documents/money-laundering-illegal-wildlife-trade.html (Accessed: 26 July 2020).

A global transition to sustainable agriculture that balances biodiversity impacts and ecosystem integrity with food production is difficult to cost; however, observations of unfolding sustainable agriculture efforts indicate that economic and social transition costs are a primary barrier to achieving sustainable agriculture.[48,49] To generate a first-order estimate of the financial resources needed to support sustainable agriculture practices as a means to promote biodiversity conservation, this report estimates the global transition cost to sustainable farming practices on 100 % of existing cropland by 2050.

The transition from conventional to sustainable agriculture practices on croplands (e.g., a transition from petrochemical industrial farming to conservation farming practices) has been estimated to take 1–7 years, a period during which the producer's income may be significantly impacted as production under modified practices stabilizes. Considerable financial resources may be needed to support farming practices during this transition. Assuming the transition to biodiversity-positive farming practices takes an average of 3–4 years, over which farming income support is needed of an amount equivalent to the production value of the land, and that a total conversion of existing agriculture lands, dominated by industrial agriculture, occurs linearly over 30 years (i.e., from 2020 to 2050, 1/30th of existing lands under non-sustainable agriculture transition to sustainable practices each year), then the estimate of financial resources to support the global transition to sustainable farming practices equates to **US$ 315–420 billion per year** in transition costs by 2030 to achieve a full transition by 2050 at which time the transition is assumed to be complete.

While this approach to focus transition costs on producer income may not fully capture upfront capital costs to support a transition to sustainable agriculture, this report assumes that existing assets for conventional farming practices could be repurposed for sustainable agriculture practices and also that producer profitability remains viable post-transition. It is also acknowledged that institutional changes, increasing awareness and capacity via extension, and research and development are important for supporting a transition to sustainable agriculture practices, and the costs for these activities are not directly included in the estimate. Furthermore, while there may be an increase in agricultural land between 2020 and 2050 for this estimate, it is assumed that the agricultural land to be converted to sustainable agriculture is held constant to the time horizon of 2050 and that any new agricultural land employs sustainable agricultural practices.

B.2. Agricultural Lands—Rangelands: In addition to croplands, livestock rangelands are globally extensive. Up to 10–20 % of rangelands are estimated to be in a significantly degraded state and 73 % affected by some form of soil and vegetation degradation[50] and in need of transition to sustainable practices to balance biodiversity positive outcomes with livestock rearing. However, unsustainable management of other rangeland areas can also result in negative biodiversity impacts. Many rangelands can provide grassland-like ecosystems that benefit some taxa, and thus the estimate is based on transitioning 100 % of global rangeland to sustainable practices by 2050. As with croplands, a similar estimation approach is utilized assuming income support over a 30-year transition period. Sustainable rangeland management practices, which include both preventative measures to mitigate habitat degradation such as strategic grazing siting and rotation practices, as well as restorative measures, such as terraforming to capture runoff or revegetation efforts,[51] have been estimated to take two years to implement.[52] Combining two years of income support with a target to transition all rangeland to sustainable practices by 2050 results in an annual cost of **US$ 81 billion per year**.

The total annual future need for biodiversity conservation expenditures for global agriculture is

therefore estimated to range between **US$ 396 and 501 billion per year** by 2030 to achieve a full transition by 2050. A more detailed description of the methodology, assumptions, and calculations can be found in Appendix A.

B.3. Forests: Forested areas cover approximately one third of the earth's ice-free surface,[53] harboring high biodiversity and providing global hydrological and carbon sequestration ecosystem services. An estimated 3–10 million ha of forested area is lost per year,[54,55] with commercial agriculture, cattle ranching, and logging for timber products representing key threats to these ecosystems.

Sustainable forestry practices promote biodiversity conservation through plantation and harvesting best practices and balance valuable fiber production for society with biodiversity conservation.[56] Sustainable forestry practices can include "no net loss" wood harvest practices where deforested areas are regenerated at a rate comparable to timber harvest-based deforestation, mitigation efforts to reduce erosion associated with wood harvesting, harvest practices that mimic "natural" forest disturbance regimes, low-impact logging practices, and smart allocation of harvesting and plantation practices away from biodiversity hotspots, among other efforts.[57] Sustainable forestry practices may be higher cost initially than industrial logging of existing old-growth forest or industrial monoculture tree plantation practices per unit of production; however, forest sustainability certifications such as the Forest Stewardship Council are growing in popularity and reward producers with economic incentives for sustainable forestry practices in addition to ensuring the longevity of working forest lands that can produce sustained fiber yields.[58,59,60] While certification may result in a potential increased cost to consumers, in a competitive market this would be minimal, and when looked at globally, the sustainable management of forests has longer term benefits to communities wider than consumers of harvested timber.

Recent syntheses estimate the average cost to sustainably manage timberlands ranges between US$ 13.0 and 21.6 per Ha/ year. After accounting for forests assumed to be protected by achieving global protected area targets (see above), and forests already currently under sustainable management practices (estimated at 11 % of working forests), globally 1.460 billion hectares of forest lands are estimated to be currently managed for productive purposes[61] and therefore require a transition to sustainable forest practices. This results in an estimated annual sustainable management cost of **US$ 19–32 billion per year.**

B.4. Fisheries: Global fishery production provides a key component of the global protein supply.[62] Presently, almost all fishery resources have been developed,[38,63] with fishing extending throughout the world's oceans.[64] While global wild seafood production has stabilized,[65] ecosystem degradation through overfishing and harmful fishing practices are widespread throughout many regions.[66] Sustainable fishing practices that control overfishing and align ecosystem stewardship with economic incentives can lead to healthy long-term harvests while mitigating impacts to marine biodiversity.[67,68,69]

In most cases, the long-term economic benefits of reformed fisheries management outweigh the additional management costs through increased sustainable harvests, fishing cost reductions, and product quality increases,[70] providing both ecological and economic rationale in moving toward sustainable fishing practices in contributing to biodiversity conservation. A recent analysis[71] estimated the global cost of managing marine fisheries using sustainable practices; scaled up, this estimate leads to a cost range of **US$ 23–47 billion per year**, depending on the type of management regimes pursued.

B.5 Critical Coastal Ecosystems: A set of five key coastal ecosystems provide significant biodiversity, as well as erosion control, flood

and storm surge protection, water purification, and carbon sequestration benefits for coastal regions globally: plant-based systems including mangroves, seagrasses, and saltmarshes, and animal-based systems including oyster and coral reefs. Among the plant-based critical coastal ecosystems, mangroves harbor significant biodiversity and provide food, fiber, and coastal protection. Mangroves reduce annual flooding for more than 18 million people globally, and with the loss of these ecosystems, flood damages could increase by an additional 16 %, or an estimated lost value of US$ 82 billion.[72] Saltmarshes provide key water filtration services as well as provide nursery grounds to many juvenile marine species. As with mangroves, salt marshes act to diffuse the impact of storms by reducing wave heights, thereby helping to protect shoreline ecosystems and local human populations against damage. For example, wave heights can be reduced by up to 50 % over the first 10–20m of vegetated salt marsh surface.[73] Finally, sea grasses support high biodiversity, improve water quality by absorbing nutrients, provide a large carbon sequestration role, and buffer coastlines against storms and erosions by stabilizing sediments through extensive root systems. Animal-dominated oyster and coral reef systems also provide vital ecosystem services supporting high biodiversity and coastal resilience. For example, oyster reefs filter pollutants from massive volumes of polluted water, and coral reefs harbor global marine biodiversity hotspots. Both systems also produce hard structures that dissipate storm and wave energy.

Combined, these coastal ecosystems were once globally distributed and ubiquitous; however, present combinations of stressors related to direct harvest or conversion, runoff and pollution, and climate warming have drastically reduced their presence. A combination of efforts is needed to restore these critical coastal ecosystems as an important contribution to global biodiversity conservation. First, it is assumed that the key environmental stressors related to water pollution and sediment runoff are addressed through other biodiversity conservation needs addressed in this report. Specifically, a transition to sustainable agriculture and forestry practices will reduce runoff and nutrient pollution from working landscapes, and investment to adequately address water treatment in urban areas will address key pollution stressors. These coastal systems show varying degrees of ability to adapt to climate-driven ocean changes, such as rising sea levels; however, addressing global GHG emissions will also promote the persistence and recovery of these critical coastal ecosystems, noting costs associated with global climate warming mitigation are outside the scope of this report. Second, beyond reducing stressors as captured in other biodiversity conservation funding needs, active restoration activities can catalyze ecosystem recovery and recoup vital ecosystem services that support biodiversity conservation in coastal zones.

To estimate future needs for biodiversity conservation in coastal zones, the financial costs to restore mangrove, saltmarsh, and seagrass coastal ecosystems globally to historical benchmark levels were assessed. While the importance of oyster and coral reef-based coastal ecosystems are emphasized and new technologies are being developed that make restoration more efficient and cost effective, up until recently restoration for these systems has been of variable effectiveness and high cost such that scaling up active restoration for these animal-based coastal ecosystems is assumed to not be presently viable.[74] Therefore, an estimate of financial needs for direct reef restoration is not calculated. Instead, the importance of addressing wide-scale environmental stressors through other biodiversity conservation needs identified in this report is highlighted, which can go a long way to promoting reef-based ecosystem recovery as well as emphasize a need for continued research and development efforts to improve restoration tools for coral and oyster reef systems.

Scaling up per-unit area information on restoration costs for mangroves, seagrasses, and saltmarshes to achieve a recovery of these ecosystems to historical baseline levels by 2050 provides an estimate of annual costs to be **US$ 27–37 billion per year**.

B.6. Invasive Species Management: Invasive alien species are animals, plants, pathogens, and other organisms that are nonnative to an ecosystem. They negatively impact biodiversity by driving the decline or elimination of native species and local ecosystem, resulting in significant environmental, health, and/or economic harm. According to the CBD, since the 17th century, invasive species have contributed to about 40 % of all animal extinctions. They present a major global biodiversity threat,[75,76,77] with global economic impacts from introduced species estimated to range in the trillions.[78,79] The First High-Level Panel 2012 report to the CBD on resource needs to achieve the Aichi targets related to invasive species management estimated to be US$ 38–49 billion in equivalents for upfront investments and US$ 23.3–55.6 billion in recurrent annual costs to address invasive species globally.[80,81] This value incorporates a mix of investments in research, prevention measures to slow or stop further invasive species introductions, and control and eradication measures to address existing invasive species infestations. Illegal wildlife trade is also increasingly driving biodiversity declines worldwide as a major source of invasive species in regions receiving illicitly traded animals.[82.83.84,85,86,87]

Recent analyses have demonstrated that the rate of invasive species introductions and establishments tracks closely with foreign trade flows, with international shipping representing the primary introduction vector of exotic species.[88,89,90] These reports indicate that invasive species establishments will accelerate into the future, exacerbated by global climate change, which can impact the suitability of invaded habitats in a manner that facilitates the success of invading species. The World Trade Organization reports an average annual increase in the global trade of approximately 2.5 % per year over the last decade.[91] Assuming this trend will hold in the future and that both upfront investments (e.g., additional species monitoring or control infrastructure) and recurrent invasive species management costs will scale in tandem with trade activity, the average annual cost to 2050 is calculated as **US$ 36–84 billion per year** moving forward.

C. Biodiversity Conservation in Urban Environments

Whereas protected areas encompass the strictest restrictions against human impacts on ecosystems, urban areas encompass the opposite extreme of ecosystem modification. Urban areas typically entirely transform ecosystems and therefore have not historically been considered as areas for biodiversity conservation. However, if the aim is to achieve a human society that lives in harmony with nature, it must be acknowledged that more people are moving to urban environments. In 2018, about 54 % of the world's population, some 4.2 billion people, already called a city or a town their home, and this is expected to grow to 68 % by 2050, which is just over 6 billion people. Thus, urban areas will continue to increase in importance as centers of anthropogenic activity and, as such, represent important opportunities to integrate biodiversity conservation in resource systems driven by urban demand as well as urban ecosystems themselves.

Urban areas impact natural ecosystem integrity through a suite of processes. First, urban areas have a spatial footprint in which habitat is entirely converted to anthropogenic uses. This footprint is estimated to grow quickly as both the human population and the concentration of people in urban areas increases.[92] It has been estimated that by 2030 urban areas will likely expand by 1.2 million km^2, an area the size of South Africa,[93] potentially imperiling 13 % of

the world's vertebrates endemics[94] highlighting the potentially large impact on biodiversity associated with unchecked urban spatial expansion. This report assumes that the spatial expansion of urban areas can be mitigated in part by the 30 % protected area goal outlined elsewhere in this report, with strategically placed reserves that represent biodiverse regions in peri-urban environments. However, we also contend that additional spatial protections in watersheds surrounding urban areas present an opportunity to secure clean water for cities and towns—a vital ecosystem service—as well as contribute to the protection and restoration of intact ecosystems in peri-urban areas. The estimated global cost of this protection is low (**US$ 0.01–0.54 billion per year**); however, this is partially due to incomplete data. Notwithstanding the data limitations, this category of future needs represents a potential quick win for biodiversity conservation. It is assumed that this estimate is for conservation efforts additional to the future need category of 30 % protected area by 2030.

Second, cities draw resources (food, fiber, water, energy) from peri-urban areas and therefore contribute to ecosystem impacts associated with these input production systems. It is assumed that the ecosystem impacts associated with the food and fiber resource draw of urban areas will be mitigated by transitioning to sustainable agricultural and forest management practices. The important contribution of urban areas to climate change through significant energy consumption is acknowledged; however, transitioning to sustainable energy and climate change mitigation are outside the scope of this report.

Third, urban centers can be a source of significant waterborne pollution through poorly treated sewage and storm water runoff, threatening both human health and downstream freshwater (e.g., rivers) and marine ecosystems (e.g., oyster and coral reefs).

In addition to costs to promote biodiversity conservation through protected areas, sustainable agriculture, and sustainable forestry practices to mitigate the impacts of urban areas on ecosystem integrity (captured in the above biodiversity conservation funding needs), here costs are estimated to preserve habitat in peri-urban watersheds and to install adequate water treatment and sewage and storm water processing infrastructure to address waterborne pollution from cities.

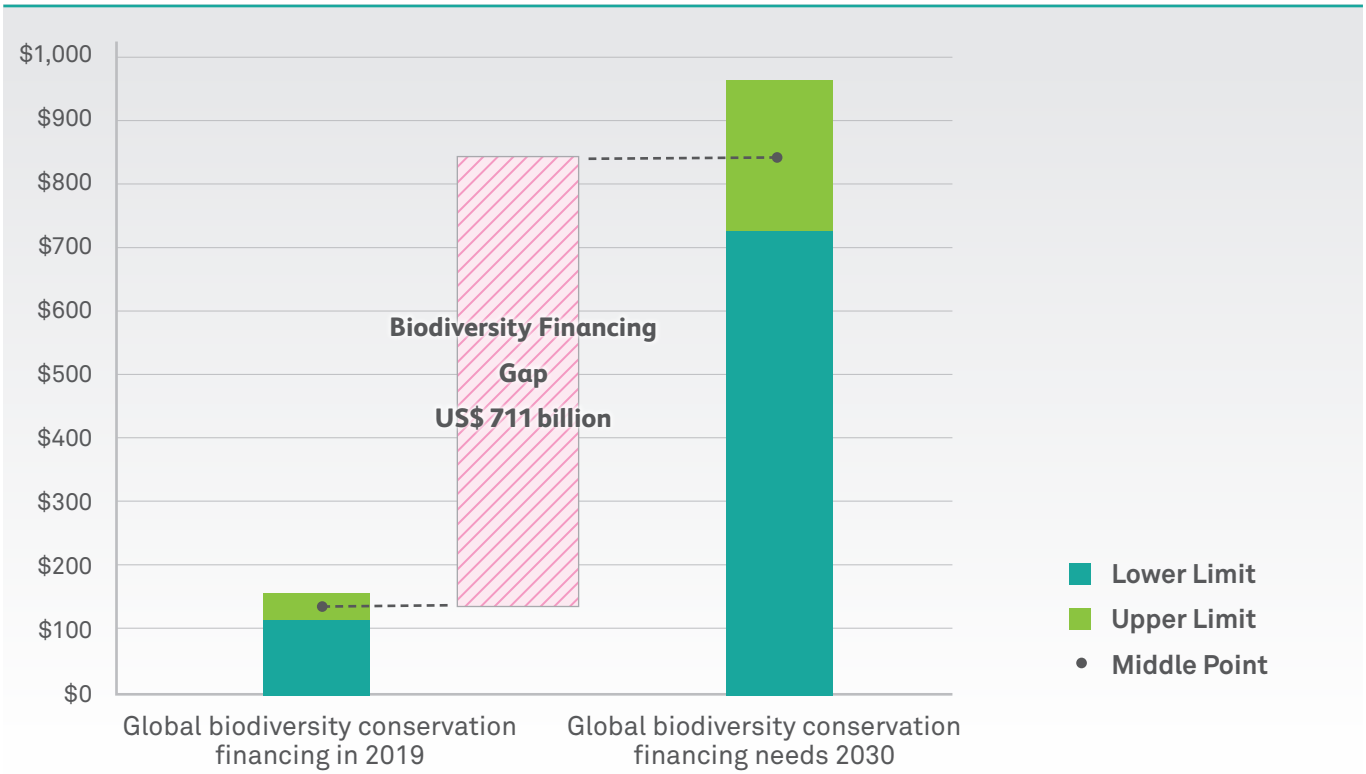
Mitigating the biodiversity impact of polluted water from urban environments requires sanitation and fecal sludge management needs of all urban areas to be met. It is estimated that achieving this pollution management requires **US$ 73 billion per year.**

A Global Biodiversity Conservation Funding Needs Estimate

Aggregating these figures leads to a global biodiversity funding need of **US$ 722–967 billion per year**.

Earth's ecosystems are complex and estimating the global funding needs for biodiversity conservation is challenging. In general, datasets on biodiversity funding needs with which to understand the current status of earth's ecosystems, at a global scale, are lacking. Accordingly, based on the best available estimates of components of biodiversity conservation funding needs, this estimate should be viewed as a first-order approximation of annualized global biodiversity conservation finance needs. However, our estimate may also miss other significant costs to support biodiversity conservation, such as research and development costs to design appropriate biodiversity conservation measures in the transition to the sustainable management of ecosystems, consumer and producer education costs, or costs to address numerous other specific anthropogenic stressors on biodiversity not directly included in our assessment approach. These difficulties underscore that an important information need moving forward is improved global- and country-

FIGURE 4.2 Global biodiversity conservation finance compared to global biodiversity conservation needs. *(US$ billions per year)*



Note: Using midpoints of the current estimates and future needs, current global biodiversity conservation finance (left graph) may need to increase by a factor of 5–7X to meet the estimated global need for biodiversity conservation (right graph).

level accounting of financial resources deployed for biodiversity conservation. Robust data in this area will provide the baseline information necessary to evaluate biodiversity outcomes from existing expenditures and to subsequently design effective biodiversity conservation strategies.

The clear message from this exercise is that existing finance flows devoted to biodiversity conservation are far below those needed to ensure the long-term health of earth's ecosystems, resulting in a global biodiversity financing gap of US$ 711 billion per year in 2019 (with a potential range of US$ 598–824 billion per year) (Figure 4.2). The numbers estimated for global biodiversity conservation needs may appear large; larger than current financing committed to global climate-related investments (US$ 579 billion in 2017/2018 according to Buchner et al. [2019][95]), however it represents a small fraction of global private invested capital. According to the Securities Industry and Financial Markets Association, the global equity market was capitalized (valued) at approximately US$ 75.0 trillion and the global outstanding bond market at an astounding US$ 115 trillion in mid-2019.[96] Compared to 2019 global GDP (US$ 99.58 trillion) the estimated global biodiversity funding need is between 0.73 % and 0.97 % of global GDP in 2019. Furthermore, as outlined in Chapter 2, financing global biodiversity conservation is a sound economic investment for which long-term benefits significantly outweigh costs. This clearly demonstrates that even with the substantial increase in financial resources required to meet the global biodiversity conservation needs, at a global scale, the availability of these resources are not a constraint and that the underlying drivers of under-investment lie elsewhere.

CHAPTER 5

Financial and Policy Mechanisms to Close the Biodiversity Financing Gap

The existing US$ 598–824 billion annual biodiversity financing gap can seem insurmountable if looked at purely from the aspect of growing the capital flows toward positive biodiversity outcomes. Therefore, this report also examines the potential of mechanisms and policies to reduce the size of the gap in the first place, thereby taking a two-pronged approach to closing the gap.

1. Mechanisms that decrease the overall need for capital to be spent on conservation. Decreasing the flow of capital into activities that have negative impacts on biodiversity reduces the need for funding to conserve or restore biodiversity that has been damaged. Implementation of certain policies and practices, both in the public and the private sectors, could reduce or eliminate activities that harm biodiversity. In the case of subsidies that harm biodiversity, these activities come at substantial economic cost to the governments implementing them, which should greatly strengthen governments' interest in addressing them. Two of the nine mechanisms in this report would, if implemented at scale, reduce the need to spend funds in a manner consistent with biodiversity protection.
2. Mechanisms that increase capital flows into conservation. While growing amounts of private, return-seeking capital are being directed toward activities that have positive impacts on biodiversity, particularly in the form of green financial products, governmental appropriations for conservation activities are increasing much more slowly and, in certain cases, decreasing. The amount of funding that has positive impacts on biodiversity could be greatly accelerated and scaled by the enactment and implementation by national and subnational governments of certain fiscal policies and incentives. Seven of the nine mechanisms discussed in this report have the potential to increase funding flows toward conservation.

In developing the estimates within each of these categories, and given different data sources, it has often not been possible to estimate the amount of double counting present, although we acknowledge its existence. Double counting risks are present between the following categories and are elaborated on in Appendix B: Domestic Budgets and Tax Policy and ODA, Domestic Budgets and Tax Policy and Green Financial Products, Green Financial Products and Sustainable Supply Chains, and Domestic Budgets and Tax Policy and Natural Infrastructure.

A key finding of this report is that even at the upper end of the estimates for increased capital flows toward biodiversity conservation of US$ 446–632 billion annually by 2030, the global biodiversity conservation gap will not be closed unless there are significant efforts to reform harmful subsidies to biodiversity and scale up private investments toward biodiversity conservation. Government subsidies that are harmful to biodiversity outweigh the total current positive biodiversity finance flows for biodiversity by at least a factor of four. Progress toward Aichi Target 3 on reforming subsidies harmful to biodiversity by 2020 has been slow, and closing the biodiversity financing gap necessitates that efforts on this front be scaled up through appropriate post-2020 targets.

TABLE 5.1 Estimated Positive and Negative Flows to Biodiversity Conservation. *(in 2019 US$)*

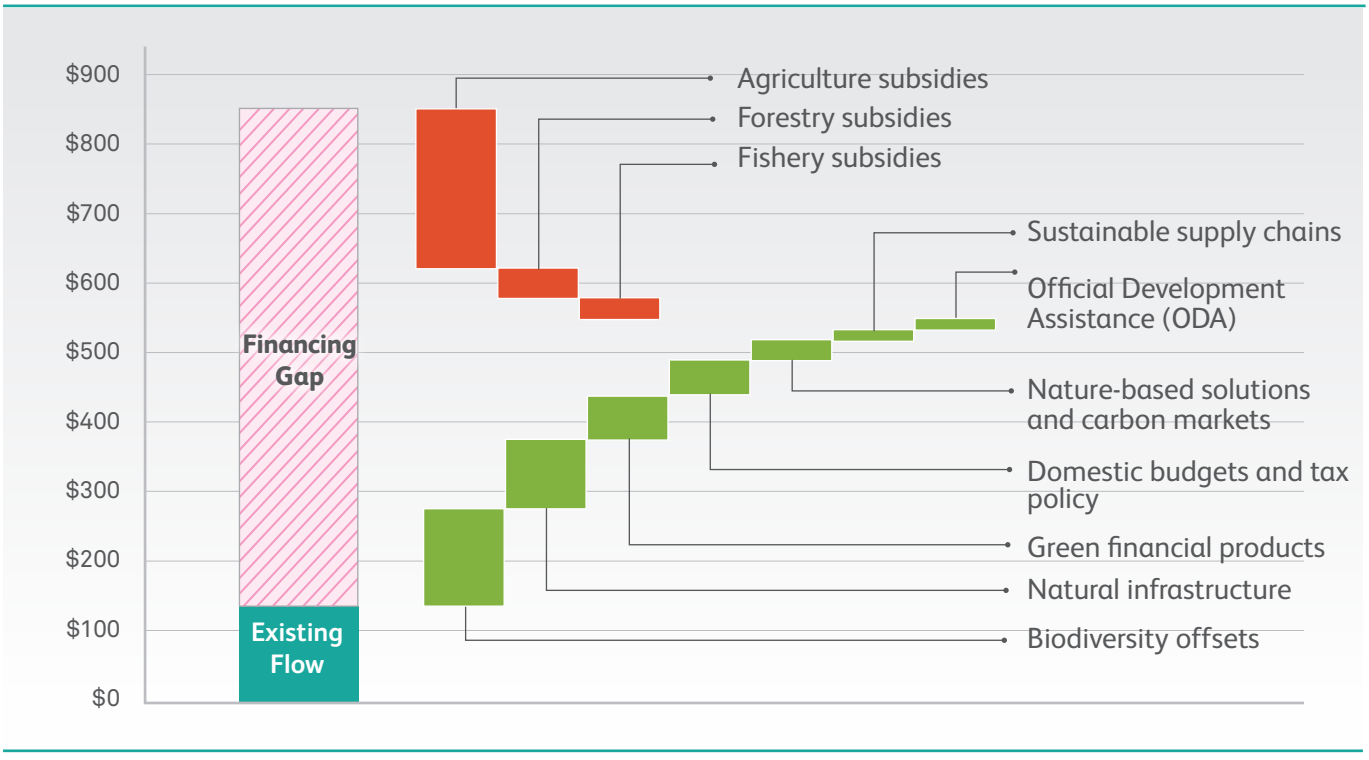
Financial and Policy Mechanisms	2019 *US$ billion / year*	2030 *US$ billion / year*
A. Mechanisms that decrease the overall need for funding to be spent on biodiversity conservation		
Harmful subsidy reform (agriculture, fisheries, and forestry sectors)	(542.0) – (273.9)	(268.1) – 0*
Investment risk management	N/A	
B. Mechanisms that increase capital flows into biodiversity conservation		
Biodiversity offsets	6.3 – 9.2	162.0 – 168.0
Domestic budgets and tax policy	74.6 – 77.7	102.9 – 155.4
Natural infrastructure	26.9	104.7 – 138.6
Green financial products	3.8 – 6.3	30.9 – 92.5
Nature-based solutions and carbon markets	0.8 – 1.4	24.9 – 39.9
Official development assistance (ODA)	4.0 – 9.7	8.0 – 19.4
Sustainable supply chains	5.5 – 8.2	12.3 – 18.7
Philanthropy and conservation NGOs	1.7 – 3.5	Not Estimated**
Total Positive Financial Flows	**123.6 – 142.9**	**445.7 – 632.5**

Note: All figures in this table are reported in 2019 US$.

* Assumes a global subsidies reform scenario that phases out by 2030 the most harmful subsidies as described by OECD (2020).

** While future flows for philanthropy and conservation NGOs are seen as highly catalytic for mobilizing private sector financial flows, it was determined that they did not pass the threshold for inclusion in this report as a main mechanism for scaling up to close the biodiversity financing gap.

FIGURE 5.1. Estimate of growth in financing resulting from scaling up proposed mechanisms by 2030. *(in 2019 US$ billion per year)*



To close the biodiversity financing gap by 2030, governments would need to reduce their annual harmful subsidies to agricultural, fisheries, and forestry sectors by US$ 273.9 billion, representing the subsidies currently classed as the most harmful to biodiversity, and the private sector will need to enhance its risk management practices to better support biodiversity conservation and minimize investments that drive environmental degradation. Acknowledging the challenge inherent to these global commitments, this report contains dedicated sections on Harmful Subsidy Reform and Investment Risk Management.

The biodiversity mechanisms described in this report can have multiple co-benefits beyond biodiversity, and using multiple mechanisms simultaneously may further accelerate the scaling up of positive impacts. For example, a national government can reform a specific harmful agricultural subsidy and use the freed-up funds to finance the sustainable agricultural transition for particular practices by issuing green bonds backed by increased buyer demand for sustainably produced goods in supply chains. In this way, biodiversity finance mechanisms can build on each other, creating a synergistic cycle of improvement.

The estimates of the future potential of mechanisms in this report are detailed in Appendix A. Recognizing the uncertainty in making future projections of financial flows, this report presents uncertainty ranges for all future mechanism financial projections that correspond to low ambition and high ambition growth scenarios.

Each mechanism has the following sections: Background, Description, Why Is It Important for Biodiversity?, Current and Future State of Financing, Obstacles and Enabling Conditions, and Recommendations. A brief description of each mechanism is presented in Table 5.2.

TABLE 5.2 Description of Mechanisms

Mechanism	Description
Harmful Subsidy Reform 	Subsidies are fiscal policy tools used by governments that aim to benefit a specific population orsector through production support, income support, or reduced costs of inputs. Subsidies deemed harmful to biodiversity are those that induce production or consumption activities that exacerbate biodiversity loss, particularly important within the agriculture, fisheries, and forestry sectors. Some of these damaging activities include deforestation, overexploitation of fish stocks, and pollution from excessive fertilizer use. Agricultural subsidies that focus solely on increasing crop output have led to actions that are degrading natural resources and biodiversity. This report does not take a position on whether subsidies are inherently positive or negative for the economy or for the functioning of markets. Instead, this report focuses on proposing pathways that allow governments to modify existing subsidies and deliver them in a manner that has a net positive effect on biodiversity rather than damaging biodiversity, while at the same time meeting the government's other social and economic objectives.
Investment risk management 	Investment risk management described in this report involves actions taken by financial institutions to understand and manage the risks to biodiversity from their investments. The report reviews a range of both mandatory and voluntary investment risk management practices, many of which are becoming more established in mainstream investing. These include a number of screening tools and standards that investors are adopting that enable them to review risks and make informed decisions to avoid investments that may have negative impacts on biodiversity, or to invest in areas that have positive biodiversity impacts. Given the enormous scale of global capital markets and the trillions of dollars invested in infrastructure, energy, transportation, extractives, and other damaging projects, the mainstreaming of these biodiversity-related risk management practices in conventional financial markets presents an enormous opportunity to prevent negative impacts to biodiversity.

Mechanism	Description
Biodiversity offsets 	Biodiversity offsets are the last option in the mitigation hierarchy (avoid, minimize, restore, and offset), a biodiversity protection policy mandated by governments to compensate for unavoidable damage to biodiversity by a development project when the cause of damage proves difficult or impossible to eliminate. Offsets should be implemented once development projects have done their utmost to avoid and minimize adverse environmental impacts. Given the rapid expansion of urban centers and the associated development of infrastructure, biodiversity offsets are a way for biodiversity to receive increased financing and protection. Under an offset policy, any biodiversity lost to development must be compensated for such that there is a net gain or, at least, no net loss of biodiversity. Currently, 42 countries have biodiversity offset policies in place, but with evidence of enforcement from fewer than 20 % of these countries. Estimates for scaling up biodiversity offsets in this report are based on full implementation of existing policies by these 42 countries plus expanded application of offset policies in countries.
Domestic budgets and tax policy 	Governments have the power to influence and direct their economies through the use of government taxation, budgeting, and spending. Governmental budgets are currently the main source of financing for biodiversity conservation, representing 55–61 % of total funding recorded and presented in this report. However, while prioritizing government budget expenditure for biodiversity, raising revenue from taxation may be insufficient to close the biodiversity financing gap. This report describes several categories of special taxes, fees, levies, and other innovative fiscal measures that both national and subnational governments can impose to either increase revenue to fund biodiversity protection or to incentivize or disincentivize activities that either benefit or degrade biodiversity. To ensure that these additional revenues are devoted directly to biodiversity conservation (and not just diverted to the general budget), the report further recommends that governments restrict or “earmark” these funds to the biodiversity conservation uses for which they were created.
Natural infrastructure 	The protection of natural infrastructure serves a dual purpose. First, it maintains healthy ecosystems for the long term and, second, it delivers ecosystem services to human populations, supporting livelihoods and communities. In this report, natural infrastructure investments are described through the lens of watershed and coastal protection programs. In recent years, urbanization and the resulting increase in demand for resource from cities have elevated the importance of water supply and watershed protection, while the growing risk from extreme weather events and sea-level rise has highlighted the importance of coastal protection. Natural infrastructure funding is almost entirely provided by public entities through grants and contracts for watershed protection, but there are emerging areas that include both public and private sector investment, including user-driven watershed investments, water quality offset trading, and others. Additionally, there is growing evidence that the relative costs of protecting and managing natural water supplies and flood control can be cheaper than traditional engineering approaches.
Green financial products 	Green financial products are a collection of financial instruments, primarily debt and equity, that facilitate the flow of investment capital into companies and projects that have a positive impact on biodiversity. The interest of individuals and institutions to invest sustainably, either out of a belief that companies and industries that do not damage the planet represent better long-term value or simply to align their investment portfolios with their personal values, has dramatically increased in recent years. This report discusses a range of green financial products that can channel financing toward green investments that produce environmental benefits. The report discusses the role of green bonds, green loans, and private equity funds in supporting biodiversity. The report also notes emerging and innovative new developments in green finance such as impact bonds, insurance products, and the growing roles that governments are playing through green banks, finance facilities, and specific efforts to incentivize increased private investment.

Nature-based solutions and carbon markets

As countries move toward development of new programs to support delivery of their national climate goals (specifically through their Nationally Determined Contributions, or NDCs), there is a growing emphasis on the protection and restoration of forests and other biodiversity-rich ecosystems in what are called Natural Climate Solutions (NCS). The report describes several pathways countries might take to develop one or more NCS strategies as part of meeting their NDC goals, and it provides estimates of the amount of funding these efforts could generate that will have direct biodiversity benefits. Additionally, a number of countries are developing national (or, in some countries, subnational or jurisdictional) policies that use the pricing of carbon as part of their overall climate strategies. These policies typically take the form of direct carbon taxes or the creation of a regulated cap-and-trade program in which greenhouse gas emitters are capped and regulated through programs that allow the creation and trading of carbon credits. The active trading of these credits (which are issued in metric tons of carbon dioxide equivalent [tCO_2e]) enables creation of a robust carbon market. When countries allow the creation of carbon offsets from forest practices or other natural and land-based projects, the sale of these credits can create an important source of funding for forest and biodiversity protection.

Official Development Assistance (ODA)

Official development assistance (ODA) is broadly defined as aid, either disbursed by countries directly or through multilateral institutions, designed to support and promote the economic development and welfare of developing countries. It includes concessional finance, grants, and the provision of technical assistance. In the context of the Convention on Biological Diversity (CBD), the 2010 Aichi Targets called for a "substantial increase" in resources available from all sources to support the implementation of the convention. In 2012, the Parties adopted a decision calling on donor countries to double foreign aid flows for biodiversity by 2015 relative to 2010 levels, and at least maintain them at that level through 2020. That target has essentially been met by donor countries. The report describes current ODA spending and suggests that ODA funding to biodiversity-rich countries double again between 2020 and 2030, with the new funding primarily targeted to supporting country efforts to develop other strategies and programs (such as are described in this report) to increase financing and protection of biodiversity.

Sustainable supply chains

Supply chain sustainability relates to the management of environmental, social, and governance aspects of the movement of goods and services along supply chains, from producers to end consumers. The historical impact of global supply chains on biodiversity has been largely negative, driven by land use change and unsustainable agricultural, forest, fisheries, and other practices associated with commodities. However, a shift toward more responsible supply chain management practices offers an opportunity to avoid harm and support biodiversity. This report explores a range of actions to reduce negative supply chain impacts on biodiversity, including better land use planning, more sustainable production, improved corporate policies, the use of third-party sustainability standards, and providing corporate funding to support sustainability practices. The report also examines actions to achieve positive impact, such as sustainable jurisdiction/landscape-level sourcing initiatives. Although the report puts forth some estimates on current and projected future funding for sustainability, much of the spending on sustainable supply chains is by companies and is not publicly available information. As such, the amount spent by companies on increasing sustainability of supply chains might be higher than projected here.

5.1 Harmful Subsidies Reform

A. Background

The decision whether or not to use agricultural, forestry, and fishery subsidies to achieve policy objectives is a political choice, and this report does not presume to take a position on whether subsidies are intrinsically positive or negative. Instead, it recognizes that many governments make choices about subsidy allocation and design based not only on economic grounds but also based on social, cultural, historical, and geopolitical considerations. This report does, however, take the position that, if a government decides to use subsidies, it should implement them in a manner that supports long-term biodiversity conservation rather than, as has so often happened, lead to the depletion of biodiversity and the degradation of ecosystem services.

In this report, subsidies are defined as unrequited payments provided by governments to benefit producers in certain sectors or industries "on the basis of the levels of their production activities or the quantities or values of the goods or services which they produce, sell or import," in line with the definition used by the Organisation for Economic Co-operation and Development (OECD).[97] Subsidies can be useful economic instruments to achieve policy objectives such as supporting strategic economic sectors or particular populations and preserving culturally significant activities. Certain subsidies, such as government support to domestic fisheries through disaster insurance or technical training, have relatively low effects on output volume while achieving a high transfer efficiency of the benefits. Other subsidies intend to reduce delivery costs for commodities such as electricity or transportation services at a national level. However, certain subsidies are deployed in a manner that may be socially inequitable, trade-distorting, economically inefficient, and environmentally harmful.[98] Given that subsidy objectives and impacts are multidimensional, their introduction should be purposeful in intent and thoughtfully implemented, with full consideration given to their positive and negative impacts.

National governments have used subsidies to influence the activities of domestic producers in a variety of economic sectors including agriculture, fisheries, and forestry, within and beyond their national borders. Some of the subsidies that incentivize surplus production, either through tying subsidies to production volumes or facilitating access to production inputs, have underpinned the growth of agricultural commodities production.[99] When divorced from environmental considerations, however, subsidies that enable production increases can lead to the degradation of natural habitats, and with them, the loss of ecosystem services and resources.[100]

In general, a subsidy harmful to biodiversity (referred to hereinafter as a "harmful subsidy") is one that induces production or consumption behavior that exacerbates biodiversity loss through land and ocean degradation, unsustainable exploitation of renewable natural resources, overuse of inputs, or ineffective waste management, to name a few.[101] Other examples include unsustainable water use for crops, deforestation for forestry products and for agricultural expansion, pollution from fertilizer use, and exhausted fish stocks. The expansion of the agricultural frontier alone accounts for the majority of land-use change globally and is the single largest contributor to the degradation of nature.[102]

The agriculture, fisheries, and forestry sectors are among the leading recipients of harmful subsidies. The 53 countries monitored by the OECD for agricultural support spent a total

of US$ 705 billion per year to support their respective agricultural sectors in 2016–2018.[103] In 2017, OECD countries alone provided US$ 116 billion worth of support classified by the OECD as potentially most environmentally harmful, which primarily consists of market price support.[104] Estimates of total support, according to the OECD criteria on support monitoring, include direct transfers to agricultural producers, support that targets the agriculture sector as a whole (e.g., by subsidizing the cost of fertilizer), and incentives to bolster consumption of agricultural products. Similarly, fisheries support consists of direct transfers to sector workers (e.g., fishers, vessel owners, intermediaries) and support from policy measures that indirectly affect production and consumption of fisheries' outputs.[105] There is limited recent data on support to the forestry sector, although an earlier study estimated the sector received US$ 35 billion per year from 1994 to 1998.[106] Forestry subsidies generally cover quotas or taxes on timber exports, actions of value to the sector (e.g., access road construction in remote areas), and resource rent.[107]

Fossil fuel subsidies can also be viewed as potentially harmful to biodiversity by incentivizing practices that drive climate change and overexploitation of natural resources.[108] In 2019, 77 nations surveyed by the OECD and the International Energy Agency (IEA) spent a total of US$ 478 billion on environmentally harmful subsidies to the fossil fuel sector.[109] This figure includes tax relief (e.g., refundable income-tax credits) and royalty relief, which are considerably higher for fossil fuel subsidies when compared to agriculture, fisheries, and forestry subsidies. While fossil fuel subsidies are among the largest category of government fiscal support that is potentially harmful to biodiversity, due to the indirect nature of their impacts on biodiversity, a discussion of fossil fuel subsidies reform is outside the scope of this report (see Chapter 3).

The need to reform subsidies harmful to biodiversity has been widely acknowledged. United Nations (UN) Sustainable Development Goals 14 and 15 require nations to protect and restore terrestrial and marine ecosystems and halt biodiversity loss.[110] Subsidies harmful to biodiversity were explicitly addressed in the UN Convention on Biological Diversity's Aichi Biodiversity Target 3,[111] which set a date of 2020 to eliminate, phase out, or reform all subsidies and incentives harmful to biodiversity. Since the Aichi Biodiversity Targets were agreed on, several countries have taken steps to incentivize biodiversity-supportive agricultural practices and REDD+ schemes. However, these have failed to reach the necessary scale to deliver substantial progress,[112] and little progress globally has been made toward meeting Aichi Biodiversity Target 3.

Harmful subsidies can persist because they provide socioeconomic benefits to particular citizens (or the citizenry as a whole) and/or because of political pressure from interest groups. Some of these benefits include support for poor households to afford basic necessities, income protection in the face of market fluctuations or price shocks, diversity in resource supply, and sustaining domestic production of a necessary good.[113] Once a subsidy is established, interest groups often work to prevent their removal or even increase their scope, especially when those subsidies benefit narrow groups at the expense of the greater public.[114] Well-intended goals of achieving poverty reduction or boosting international market competitiveness may also disadvantage a large portion of the population that is less concentrated or aware of the environmental harm subsidies cause.[115] Voters may also have difficulty understanding the motivations, intended results, distributional aspects, or effectiveness of subsidies reform and hold a default position that supports the status quo.[116,117]

Decision makers can bolster their arguments for policy shifts by emphasizing that some subsidy reforms can also offer social and economic benefits.[118] Food production systems that favor crop diversity and plant-based nutrition tend to be more biodiversity-supportive than systems

that prioritize animal protein, dairy, and starchy vegetables.[119] Reforming these systems not only helps farmers adapt to climate variability and promote on-farm biodiversity but also encourages healthier diets and improved food security.[120] Furthermore, systems that prioritize food health over food output and combine traditional techniques such as crop rotation with advanced precision-farming technologies will allow a more judicious use of inputs such as water, synthetic and natural fertilizers, and pesticides.[121]

Subsidy reform could also alleviate distributional challenges that exist within current subsidies. A subsidy's influence across different socioeconomic classes—consumers versus producers, high-income versus low-income, male versus female, minority versus nonminority—is a function of how a subsidy is structured and how the subsidized good is used. In Vietnam, a nation highly dependent on its fishing sector, the government implemented subsidies to develop offshore fishing, but the subsidies disproportionately benefitted industrial over artisanal fisheries, as the latter lacked the capacity and capital required to operate offshore.[122] In addition, most benefits targeted extractive activities, which are male-dominated, with little economic support given to processing activities, which are dominated by females and youth. As such, even subsidies intended to support socioeconomic development can have unintended distortionary results that exacerbate the condition of disadvantaged groups.[123] Steps to ensure a just reform of subsidies that benefits all groups will vary according to each country's needs, demographics, economic system, and institutional framework.[124]

While subsidies are, for the most part, deployed within the country granting the subsidies and can only be reformed through the actions of domestic governments, reforming harmful subsidies still requires an international effort. International organizations facilitate changing the status quo on subsidies reform and encourage governments to cooperate on ways to implement change.[125] In addition, coordinated public declarations and collaborative peer reviews enhance a government's credibility on subsidies reform and set the stage for diplomatic relations. The European Union (EU) recently announced its EU Biodiversity Strategy for 2030 that explicitly calls on members to "phase out subsidies harmful to biodiversity" and ban subsidies that exacerbate illegal, unreported, and unregulated fishing.[126] In light of the COVID-19 crisis, the IMF has urged governments to incorporate environmental concerns into their fiscal recovery packages to ensure a sustainable recovery.[127] Other international organizations such as the World Trade Organization (WTO) are able to serve as watchdogs and develop international rules and disciplines on harmful subsidies. In its 2017 Ministerial Conference, the WTO required members to enhance transparency on fishing subsidies. The WTO is also currently developing an international agreement on prohibiting fisheries subsidies that promote illegal, unreported, and unregulated (IUU) fishing.[128] International organizations can also reduce the costs of reform by gathering critical data on the economic, social, and environmental effects of particular subsidies or offering technical support.[129] Organizations such as the UN Development Program Biodiversity Finance Initiative (UNDP BIOFIN), the Global Environment Facility, and the US Agency for International Development (USAID) are examples of organizations operating globally that have provided critical technical support for developing countries seeking to improve their biodiversity commitments.

B. Description of Mechanism

For the purposes of this report, subsidies, including those that might be harmful to biodiversity, are defined according to how they are identified and measured by the OECD's total support estimates. For agriculture, subsidy estimates include direct budgetary transfers to individual farmers, transfers from policy

measures that benefit the agriculture sector as a whole, and support to consumers of agriculture products.[130] For fisheries, total support includes transfers to individual fisheries or fishers and transfers from policy measures that benefit the fishery sector as a whole.[131] Forestry subsidies cover policies and actions of value to the sector (e.g., access road construction in remote areas), government interventions on timber exports, and resource rent.[132] Resource rent refers to the practice of selling extracted resources at prices below the cost of what it took to extract that resource.

As described in the EU Common Agricultural Policy (CAP) case study, many nations acknowledge the negative economic and environmental effects of subsidies and are documenting their progress on phasing them out. The Pacific Islands used its Restoration of Ecosystem Services and Adaptation to Climate Change program to identify harmful financial incentives across nine economic sectors and examine reform options of the most harmful taxes and subsidies.[133] From 1984 to 1986, partly driven by a fiscal crisis, New Zealand phased out all agricultural and fisheries subsidies including price support, concessionary lending, development loans, and tax concessions.[134] The government helped with the transition through payouts for those leaving their respective sectors, shifting to rights-based management in fisheries, social welfare programs, and loan restructuring. Now, New Zealand's meat sector is the second-most efficient in the world, employment has risen overall in agriculture, and some fish stocks have recovered.

Most harmful subsidies are delivered by one of three methods: (1) support based on production levels or prices, (2) income support, or (3) indirect support. An example of a subsidy that offers support based on production levels is the sugar program in the United States, where the US Department of Agriculture (USDA) authorizes loans based on the number of pounds of raw and refined sugar produced.[135] Similarly, one form of income support given by the USDA is its Agriculture Risk Coverage-County program where the US government offers payments to a farmer if the farmer's revenue for the year is below a benchmark set by the government.[136] Indirect subsidies involve subsidizing inputs (such as fertilizer), subsidizing consumption (such as subsidies to encourage the consumption of biofuels and ethanol), or providing support for essential infrastructure.[137]

As governments reform their agriculture, fisheries, and forestry support to benefit biodiversity, it is crucial for decision makers to analyze the "sparing or sharing debate" consisting of three response pathways to managing resource production and biodiversity conservation: (1) land sharing through overall biodiversity-supportive production, (2) land sparing through production intensification, and (3) a combination of the two through sustainable intensification. Land sharing, or biodiversity-supportive production, would require all agriculture, fisheries, and forestry landscapes and seascapes to become as biodiversity-supportive as possible. However, adopting this framework can sometimes involve a cost in terms of reduced crop yields, which, in turn, might cause further environmental harm if it requires farmers to extend their area of land under production.[138]

In contrast, land sparing would require intensifying production to maximize yields for agriculture, fisheries, and forestry products. Any land not used would be dedicated to protection and biodiversity restoration. Most empirical models support the argument that land sparing produces the greatest biodiversity and environmental gains;[139] in a model of land-sparing in Africa, even in the case of 100 % biodiversity loss from areas under full production intensification, land-sparing provided the best results for biodiversity compared to a case of no intensification with no additional detrimental effects to existing biodiversity (although it is important to note that results may vary by geography).[140]

Sustainable intensification is a mix of land sharing and sparing where areas for agriculture, fisheries, and forestry products are reallocated to areas that are robust enough to support these intensified practices, and other more marginal areas are left for restoration. Production is concentrated and intensified in certain areas, but biodiversity-positive practices are still utilized. The United Nations Convention to Combat Desertification's Global Land Outlook champions this method and recommends multifunctional land-use planning where areas are specialized to yield certain services and which are also, in the long term, balanced with the landscape's biophysical parameters.[141]

There is also an argument for decoupling subsidies where support is given according to production levels. This argument asserts that the bulk of adverse environmental effects from harmful subsidies are due to production maximization where producers use input intense methods and widen their production area.[142] Reducing the pressure on output quantity can free producers to consider more environmentally friendly and efficient techniques.[143] Decoupling of direct farmer support from production and input use has been practiced in the EU since 1992 (see Case Study: Positive EU CAP Subsidies). After a series of reforms from 1990 to 2015, the EU reported a 20 % decline in nitrogen fertilizer use and 17 % decrease in agricultural nitrous oxide emissions.[144]

CASE STUDY:

Forest Biodiversity Program for Southern Finland[145]

Finland has about two thirds of land cover occupied by forests and contains 16 % of the EU's total forests. In southern Finland, forestry subsidies can only be granted to ensure sustainable timber production, to maintain the biological diversity of forests, and for forest ecosystem management activities. Sustainable management of forests is a prerequisite for forest subsidies.

Finland implemented policy reforms for biodiversity conservation through natural values trading, competitive tendering, and forest biodiversity cooperation networks in southern Finland to protect biodiversity. Natural values trading is accomplished by landowners agreeing to maintain or improve specified biodiversity values of the forest in return for regular payments from the state as buyer of these natural values. In competitive tendering, environmental authorities invite landowners to submit tenders on areas to be protected based on biological criteria and the price at which they are willing to offer. Forest protection overall is dependent on cooperation between networks that include local authorities, nongovernmental organizations, and other stakeholders at the local level.

Experiences with the program are encouraging as forest owners and other stakeholders have been active in the pilot projects. The program should increase the social acceptability of forest biodiversity protection and decrease environmental conflicts in forestry. While there may be a time lag in the positive effects on forest biodiversity, the program benefits from better landowner attitudes in regard to biodiversity protection.

CASE STUDY:

Kyrgyzstan Biodiversity Finance Plan and Reforming Harmful Subsidies[146]

Located in a highly biodiverse region of Central Asia, the nation of Kyrgyzstan announced its Biodiversity Finance Plan in 2019 to protect 10 % of land area within Kyrgyzstan, aid in the protection of 65 % of all endangered species, restore 10 % of degraded ecosystems, and plant 2,000 hectares of forest area per year. Part of this initiative was also phasing out harmful subsidies in which UNDP BIOFIN prepared an Environmental Finance Political and Institutional Review (PIR) to mainstream biodiversity protection within Kyrgyzstan's national strategy, economic and fiscal policies, and institutional frameworks. Key to the PIR was also BIOFIN's identification of six agricultural subsidies that were potentially harmful to biodiversity, including a tax exemption for fertilizers and pesticides. Examples of sustainable subsidies that could replace harmful subsidies are those that encourage a shift to organic agriculture and government support that implements drip irrigation.

C. Why Is It Important for Biodiversity?

Agriculture is one of the largest drivers of land-use change, land degradation, and water pollution, which are, in turn, the main causes of biodiversity loss.[147] By itself, agriculture expansion has led to a state where approximately one third of global land surface area is dedicated to crops and livestock,[148] 52 % of which is moderately to severely degraded.[149] As much as 70 % of global water withdrawals are used for agriculture, with the majority of water pollution attributed to agricultural byproducts of fertilizer residues, agrochemical runoff, nitrate contamination, salinization of groundwater, and more.[150] In addition, agricultural production accounts for upwards of 25 % of GHG emissions[151] and nearly 80 % of global deforestation.[152] As a result, 70 % of terrestrial biodiversity loss and 50 % of freshwater biodiversity loss will be attributed to unsustainable agricultural practices by 2050 in a business-as-usual scenario.[153]

The most damaging agriculture commodities are beef, palm oil, and soy; when paired with pulp and paper, production for these four commodities led to 40 % of tropical deforestation between 2000 and 2011.[154] Unfortunately, harmful subsidies are further decreasing the extent and species composition of natural areas around the world, particularly those not set aside as designated protected areas, threatening the survival of vulnerable species and diminishing the provision of ecosystem services.[155] Subsidies also encourage highly intensive practices such as continuous cropping and tillage and excessive nutrient and pesticide applications.[156]

Transforming agricultural, fisheries, and forestry practices can not only dramatically reduce the biodiversity financing gap but can also deliver economic co-benefits. According to a Food and Land Use Coalition model, by 2030 a total of US$ 4.5 trillion in new commercial opportunities could be realized through key food system transformations, including regenerative agriculture, healthy oceans, and nature protection.[157] Similarly, mechanisms that allow fish stocks to recover from overexploitation would have increased global fisheries revenues from US$ 3 billion to US$ 86 billion in 2012.[158]

Paradoxically, the sector is dependent on ecosystem services associated with healthy biodiversity. For example, 71 out of the top 100 commonly used crops rely on animal pollination and, as discussed in Chapter 2, these pollinators are threatened by human activity.[159] Other

critical ecosystem services for agriculture include natural mineralization, soil health, climate regulation, and pest control.[160] Phasing out harmful subsidies to agriculture would not only protect biodiversity but also maintain services critical to agricultural production and livelihoods dependent on agriculture, which employs nearly 1.25 billion people around the world,[161] with an average of 65 % of the workforce in low-income countries.[162]

A further issue with harmful agricultural practices is food waste management. Most food waste originates from developed nations; food waste produced by the United States and EU could satisfy over 3 times the global food demand.[163] Globally, about one third of food produced for human consumption is wasted, which in 2013 amounted to 1.3 gigatons of food waste that was still edible.[164] Food waste is a derivative result of agricultural subsidies that contribute to overproduction and undervalued food. The continuation of harmful subsidies can perpetuate food waste and the unnecessary land-use change and resource use for overproduction. For example, 250km^3 of water per year is extracted to grow food that is wasted, a volume three times that of Lake Geneva.

Currently, two thirds of the world's fish stocks are fished at maximum levels or overfished.[165] Government subsidies to marine fisheries are contributing to overfishing by reducing the fixed and variable costs of production, increasing revenues, externalizing producer risks, and encouraging excessive investment.[166] Fishing subsidies deemed to have the most harm on biodiversity include fuel subsidies, vessel buyback programs, subsidies for vessel construction and modernization, subsidies for port construction and renovation, price and marketing support, and foreign access agreements.[167] In addition, support that influences the cost of inputs, e.g., fuel and bait, are the most likely to promote IUU fishing.[168] Combined with anthropogenic pollution and climate change, pressures from overfishing are decreasing the range and habitats of marine species.[169] Limiting the long-term sustainable supply of fish through overfishing could threaten the 2.6 billion people who rely on fish as a protein source as well as the 10–12 % of world population employed by the sector.[170] A World Bank study estimated total global rents from marine fisheries and found that overfishing revealed economic losses of US$ 83 billion in 2012.[171] Compared to US$ 3 billion in annual net benefits for fisheries, aggregate fishing revenues do not outweigh the environmental costs or even the financial costs, thereby necessitating further subsidies to remain viable.

Tree cover in forests has also seen declines due to harmful subsidies. The global rate of tree cover loss has increased by 43 % since 2018 and there is little progress on disincentivizing practices that contribute to deforestation.[172] Destructive logging and illegal deforestation partly originate in subsidies to the forestry sector, mainly through resource rents,[173] and are partly driven by expanding agriculture. Artificial price depression of raw forestry products can reduce the processing efficiency of wood into lumber and other finished goods.[174] In the US lumber sector, approximately 3 billion board feet of timber is extracted each year and sold below cost.[175] This results in a US$ 1.4–1.8 billion cost to taxpayers every year. Support based on stumpage value, area logged, and finished products is another example of subsidies that affect the amount of forests logged.[176]

Equally important within the chosen sectors of subsidies reform are the geographic areas in which they take place. Developing countries and emerging economies in the tropics and subtropics are some of the most biodiversity-rich countries in the world. A recent study argues that one third of projected biodiversity loss could be avoided by 2040 if only 10 key countries switch to sustainable intensification and land-use optimization, including Brazil, China, India, and Indonesia.[177] Looking closer at these 10

countries, part of Brazil's deforestation rate can be attributed to its beef and soy subsidies that increase production and transportation, even in areas of high forest loss.[178] Similarly, in Indonesia, subsidies mandating the blending of palm oil into fuel and eliminating the transport fuels tax for biofuels encouraged the conversion of forest land to palm oil plantations.[179]

Even though biodiversity is concentrated in a few choice countries, it is important to acknowledge that biodiversity protection is the responsibility of all nations, especially considering that subsidies to increase production are connected to increasing international demand. For example, the dominant position in global soybean exports (83 % of global soybean exports) for the United States and Brazil is largely a result of demand from China, who accounts for 65 % of all soybean imports.[180] Developed countries are also able to limit production of goods that are more harmful to biodiversity and instead import those goods from developing nations, thus greening their own industries and shifting the burden of production reform to poorer countries.

CASE STUDY:

Positive EU Common Agricultural Policy (CAP) Subsidies

The EU CAP is a framework mandated in EU countries that uses generally voluntary schemes to incentivize farmers to conserve their individual farmlands and prevent agricultural land degradation. Under the CAP, farmers are required to make a five-year obligation to use environmentally friendly farming practices (for example, organic agriculture, low-intensity systems, integrated farm management), and they receive payments to cover the cost of these enhancements or income lost from doing so. However, the agri-environmental payments of the CAP, in particular, are reported to have only a moderate positive impact on biodiversity. Switzerland, Italy, and Germany are some examples of EU members who have identified monetary estimates on subsidies harmful to biodiversity and created frameworks on how to track harmful subsidies.

Following a series of reforms, the share of market-distorting support in EU countries, as a share of producer support, decreased from 92 % in 1986–1988 to 27 % in 2015–2017. The largest share of the CAP budget, 69 % in 2017, goes to direct payments. However, about 10 % of direct payments to EU farmers are still coupled to production. Approximately 70 % of this amount is used to support livestock and livestock products (mainly beef and veal). Redirecting these funds to decoupled payments or narrowing the eligible crops (excluding livestock) could further improve environmental outcomes. In addition, strengthening the greening requirements for producer budgetary payments and their implementation could help improve environmental impacts. With the EU's recent pledge to its Biodiversity Strategy for 2030, 40 % of the CAP budget will be dedicated to addressing climate change with future policies/subsidies focusing on conditionality to environmentally friendly agriculture, new funding strategies for climate resilient agriculture, resource efficiency, and a farmer advisory service that will keep farmers up to date on technology and sustainable practices. The pledge also commits the EU to a zero-tolerance policy on illegal, unreported, and unregulated fishing and an action plan to limit fishing gear and techniques most harmful to marine biodiversity, which includes negotiations with the WTO on banning harmful fisheries support.

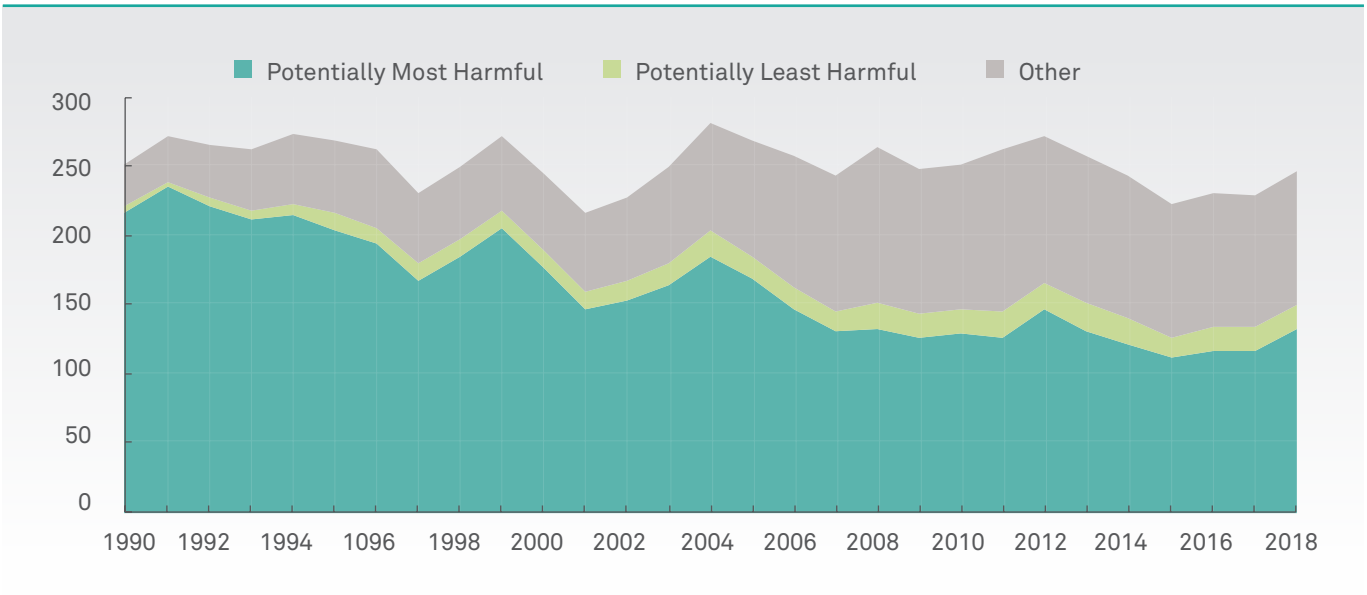
D. Financial Impact: Current and Future

The US $230–451 billion agricultural subsidies estimate used herein is derived from the OECD's 2019 Producer Support Estimates (PSE) database, which covers 22 OECD countries as well as 12 emerging economies including Argentina, Brazil, China, Colombia, Costa Rica, India, Kazakhstan, Philippines, Russia, South Africa, Ukraine, and Vietnam.[vii,181] The OECD's 2013 report on *Policy Instruments to Support Green Growth in Agriculture* describes that market price support mechanisms and payments based on commodity output are the potentially most harmful subsidies to biodiversity.[182] OECD countries made significant efforts to reduce the most harmful agriculture—from over an annual average of 74 % from the total subsidies in 1995–1997 to 50 % in 2009–2011. However, the potentially most harmful subsidies to biodiversity have remained relatively constant at an average of 51 % between 2011 and 2018, and in 2017 represented US$ 116 billion of OECD countries' agricultural subsidies, as shown in Figure 5.2.[183]

The US$ 16–36 billion fisheries subsidies estimate was re-estimated from Sumaila et al. (2019) research on global subsidies.[184] The OECD has estimated that support payments lowering the cost of variable inputs[viii] are potentially the most harmful to biodiversity and represent about 40–44 % of the total fisheries subsidies. This global estimate includes the US$ 5 billion in most harmful subsidies (2015–2017 average) from 28 OECD countries and nine non-OECD countries, including Argentina, Brazil, China, Costa Rica, Indonesia, Malaysia, Peru, Philippines, and Chinese Taipei, detailed in the OECD's 2019 Fisheries Support Estimate (FSE) database. Non-OECD, emerging market countries represent more than 55 % of the global fisheries subsidies.[185]

Reliable global estimates of subsidies to the forestry sector have not been generated for more than two decades. The US$ 28–55 billion

FIGURE 5.2 Agricultural producers support in OECD countries (1990–2018, US$ billions)



Source: OECD, 2019. A Comprehensive Overview of Global Biodiversity Finance. Note: Support considered potentially less harmful consists of payments based on area/animal numbers/receipts/income with environmental constraints, payments based on input use with environmental constraints, and payments based on non-commodity criteria. Other refers to remaining support that does not fit in either of these categories. This graph does not include the 12 emerging economies tracked on the OECD PSE database.

[vii] As of April 2020, Colombia is a member of the OECD.
[viii] Such measures include payments contingent on the purchase of gear, bait, ice, vessels, and use of port services.

estimates were derived from the van Beers and de Moor (2001) research on global subsidies estimated for 1998.[186] The absence of consistent and comprehensive data on forestry sector subsidies represents a significant limitation on the attempt to quantify the extent of these subsidies globally. At the global level, not accounting for regional fluctuations, values have been assumed to be constant and therefore have been adjusted for inflation to estimate 2019 figures.

In 2019, biodiversity harmful subsidies from agriculture, fisheries, and forestry amounted to an estimated US$ 274–542 billion annually, exceeding actual spending on biodiversity protection by a factor of four.[187] If fossil fuel subsidies were included in these calculations, subsidies harmful to biodiversity would be in the range of US$ 670–1,020 billion per year.

This report estimates that in order to guarantee reform of the most harmful subsidies to biodiversity by, at the latest, 2030, countries would need global annual reduction commitments of harmful subsidies to agriculture, fisheries, and forestry of at minimum -6.3 %, -5.1 %, and -6.3 %, respectively (percent values are based on 10-year compound annual growth rates for reduction in subsidy amounts if subsidies "most harmful" to biodiversity are reformed; see Appendix A for a more detailed description of the methodology). In some cases, this target may be achieved earlier, as in the case with New Zealand. This would result in the reform of US$ 273.9 billion of subsidies per year away from harmful activities that could be revenue neutral and represent no additional net loss for nature. These resources should also be redirected toward biodiversity-positive activities through the other mechanisms described in this report, though redirection would not be revenue neutral. Note that the underlying assumption is that US$ 1 of harmful subsidy reformed equates to US$ 1 less that needs to be spent on biodiversity conservation.

Table 5.4 shows that, if policy makers commit to reforming subsidies that are "most harmful"

TABLE 5.3 Current State (2019)

Category	Most Harmful Subsidies US$ bn in 2019	All Harmful Subsidies US$ bn in 2019 (including the most harmful subsidies)
Support to agricultural production	230.0	451.0
Support to fishery production	15.8	36.1
Support to forestry production	28.0	54.9
Total in 2019	273.9	542.0

Source: Agricultural subsidies are from OECD (2019), and the methodology for identifying the most harmful subsidies is from OECD (2013). Fishery subsidies are from Sumaila et al. (2019), and forestry subsidies are from OECD (2002) and Center for Sustainable Economy (2019). Adjusted to 2019 US$. See Appendix A for a more detailed description of the methodology.

TABLE 5.4 Future State (2030)

Category	Remaining subsidies - 2030 scenario US$ bn	% of Global annual reduction needed 2019-2030
Support to agricultural production	220.9	6.3 %
Support to fishery production	20.2	5.1 %
Support to forestry production	26.9	6.3 %
Remaining harmful subsidies by 2030	268.1	

to biodiversity by 2030, leaving behind only the "potentially harmful" subsidies, there will still be a total of US$ 268.1 billion per year of subsidies harming biodiversity across the agricultural, fishery, and forestry sectors. Note that the assumption made here is that the reformed subsidies are not necessarily redeployed as increased financing toward supporting biodiversity. Should that decision be made then the newly designed positive subsidies would fully counteract the remaining harmful subsidies.

E. Obstacles and Enabling Conditions

Harmful subsidies reform is a political process and will therefore encounter barriers similar to any political reform agenda: entrenched interests and political acceptability. Elected officials are beholden to voters and, in certain countries, donors and patrons, some of which may benefit from the current subsidies frameworks and are likely to object to changes in the status quo. Groups that represent subsidies beneficiaries have greater ability to mobilize against subsidies reforms compared to the general public, who are affected by their externalities. Political acceptance of subsidies reform also depends on, among other concerns, the perceived effectiveness of the policy, the degree of fairness, and the degree of awareness of the problem being addressed.[188] Reform of harmful subsidies will only be possible if decision makers and government leaders can garner enough support from the general public and stakeholders who will be directly affected by subsidy reform. This barrier can be alleviated through promoting transparency within decision making and providing evidence of the negative impacts from harmful subsidies, both of which are detailed under "Recommendations."

Another barrier to the political acceptability of subsidy reform is the slow turnaround of received benefits. In other words, it might take a longer time for governments to realize environmental and subsequent socioeconomic benefits of subsidies reform than it would for them to realize the economic benefits of a harmful subsidy, which provides variable or fixed cost relief. For example, support that changes variable costs for producers, such as fertilizer or fuel subsidies, affects sector profitability in the near-term.[189] Positive benefits of subsidies reforms, on the other hand, take time to materialize, monitor, and evaluate. Furthermore, indicators of a subsidy's effect on the environment could require extended periods of monitoring,[190] with some environmental effects not appearing until a threshold environmental condition is reached. Reforms on subsidies to fertilizer use could reduce runoff into lakes, but eutrophication may not decrease until phosphorus levels are reduced by 40 %.[191] Realizing all benefits of positive environmental subsidies thus involves sustaining reforms across changing administrations, with continued support from legal frameworks and civic society over longer time periods. This additionally requires education to voters both in and outside of these sectors on the benefits and intention of subsidies reform.

Even though there is an international consensus on the environmental damage of harmful subsidies, current data does not show an explicit and direct causal linkage between a subsidy type, or volume, and its impact on biodiversity. National monitoring systems have yet to implement standardized and adequate reporting systems. However, there is a volume of empirical research explaining the range of environmentally harmful subsidies and where their effects originate from. The OECD is continuously developing a template for identifying and reporting environmentally harmful subsidies that scrutinize the connections between government support and environmental degradation. Despite the wealth of international data on harmful subsidies, countries still need to implement adequate reporting procedures that track the distribution and effects of national support, thus allowing them to better isolate which subsidies could be reformed.

Concerning less developed countries, these countries often have economies that are heavily reliant on agriculture or commodities and, as

CASE STUDY:

Reforming Agricultural Subsidies to Support Biodiversity in Switzerland[192]

Over the past two decades, Switzerland has reformed its agricultural subsidies to better align the direct payment system to protect biodiversity. The reform, embodied in the new Agricultural Policy (AP 2014–2017), included removing direct payments to livestock farmers, introducing transition payments, and increasing payments to farmers meeting biodiversity goals. As a result of the reform, budgetary payments to the agricultural sector increased slightly over the 2014–2017 period. Although it is too early to measure the impact of the AP 2014–2017 on biodiversity, substantial progress toward meeting biodiversity targets has been achieved. Participation in voluntary programs funded by the biodiversity direct payments has exceeded expectations. Incomes and productivity in the agricultural sector are expected to be higher as a result of these reforms.

a result, have created economic policies that are contingent on supporting employment and profitability within these sectors. To balance the need in these countries for equitable growth with biodiversity conservation, reforming harmful subsidies will require a just transition of farming practices such that previously disadvantaged populations will not forfeit livelihoods or future income. International, technical, and policy support should be allocated to developing countries seeking to make biodiversity-positive transitions.

Last, IUU fishing and illegal forestry operations are major threats to biodiversity and, in some instances, are able to tap into subsidies where governments have weak monitoring, control, and surveillance. The recent 2017 WTO deliberations on fishery subsidies made progress on exploring how subsidies can avoid fostering IUU behavior, but decision makers must implement and enforce regulations to prevent subsidies going to IUU activities. Unfortunately, there are no explicit regulations or dispute cases on illegal forest practices in the WTO so far.

F. Recommendations

National and subnational governments should immediately begin the process of redesigning, reducing, or redirecting existing subsidies away from incentivizing actions that harm biodiversity to those that explicitly support it or, in the least, result in no harm to biodiversity.

- National and subnational governments should undertake an impact assessment of existing subsidies, direct and indirect and across all ministries, to determine their impacts on biodiversity and thereby enabling targeted reforms of subsidies harmful to biodiversity. This requires resources to track, report, and disclose information such as "OECD Guidance to identify and assess subsidies harmful to biodiversity" and "OECD Guidance on reforming support for fossil fuels in OECD and G20 countries".
- Governments should introduce graduated payments within subsidies to reward producers and land managers who adopt practices that have beneficial outcomes on biodiversity and environmental health. Greater payments are given to those who demonstrate a greater benefit or improvement in pre-agreed environmental criteria.
- National governments should prioritize the identification and reform of harmful agricultural subsidies that drive land degradation and soil erosion of

productive agricultural land. National governments and businesses should encourage innovative and sustainable agricultural systems to transition from intensive agriculture practices (especially in the tropical forests) to regenerative agriculture and food systems.

- Governments must assess the context of their current biodiversity stock, sector productivity, international trade, and other social, economic, and environmental factors to determine an appropriate combination of production intensification and biodiversity-conscious practices to benefit biodiversity.

Governments should consider the impacts on the poor and marginalized groups in society when designing subsidy reforms, ensure a phased and equitable transition where negative social impacts of subsidy reform are mitigated as much as possible, and ensure that groups that benefit from the status quo understand and support the impetus behind subsidies reform.

- Governments must acknowledge that subsidies reform will harm some industries or populations. To achieve a just transition, governments should identify which groups would be the most affected and provide appropriate compensation through financial, institutional, and/or technical assistance. Reforms should avoid adverse impacts to the most marginalized populations—women, youth, ethnic minorities—bearing the brunt of fiscal or social burden when it comes to reform.
- Within the design process, governments should seek to maintain the support of groups who benefit from the status quo and emphasize that subsidies are contingent on undertaking biodiversity positive practices that responsibly manage resources and land, maintain provision of public goods for the future, and mitigate damages to ecosystems.

International organizations (including academia and NGOs) should implement a coordinated research program that delivers a common understanding of what constitutes a harmful subsidy and the ways in which it can be realigned to achieve positive outcome for biodiversity. The OECD methodology on identifying, assessing, and reforming subsidies provides a good starting point for this exercise.

Donor governments and multilateral development banks should provide financial and technical support to governments of less developed economies in reforming harmful subsidies.

Businesses should recognize the global momentum and support behind harmful subsidy reform and should review, identify, disclose, and implement their commitments to transition away from dependence on harmful subsidies. They should also engage with and actively support government efforts to reform and redirect harmful subsidies.[193]

- Businesses should review, identify, and disclose their reliance on harmful subsidies as per the "OECD Guidance to identify and assess subsidies harmful to biodiversity" and "OECD Guidance on reforming support for fossil fuels in OECD and G20 countries". As part of this, business should establish and publicly disclose goals to transition their operations away from dependence on harmful subsidies.
- Businesses should proactively invest in sustainable supply chain development and support producers to transition to sustainable production practices that will benefit from the reformed subsidies.

5.2 Investment Risk Management

A. Background

Financial institutions are beginning to use protocols and implement practices similar to those used to manage other forms of risk, such as market risk, reputational risk, and regulatory risk, to identify, measure, and mitigate risk in their investment portfolios resulting from their investees' dependencies and impacts on biodiversity. Through the use of a variety of methods, several of which are discussed in this chapter, financial institutions are able to reduce their exposure to biodiversity-related risks and increase the proportion of their investments that have positive, or at least neutral, effects on biodiversity. These methods include (1) positive screening; (2) negative screening; (3) environmental, social, and governance (ESG) engagement, activism, and divestment; (4) ESG integration into business as usual risk management processes; and (5) the adoption of norms and standards that address impacts to biodiversity. The extent to which financial institutions increase their use of these methods will depend on their approach to managing their own risk exposure and, perhaps more importantly, to the expectations of their clients, regulators, and other key stakeholders.

As used in this section, financial institutions refers to banks, insurance companies, and asset managers (such as pension funds, mutual funds, and wealth management firms) that manage portfolios of investments through lending, advisory, and investing activities. The term investment, as used in relation to corporate and investment banks, refers to a portfolio of companies to whom these firms lend or provide financial advisory services. Risk management in this context involves identifying and managing investment portfolios to minimize potential risks to client relationships, risks to returns should companies be unable to repay debt, or reputational risks.

In recent years, many large financial institutions, such as pension funds, banks, and insurers, have developed considerable expertise in the field often referred to as environmental and social risk management (ESRM). The practice of ESRM has resulted in the growth of industry initiatives such as the Equator Principles and has led to implementation of a number of institutional policies on high-risk activities and industries within the banking sector. However, while they have considered environmental issues in the practice of ESRM, financial institutions have focused primarily on climate and other, non-biodiversity related, risks. While less attention has been paid to risks associated with biodiversity loss, and financial institutions have not been as forceful in their application of ESRM standards, there is now growing awareness of the interplay between biodiversity risk and credit risk, and the impact that current rates of biodiversity loss could pose to the stability of the financial system.

In countries where the financial services industry is tightly regulated, different types of financial institutions are subject to a combination of international and national regulatory structures that govern the types of investments they can make in addition to their fiduciary duties to their clients. Creating portfolios based on ESG factors has often been viewed as a potential breach of fiduciary duty if doing so could jeopardize risk-adjusted returns to the investor.[194] However, the Fiduciary Duty in the 21st Century program, led by the United Nations Environment Programme Finance Initiative (UNEP FI) and the Principles for Responsible Investment (PRI), among other initiatives, has sought to drive policy reform to incorporate ESG considerations into regulation of fiduciary duty.[195] In recent years, several

countries such as France, the Netherlands, and the UK have seen progress in incorporating ESG issues into policy and guidance on fiduciary duty, thereby enabling the use of risk management tools that incorporate biodiversity loss or gains into investments and investment portfolios.

For these policy changes to have meaningful impact, financial institutions will need to incorporate them into their mainstream business process. Even though financial institutions have been increasing their commitment to, and offerings of, green financial products in recent years and tightening their ESRM standards, it remains that, other than for specialized financial institutions operating in the sustainable finance space, sustainable finance continues to be a niche offering within most large financial institutions, and few institutions have implemented strong biodiversity risk management practices.

Although the financial services industry in a limited number of countries such as France has moved ahead, and in other countries certain financial companies stand out, in general change has been limited. ShareAction, a UK-based organization that works with investors and their beneficiaries to help them move toward environmentally and socially responsible investing, recently found that none of the world's 75 largest asset managers has a dedicated policy on biodiversity, while 61 % of them mention climate change in their investment policies.[196] Furthermore, adoption of these policies needs to be supported by regulatory systems that set high standards and create a level playing field in order to discourage all financial firms from making investments that cause material environmental harm, without putting first-movers and sector leaders at a competitive disadvantage. Even if one-off, voluntary measures are commendable and draw attention to the biodiversity crisis, the impacts are limited.

Today, the financial sector plays a central role in funding activities that lead directly to the loss of biodiversity and the degradation of ecosystems all around the world. Unfortunately, the finance industry is unlikely to transition from its current net-negative impact on nature to the net-positive impact that many would like to see unless (1) it is required to do so by applicable laws and regulations, (2) doing so would prove to be profitable enough to overcome the inertia that keeps businesses focused on tried and tested ways of generating profits, or (3) the reputational impacts of not managing biodiversity impacts aggressively and systematically become so large that it poses a material risk to their business.

These drivers of investment-risk management for biodiversity might help to mitigate some of the perceived losses associated with its implementation. Investment risk management might come at a substantial cost to individual financial institutions implementing such practices, as it will involve increasing their risk management capabilities and potentially declining to participate in a large number of financings that would likely have been approved by the institutions before the implementation of new practices. Furthermore, declining to participate in these financings may have little or no impact on the ground, as those seeking financing for activities causing negative impacts on biodiversity may still obtain financing from competing institutions with lower standards, resulting in a competitive disadvantage for the organization applying higher standards. Because of this, it is highly unlikely that there will be enough change in the finance industry's approach to biodiversity risk to make a substantial difference unless and until all firms realize the benefits of assessing this type of risk, and governments create institutional structures to necessitate its mitigation.

PwC and WWF proposed a framework for biodiversity-related financial risks that seeks to highlight the connection between biodiversity loss, economic risks, and financial performance. The framework, together with the four categories of risk it identifies, is summarized in Table 5.5.[197]

TABLE 5.5 WWF and PwC Description of Biodiversity-Related Financial Risks

Risk category	Description	Comments
1. Transition	Risks related to the transition to an economy that conserves and restores biodiversity.	Restrictions on access to land and resources, quotas, licensing procedures, and compensation taxes as a result of regulatory changes and reputational risks resulting from market changes, all of which can lead to high costs and/or stranded assets for affected businesses.
2. Physical	Risks related to the physical impacts of biodiversity loss.	Physical destruction of natural resources that industries are dependent on for value generation can result in significant losses.
3. Litigation	Risks related to litigation pertaining to biodiversity loss and breach of the underlying legal frameworks.	Noncompliance with laws and regulations on biodiversity loss can lead to significant litigation costs.
4. Systemic	Risks related to systemic impacts of biodiversity loss.	The far-reaching impact of biodiversity loss on food security, health, and socioeconomic development can have significant impacts to the stability and functioning of the global financial system leading to stranded assets.

Source: WWF and PwC (2019). Nature is too big to fail.[198]

The scale of the opportunity to prevent negative impacts to biodiversity through mainstreaming investment risk management in traditional financial markets vastly outweighs that of current global biodiversity finance. As an illustration, the global value of assets under management in 2020 is estimated to be US$ 111.2 trillion,[199] compared to the estimated US$ 124–143 billion currently dedicated to biodiversity conservation finance globally.

B. Description of the Mechanism

The numerous methods used to incorporate biodiversity risk into investment risk management practices vary in terms of scope, scale, and complexity. They can be applied at the portfolio level, the financial product or service level, or the level of the individual investee or borrower.[200] This section provides a foundational understanding of the ways in which the conservation of biodiversity can be integrated into financial risk management practices. To do so, it presents some of the more established risk management practices, ESG investment strategies, and portfolio management. This section also discusses the extent to which these practices currently address biodiversity and how they could be applied to better integrate biodiversity risks into financial risk management.

It is worth noting that financial institutions may choose to apply these practices only to their direct investments and direct (or first-tier) financing or extend them to their indirect (or second-tier) lending by requesting financial intermediaries to apply the same practices. The latter approach can be a particularly powerful mechanism for driving positive change along supply chains as financial intermediaries often lend to a different set of actors than the financial institutions from whom they receive credit.[201]

Positive Screening

Positive screening of investments is a risk management practice that involves selecting investments based on their superior performance against specified ESG criteria compared to their peers. Investments may be chosen because they contribute positively to biodiversity, have strategies in place to mitigate their impacts on ecosystems, or have shown the greatest improvement in minimizing biodiversity-related

ESG risks. This approach allows investors to select investments that perform well both financially and against ESG metrics.[202] It does not require that investors sacrifice the ability to generate returns in order to generate positive ESG impacts.

The criteria used to implement this biodiversity risk management methodology are defined by the investor and require the gathering of biodiversity-related ESG data to conduct investment analyses. This type of analysis can involve quantifying and integrating impacts of a biodiversity-positive strategy into financial forecasting and company valuation models as is done with other financial drivers that inform investment decisions.[203] Positive screening is predominantly conducted on a company-by-company basis. However, some investors may choose to make portfolio-level asset allocation modifications informed by forward-looking scenario analysis of the potential impacts of biodiversity-related ESG risks and opportunities based on the financial performance of certain sectors. Positive screening conducted at the project level requires investors to ensure that each project has a neutral or improved effect on biodiversity.[204]

Many investors that choose to take a positive screening approach are not necessarily driven by moral and ethical arguments but instead base themselves on a growing body of evidence suggesting that companies with strong ESG credentials may perform better financially than investments that are otherwise comparable, although the evidence suggests this is largely due to companies with strong ESG practices having better governance. As more data becomes available on the impacts of environmental risks on investment performance and the dependencies of investments on biodiversity, it is likely that this correlation will strengthen.

A number of ESG funds have been launched by mainstream investors in recent years, and as of the end of 2019 it was estimated that there were more than 300 mutual funds and exchange-traded funds with an ESG focus.[205] The US $20.6 billion of new finance that flowed into these funds in 2019 alone was almost four times more than the US $5.5 billion in 2018, which was the previous record.[206] There has also been a proliferation of impact investing funds (described in Section 5.6. Green Financial Products) that offer both financial returns and positive environmental impacts accompanied by social co-benefits.

Negative Screening

Financial institutions can use negative screening to make investment decisions based on whether an asset negatively impacts biodiversity. Negative screens screen investments against established "negative" criteria through using, for example, an established exclusion list to evaluate investments against a defined set of excluded activities or sectors, or an ESG negative screening process, where aggregate criteria based on environmental and social outcomes determine an investor's decisions.

Exclusion lists are often adopted by development finance institutions, impact investors, foundations, other mission-driven investors, or by public fund managers. In recent years, the adoption of negative screening has greatly increased among mainstream investors. Many of the original values-based investors were religious organizations, and exclusions applied to controversial products and services such as weapons and "sin stocks," including alcohol, tobacco, and gambling.[207] But exclusions increasingly apply to investments in sectors that are linked to negative environmental impacts such as mining, fossil fuels, and commercial logging, as well as social impacts such as forced and child labor.[208]

The integration of biodiversity into this form of risk management can involve excluding investments in potentially destructive activities in geographies of high biodiversity value, or sectors that are considered high risk to biodiversity. Exclusion lists, therefore, are

generally made at the portfolio level, where the main business operations and activities are screened to inform investment decisions.[209] For example, the Integrated Biodiversity Assessment Tool (IBAT), a global biodiversity database that draws information from the IUCN Red List of Threatened Species, the World Database on Protected Areas, and the World Database of Key Biodiversity Areas, provide comprehensive data that could facilitate the implementation of exclusions based on biodiversity risk.[210] Similarly, the Paulson Institute has developed the Environmental Risk Screening Tool (ERST) for the Chinese Ministry of Ecology and Environment to enable better environmental screening of the country's overseas investment projects.[211]

Another form of negative screening is ESG screening, which focuses on a broader list of environmental criteria instead of solely assessing investments' impact on nature. This practice uses ESG criteria to screen potential investments based on minimum eligibility for environmental impacts related to climate change, natural resource management, and pollution and waste; social practices in relation to employees, customers, communities, and other stakeholders; and corporate governance and corporate behavior.[212] There is currently no standardized framework for ESG criteria, but there are a number of leading global frameworks including the Global Reporting Initiative (GRI) Sustainability Reporting Standards, the UN Global Compact (based on 10 principles concerning human rights, labor, the environment, and anti-corruption), the Transition Pathway Initiative (TPI), and CDP (formerly the Carbon Disclosure Project), which collect standardized information on climate change and the use of natural resources.[213] ESG criteria, and the weight placed on each criterion, are determined by individual assets managers or investors. Therefore, investment impacts on biodiversity have varying effects using this negative screening processes. While some argue that ESG biodiversity standards may fit within existing ESG climate frameworks, others assert that mainstreaming biodiversity risk into ESG screening processes will require frameworks that explicitly screen for the risks of biodiversity loss.

ESG Engagement, Activism, and Divestment

Corporate engagement in the context of ESG risk management involves the use of shareholder power to influence corporate behavior in relation to potential impacts on biodiversity. In this form of risk management, financial institutions apply an active ownership investment strategy and wield their voting power as shareholders to influence the management of ESG risks.[214] Influence may be exerted through direct engagement with senior management and board members, and by filing or supporting biodiversity-supportive shareholder proposals. Investors may use this mechanism to influence the companies they invest in to align their risk management practices with the investors' standards and to improve the investees' disclosures of ESG risks so they can make better informed investment decisions. Underlying these pressure tactics is the often unspoken threat from investors of making a "noisy withdrawal" and divesting themselves of their shareholdings, which, depending on the size and visibility of the investor, may be viewed as a damaging vote of no-confidence in management by the investor community.

Financial institutions that use this strategy to manage biodiversity risk may believe that the primary objective of corporate engagement is to use shareholder rights to influence companies on ESG risks and opportunities.[215] If a company's management of ESG risks and performance against ESG criteria is unsatisfactory, the desired solution is generally to engage with the company to achieve demonstrable positive change.[216] Engagement and the threat of divestment can therefore be seen as a "carrot and stick" mechanism. According to the ESG & Investor Engagement report published in 2019, 68% of 200 corporate governance professionals surveyed had a personal interaction with investors

regarding ESG matters over the past year.[217,218]

An example of investors using corporate engagement in the context of ESG is Climate Action 100+ (CA100+), a global coalition of more than 450 investors with US$ 40 trillion in assets under management committed to ensuring "that the world's 100 largest corporate greenhouse gas emitters take the necessary action against global warming."[219] TPI, mentioned above, informs the corporate engagement and provides the indicator framework to track corporate performance against CA100+'s asks. These investors aim to engage corporations such that their senior management teams and boards employ strong governance frameworks that understand climate risks, take meaningful action to reduce greenhouse gas emissions, and enhance corporate disclosures in alignment with TCFD guidelines.[220]

Although corporate engagement generally occurs at the investor-investee level, there are instances in which financial institutions come together to call for corporate action on specific issues. In 2020, 254 investors representing approximately US$ 17.7 trillion in assets under management made a statement on deforestation and forest fires in the Amazon via the Principles for Responsible Investment (PRI), drawing attention to the role of tropical forests in harboring biodiversity and ecosystems services and raising concerns around the "financial impact deforestation may have on investee companies, by potentially increasing reputational, operational and regulatory risks."[221] The group of investors, which includes BNP Paribas Asset Management, Aviva, HSBC Global Asset Management, and Legal and General Investment Management, called for companies to commit to eliminating deforestation within their operations and supply chains to manage these risks and reduce the systemic risks deforestation poses to their portfolios and the sustainability of financial markets. Similarly, in response to the 2019 Brumadhino mining disaster in Brazil, which killed several people and affected nearby water supplies, the Mining & Tailing Safety Initiative created a new global standard to manage tailing dams. The initiative consists of 750 investors, which together represent more than US$ 13 trillion in assets under management, led by the Church of England and the Swedish Pension Plan Investment Fund.[222] In addition to the introduction of new standards, the initiative, in partnership with the UN, also produced an independent global data portal to track company disclosures on the matter.[223]

ESG Integration

ESG integration differs from ESG screening in that it does not involve a blanket exclusion of investments based on certain products, services, activities, or sectors. Instead, ESG integration involves analyzing ESG information about an investment together with financial information and identifying material risks across both categories. Like traditional investment analysis, decisions are made based on the potential impact of these risks on the financial performance of an investment.[224] Therefore, ESG criteria would only be considered if the risks are deemed to be material to investment performance.

Integrating ESG criteria related to biodiversity into financial risk analysis involves understanding how environmental issues might affect a particular sector, industry, or geography. The Sustainability Accounting Standards Board (SASB) has developed a materiality map that identifies sustainability issues that are likely to affect the financial condition or operating performance of companies within an industry.[225] Table 5.6 provides an example of the environmental dimension of this map for the sectors that are acknowledged as having significant biodiversity risks. While useful, it is important to note that materiality maps are not the only type of ESG analysis that can highlight biodiversity-related risks and may also not be effective for identifying direct and indirect risks in all sectors.

TABLE 5.6 SASB Environmental Dimension of ESG Materiality Map for Selected Sectors[226]

Dimension	General Issue Category	Extractives & Minerals Processing	Financials	Food & Beverage	Health Care
Environment	GHG Emissions				
	Air Quality				
	Energy Management				
	Water & Wastewater Management				
	Waste & Hazardous Materials Management				
	Ecological Impacts				

- Material Issue - is likely to be material for more than 50% of industries in sector
- Lower Material Issue - is likely to be material for fewer than 50% of industries in sector
- Immaterial Issue - is not likely to be material for any of the industries in sector

ESG risks related to biodiversity are ones that arise either from dependence on degraded biodiversity or dependence on harmful production processes that increase dependency and exacerbate biodiversity loss. Using ESG integration as a method for portfolio analysis highlights inefficient dependencies on natural resources, and production processes that overexploit these resources. In doing so, it allows portfolio managers to make a business case for investing in companies that have long-term biodiversity conservation plans that will overcome such strategic risks.

ESG risks related to biodiversity loss can be quantified into investors' valuation models adjusting revenue growth rates, estimated operating costs and capital expenditures, discount rates, and terminal values based on these risks. Data on investments' dependencies and impacts on biodiversity are key to facilitating this analysis, and there are a number of data and service providers such as MSCI's ESG Ratings, S&P Global Ratings' ESG Evaluation, and RepRisk. There are, however, data and methodological limitations to doing this for biodiversity, which will be in the following pages in the "Barriers" section.[ix]

To integrate biodiversity into traditional financial risk management, it is crucial to have a clear understanding of a portfolio's dependencies and impacts on biodiversity. One of the reasons that financial institutions historically overlooked biodiversity risks is a lack of understanding of these dependencies on healthy ecosystems, largely driven by the high costs and complexity associated with gathering information on biodiversity implications of investments. The Natural Capital Protocol has developed a four-stage framework for financial institutions to integrate biodiversity into financial risk management.[227] An overview of this is provided in Table 5.7.

Although this framework does not include standardized methodologies and metrics for the measurement of biodiversity risks and valuation of their impacts, there are a number of recent initiatives that have proposed solutions. The Natural Capital Finance Alliance and the UNEP Finance Initiative have developed the ENCORE tool (Exploring Natural Capital Opportunities, Risks and Exposure), which enables users to visualize companies' dependencies on nature across a range of sectors and geographies and understand how biodiversity loss could pose

[ix] More information on Natural Capital Risk Assessment is available from: https://www.unepfi.org/publications/ecosystems-publications/integrating-natural-capital-in-risk-assessments/

TABLE 5.7 Framework for Integrating Biodiversity into Financial Risk Management[228]

Assessment stage	FRAME Why?	SCOPE What?	MEASURE AND VALUE How?	APPLY What next?
Objective	Define the purpose for assessing biodiversity risk.	Establish the elements that should be included in the risk assessment.	Select methodologies and data sources for the quantification of risks and impacts on investment valuation.	Make investment decisions based on results of valuation.
Output	Business case for the assessment of biodiversity risk, including opportunities and benefits for the investor and investee.	Objective and scope of assessment including level of assessment (portfolio, financial instrument, company/asset), focus on impacts and/or dependencies, value perspective (economic or financial), materiality.	Indicators, data sources, theory of change (understanding of how a change leads to a relevant impact), assumptions and methodologies. Comprehensive valuation of relevant biodiversity costs and benefits (qualitative and/or quantitative) and impacts of these on investment performance and valuation.	Validation and verification of process and results. Agreement on investment decisions based on assessment. Internal and external communications for relevant stakeholders.

business risks and therefore financial risks. The Natural Capital Coalition and the Cambridge Conservation Initiative (CCI) are also currently working on developing methodologies to value biodiversity impacts and dependencies within natural capital assessments for financial institutions.[229]

Adoption of Norms and Standards

The adoption of norms and standards in ESG risk management involves setting minimum standards for business practices and screening investments against these standards. In this context, biodiversity-related risk management involves investors implementing business-as-usual risk management strategies that evaluate impacts to the business caused by ecosystem and natural resource degradation. Financial institutions can choose to adopt one or a combination of different international standards such as those in the Universal Declaration of Human Rights, the ILO's International Labor Standards, the UN Global Compact's Ten Principles, and the OECD Guidelines for Multinational Enterprises.[230] Financial institutions may use these norms and standards as negative screens to exclude certain companies based on their past violations or choose to divest from current investments if companies are found to contravene them. In the alternative, financial institutions may choose to positively screen investments based on these norms and standards by investing in those that perform best in those areas.

Civil society and the public and private sectors all play important roles in setting standards, validating tools, and (in the case of the public sector) passing enabling legislation to mainstream biodiversity-related risk management. The World Economic Forum International Business Council, for example, has responded to demands for standardized ESG metrics by recently launching a project that explores common metrics and disclosure recommendations that its members can use to mainstream reporting on ESG-related issues.[231] To the extent that standards proposed by civil society organizations become widely accepted and adopted, they may come to be viewed as "soft law" by market participants even when they

are not legally binding—and a breach of these norms and standards may have reputational impacts on a company that make them even more feared than some legally binding laws.

Private sector actors within a particular industry or geography may choose to collaborate on the development of ESG norms and standards that members agree to abide by. These unofficial regulations, resulting from a drive toward self-regulation in the absence of a sophisticated legal framework and/or lax enforcement, serve the interests of the adopting members by providing some clarity on the rules of business engagement and levelling the playing field for market actors that normally compete against each other that are looking to avoid a race to the bottom on ESG matters and the associated reputational risks. Often these unofficial regulations build on existing standards issued by organizations that are viewed as unbiased by these market actors. One such set of standards is the International Financial Corporation (IFC) Sustainability Framework and the related Environmental and Social Performance Standards, which are used in project financing. These standards also represent a key element of the Equator Principles, which were agreed on by 10 banks in 2003 and currently convene more than 100 financial institutions from nearly 40 countries around the world. The Equator Principles provide a framework for private financial institutions to manage ESG risks in infrastructure and industrial projects.[232]

The sustainability risk management framework put forth by the IFC requires the assessment and ongoing management of environmental and social risks and impacts of business activities or projects. The standards also include five standards on social risks and impacts and two standards on environmental risks and impacts, all of which are based on international norms and best practices. Performance Standard 6 (PS6—Biodiversity), in particular, calls for biodiversity conservation and sustainable management of living natural resources and, in combination with PS1 (Risk Management), requires investees to assess the potential risks and impacts of their activities to biodiversity and take action to mitigate and manage these.[233]

Many multilateral development finance institutions such as the World Bank and the European Bank for Reconstruction and Development, the Green Climate Fund, and a variety of bilateral donors have adopted the IFC PSs or developed their own standards based on them, and require that all organizations, projects, and financial intermediaries they lend to also adopt these standards.[234] In the case of project finance, institutions adopting these standards will need to take into consideration the potential risks and impacts associated with a project when deciding to finance it and, when a project is financed, investors may require that investees report on indicators for environmental and social risks and impacts and conduct ongoing monitoring and reporting of performance against these indicators.

In contrast to civil society, national governments can implement laws that force investors to comply with reporting standards on ESG risks related to biodiversity loss that carry the full weight of the law. An example of government-led regulatory support for environmental and social matters is Article 173 of the French Energy Transition for Green Growth Act, which was passed in 2015 and which requires that financial institutions report on their ESG policies and their plans to develop capacity to monitor and evaluate ESG standards.[235] In addition, firms are required to report the impacts of climate risk on their investment profile, as well as the methodologies used to calculate these impacts.[236] In 2019, France introduced the Law on Energy and Climate, which added that financial services firms must also consider risks related to biodiversity loss.[237] While both frameworks acknowledge biodiversity in their ESG standards, greater attention will need to be

TABLE 5.8 Framework for Integrating Biodiversity into Financial Risk Management

Type of Risk Management Practice	Intended Impacts	Potential Weaknesses
Positive screening	• Directs finance toward investments that have the most sustainable and responsible practices in relation to the conservation of biodiversity. • Could support the protection and restoration of biodiversity by increasing the supply for finance to companies that are the best stewards of nature. • Rewarding companies that are the best stewards of nature by allocating finance to them, thereby limiting future finance needed to protect and restore biodiversity.	• Requires a great deal of in-house expertise (or high-cost external advisory services) and access to high-quality information to select the sustainability leaders. • Currently not a mainstreamed ESG practice; it is unlikely investors will be willing to invest in the implementation of this practice until they become more aware of the dependencies of their investments on nature, the importance of pristine biodiversity to the generation of value, and the materiality of risks posed by the degradation of biodiversity.
Negative screening	• Generate rigorous exclusions and environmental screening criteria of the most damaging investments, informed by knowledge of biodiversity risks inherent to specific industries, sectors, geographies, and commodities. • Provide financial institutions with decision-making tools to avoid financing companies and activities that will have a negative impact on biodiversity.	• Gathering asset level data on ESG risks, and particularly context specific biodiversity risks can be prohibitively expensive, particularly to smaller scale investors that cannot benefit from economies of scale.
ESG engagement, activism, and divestment	• Engagement undertaken by financial institutions to push corporations to minimize biodiversity-related risks. • Utilize direct engagement, shareholder activism, or voting to address activities harmful to biodiversity or that could have a net positive impact compared to business as usual practices.	• Investees may not be willing to change their practices. • Requires the investor to find the right balance between incentivizing positive change using corporate engagement and the threat of divestment.
ESG integration	• Integrate biodiversity-related ESG risk assessments into business-as-usual risk management practices for financial institutions. • Identify material risks related to biodiversity and equate them with operational risks associated with their investment. • Drive participation of a broad group of financial firms, some of whom are unwilling to sacrifice financial returns, and reduce financing for activities that negatively impact biodiversity if the risk is deemed material.	• Does not eliminate financing of investments with biodiversity-related risks, but, instead, manages risks in a way that maximizes returns and shareholder value—divestment from harmful production practices is not assured. • This practice may not drive change in instances where biodiversity risk is present but the link to investment performance cannot be made.
Adoption of norms and standards	• Create frameworks and standards that portfolio companies must comply with to have net zero or positive impacts on biodiversity. • Ensuring finance is only provided to investments that conserve biodiversity and activities that sustainably manage natural resources on an ongoing basis.	• Implementation of these in practice can be costly, time intensive, and complex and are therefore less popular among mainstream investors than concessional finance providers.

paid in the future to highlighting biodiversity risk as a distinct ESG issue and a risk to businesses.

A framework currently under development that seeks to ensure compliance with minimum environmental and social safeguards in financing activities is the EU Taxonomy on sustainable finance. This new classification system includes technical screening for economic activities that could be classed as sustainable, such as contributing to climate change mitigation and adaptation while avoiding harm to other environmental objectives including protection and restoration of biodiversity and ecosystems.[238] The EU Taxonomy will support the implementation of the proposed Taxonomy regulation regarding the standards an investment must meet to be officially considered an environmentally sustainable financial product.[239] The development of the EU Taxonomy has not been without controversy, as a number of critics have expressed concern that it unnecessarily imposes limits on what is or is not a sustainable finance product, which could in turn stifle innovation. However, there seems to be enough demand from EU governments and investors alike for a level of clarity and predictability missing in the field until now, which is likely to translate into broad support for the framework.

A summary of the distinguishing features of some of these practices and strategies is presented in Table 5.8.

C. Why Is It Important to Biodiversity?

The investment risk management practices described in this section can influence business practices and investment decisions by rewarding investors and investees that engage in activities that have neutral or positive effects on biodiversity and limiting investments in businesses and projects that do not. On a global level, biodiversity conservation will only significantly benefit from the incorporation of these practices if governments, and international regulatory bodies, institutionalize their use. Doing so will maximize biodiversity conservation efforts by eliminating the possibility of financial institutions competing with each other to gain revenue opportunities in high biodiversity risk sectors.

The World Economic Forum recently reported that "US$ 44 trillion of economic value generation—more than half of the world's total GDP—is moderately or highly dependent on nature and its services, and therefore exposed to risks from nature loss."[240] This figure is even more striking when compared to the limited US$ 123–142 billion—less than 0.1 % of the world's total GDP—annually mobilized toward biodiversity conservation (see Chapter 3). In 2020, for the first time, the World Economic Forum's annual Global Risks Report found that the top five most likely global risks over the next 10 years are all environmental.[x,241] Among these, biodiversity loss and ecosystem collapse are considered highly likely to occur and would have severe impacts. So, it is not surprising that forward-thinking investors are increasingly concerned with the connection between biodiversity degradation and economic loss, and view impacts on biodiversity as a material financial risk that should not be ignored. Material impacts on investment returns resulting from biodiversity loss can be caused by a variety of risks including reputational risk, limited access to capital resulting from ecosystem loss, limited access to markets, compromised supply security, breaches of compliance standards, and unforeseen financial liabilities.[242]

Biodiversity loss is a material financial risk to a significant portion of global investments and "unanticipated biodiversity exposures can blow budgets, derail projects and shred corporate reputations."[243] Three of the most nature-dependent industries are construction, agriculture, and food and beverages. Together,

[x] These risks in order of likelihood are: extreme weather; climate action failure; natural disasters; biodiversity loss; and human-made environmental disasters. In terms of severity of impact, the risks are: climate action failure; biodiversity loss; extreme weather; natural disasters; and human-made environmental disasters.

these industries contribute to US$ 8 trillion of global gross value added (GVA).[244] Industries that rely directly on the extraction of natural resources and use of ecosystems services, such as wild-caught fisheries and productive forestry, account for almost US$ 3.4 trillion of global GVA, which, together with agriculture, pose the greatest risks to biodiversity.[245]

Focusing solely on climate risks would not address all drivers of biodiversity loss. Biodiversity loss and anthropogenic climate change are deeply interconnected—indeed, climate change is one of the principal threats to biodiversity. Conversely, biodiversity management in the form of natural habitats that sequester carbon, increase coastal resilience, ensure an adequate water supply, and provide other ecosystem services can be an effective tool to meet climate change mitigation and adaptation needs. In addition to climate change, other important drivers of biodiversity loss include changes in land use and sea use (and in particular the expansion of the agricultural frontier), habitat degradation, the impacts of invasive species, and indirect drivers such as human population increase, unsustainable production and consumption, and mismanagement of natural resources. Therefore, either an additional effort to manage biodiversity impacts or an integrated risk management approach addressing climate change and biodiversity loss will be needed.

An important step in the direction of managing biodiversity risk in finance is the development of a framework to identify and evaluate potential investment risks associated with biodiversity, as has happened with climate-related financial risks, which are better understood by mainstream investors. The Task Force on Climate-related Financial Disclosure (TCFD), established by the Financial Stability Board (FSB) in 2015, proposes two categories of climate related risks: *transition risks* (including policy, legal, market, and reputational risks) resulting from the transition to a lower carbon economy, and *physical risks* resulting from the physical impacts of climate change.[246] Recently, the Climate Disclosure Standards Board (CDSB) launched a consultation to advance the disclosure of nature-related financial information, potentially through a Task Force on Nature-related Financial Disclosure (TNFD) to complement the work of the TCFD. The aim of this task force is to give investors and lenders a better picture of their exposure to biodiversity loss, as well as the potential financial losses of inaction.[247] This initiative enables investors and lenders to understand not only the losses that stand to occur if they continue to invest in activities harmful to biodiversity, but also how they can incentivize companies in their portfolio to operate more sustainably.

The investment risk management tools described in this section provide ways for financial institutions to scale their involvement in conservation through scrutinizing their portfolios for borrowers' or investees' exposure to biodiversity risk. Positive screening rewards companies that are making strides with respect to biodiversity risk minimization by allocating more capital to such business operations. Negative screening minimizes investments in companies that underperform in relation to minimizing biodiversity-related risks. Decreasing investments in such companies signals to comparable companies within specific sectors that their production practices must be improved to gain investor confidence. Similarly, ESG engagement, activism, and divestment, ESG integration, and the adoption of norms and standards use ESG frameworks as a foundation for incorporating biodiversity risk analyses into investment processes. Doing so could force investors, and with them their investee companies, to assess biodiversity risks that are like other types of financial risks. Through mainstreaming biodiversity risk management, financial institutions have the power to incorporate biodiversity into the future strategic initiatives of businesses that would otherwise overlook their ecological impacts.

D. Financial Impact: Current and Future

Current State

This report uses categories from the GSI Alliance's 2018 Global Sustainable Investment Review[248] report on investment risk management, with changed mechanism descriptions, where relevant. These changes apply to descriptions of ESG engagement, activism, and divestment, as well as the adoption of norms and standards in risk management mechanisms, both of which were expanded from GSI's original terminology ("corporate engagement and shareholder action" and "norms-based screening," respectively). The change to ESG engagement, activism, and divestment was included to highlight the role that shareholder activism and the possibility of divestment can play in informing more sustainable corporate decision making. The discussion around the adoption of norms and standards was adjusted to include widely used and/or acknowledged standards that financial institutions can use when setting norms, as opposed to solely norms-based screening. Nevertheless, the estimates for the mechanisms included in this section are based on GSI's report and apply to their respective categories irrespective of alterations to names made by this report.

GSI Alliance reported that in 2018 global investments subject to sustainability risk management practices reached US$ 30.7 trillion in five major markets (Europe, United States, Japan, Canada, and Australia/New Zealand) having grown 34 % in two years.[249] Negative screening is currently the most popular form of sustainability-related financial risk management with an estimated US$ 19.8 trillion in assets under management that are subject to some form of negative screening. According to GSI Alliance, this amount grew 31 % between 2016 and 2018.[250] However, exclusions and criteria related to biodiversity loss still represent a small portion of the screens applied by financial institutions. Of the investment processes they do affect, they may result in a reduction in the size of an investment rather than total divestment from opportunities with significant biodiversity risk. According to Schroders, an asset management company, sin stocks, weapons, and armaments dominate the screens they apply to their clients' portfolios, although "rising concerns over climate change have driven dramatic divestment in oil, gas, and coal, with globally screened assets more than doubling from US$ 2.6 trillion to US$ 5.4 trillion" between 2015 and 2017.[251]

An interesting trend has been the decrease in the total value of assets subject to the use of norms and standards in financial risk management between 2016 and 2018. This is the only risk management practice that has seen a decrease and may have been subject to cannibalization by other risk management practices as more comprehensive ESG frameworks, methodologies, and data sources have become available.[252] Continued growth in the corporate engagement mechanism is promising, particularly given the increasing focus that is being given to issues related to biodiversity as illustrated by the development of such initiatives as Business for Nature, a global coalition of organizations and networks working with business to reverse the loss of nature.[253]

The growth of the use of ESG integration has also been significant in the past few years, with total assets subject to this strategy reaching approximately US$ 17.5 trillion in 2018. The practice of positive screening, while still relatively small in comparison to the other risk management practices, has grown at an annual rate of 50.1 % between 2016 and 2018. Given the estimate of US$ 111.2 trillion of total assets under management in 2019, it appears clear that these practices are being applied to a significant portion of global assets.[254]

Table 5.9 summarizes information on the recent growth of the various sustainability risk management practices discussed in this section of the report.

TABLE 5.9 Growth in Sustainability Risk Management Practices, 2016–2018[255]

	Positive screening	Negative screening	ESG engagement, activism, and divestment	ESG integration	Adoption of norms and standards
2018 (US$ billion)	1,842	19,771	9,835	17,544	4,679
2016 (US$ billion)	818	15.064	8,385	10,353	6,195
Growth 2016–2018	125.0 %	31.0 %	17.0 %	69.0 %	-24.0 %
CAGR	50.1 %	14.6 %	8.3 %	30.2 %	-13.1 %

Note: Values for Adoption of Norms and Standards represents growth in the adoption of norms-based screening and does not capture value changes from the implementation of standards. The methodology behind these figures is presented in Appendix A.

The penetration of sustainability risk management practices varies greatly across geographies and by asset type. Europe and the United States account for a large majority (over 80 %) of sustainably managed assets globally, with Japan, Canada, Australia, and New Zealand accounting for much of the remaining portion.[256] However, the African Investing for Impact Barometer found that US$ 428.3 billion in assets across Africa were being managed according to ESG risks criteria in 2017, with ESG integration as the primary strategy.[257] In Latin America, 65 financial institutions with collective assets of US$ 1.2 trillion under management were signatories to the PRI in 2018, although it is not clear to what extent those assets were subject to sustainability risk management practices.[xi,258] In terms of the categories of assets subject to these practices, 51 % were public equities, 36 % were fixed income investments, real estate accounted for 3 % , and private equity and venture capital for 3 % in Europe, the United States, Japan, and Canada.[259]

Estimating the actual portion of the assets under sustainability risk management practices that are subject to biodiversity related risk management practices is difficult. For example, the 2018 Global Sustainable Investment Review found that climate change was the leading ESG issue for investors, but biodiversity was not mentioned in the report.[260] Due to the complexity of the issue and the fact that biodiversity has only recently attracted the attention of a larger number of investors, there are many financial institutions that use risk management practices such as exclusions focused on sin stocks or ESG integration without understanding their investments' dependencies on biodiversity or appreciating the materiality of biodiversity-related risk. In cases such as these, financial institutions may not be incorporating biodiversity risk into their financial risk management practices effectively. Indeed, while the percentage of overall global assets under management that are subject to some kind of ESG review or screening is high, it is understood among many practitioners that a significant proportion of those assets have been subject to narrowly tailored screenings that apply only one or a small number of criteria, such as production of controversial weapons including cluster munitions and anti-personnel mines.

Certain sectors and industries are associated with higher biodiversity-related risks due to the nature of the activities involved. These include, but are not limited to, mining, oil and gas, infrastructure, real estate, forestry, and, most importantly, industrial agriculture. There is limited information on the percentage of assets within each of these sectors that are subject to sustainability risk management practices, and little or no

[xi] The PRI has taken actions to address the issue of signatories not demonstrating a minimum standard of responsible investment activity. In 2018 the PRI placed 180 signatories on a watch-list following an audit and gave them two years to improve their ESG performance or face being delisted. More information available from https://www.ft.com/content/ad38f37f-bd9c-34f1-848d-e5773be45b80.

information on those that are subject specifically to biodiversity risk management protocols. The concentration of assets subject to sustainability risk management practices in OECD countries suggests that biodiversity risk management is likely also to be lagging in developing economies, which are home to a significant amount of high value biodiversity.

This highlights the need for financial institutions to transition from commitments and policies on the financing of activities that pose risks to biodiversity to actually implementing those policies so that financial flows are directed away from harmful practices and toward more sustainable practices, which ultimately result in a more positive impact on biodiversity than is currently the case. Financial institutions are able to choose not to provide finance to investments that are harmful to biodiversity and to influence investee company action on biodiversity related issues through engagement, loan covenants,

CASE STUDY:

Risk Management Practices among Financial Institutions That Provide Finance to Companies Linked to Deforestation Risk

Over two thirds of tropical deforestation is driven by a small number of "forest-risk" commodities that are found in over 50 % of packaged products found in supermarkets around the world: palm oil, soy, timber and pulp and paper, and beef.[261] Financial institutions, which are directly linked to deforestation through the financing of companies operating in forest-risk supply chains, are increasingly aware of risks that the destruction of biodiversity and ecosystems services pose to the financial performance of their investments, and many are taking action to address these risks. As a result, many financial institutions have implemented policies and risk management practices to mitigate the financing of investments with deforestation and negative biodiversity impacts.

The Forest 500, a Global Canopy project, tracks 350 companies and 150 financial institutions that are significantly involved in the supply chains of forest-risk commodities.[262] The assessment scores the organizations based on their commitments and actions to addressing deforestation, including policies and risk management practices related to forest-risk commodities that they apply to companies in their financial portfolio. A breakdown of the criteria can be found in Global Canopy's Financial Institution Assessment Methodology 2019.[263] The criteria requiring that companies do not adversely impact protected areas and areas of global conservation importance are a form of biodiversity risk management screen. The 2019 Forest 500 assessment of financial institutions found that, although there has been a growing number of financial institutions that have recognized the need for action on deforestation, this has not translated into an increase in the implementation of relevant policies.[264]

Forests & Finance is a project that assesses the financial services received by more than 190 companies directly involved in forest-risk sector supply chains in Southeast Asia. To date it has compiled data on financial flows, in the form of corporate loans, bonds, credit facilities, and shares, from more than 400 investors to more than 100 forest-risk companies over a 10-year period from 2010–2019.[265]

To better understand how investors and companies in the Forests & Finance database mentioned above are linked, this report has cross referenced the financial institutions in the Forests & Finance dataset to the 150 Forest 500 financial institutions and found that 75 financial institutions

responsible for US$ 73.0 billion of financial flows over the 10-year period appeared in both sets. Flows of finance are based on the score band the financial institution was allocated to in the Forest 500 assessment (20th-percentile bands). This analysis shows that of the US$ 73.0 billion of financial flows, only US $1.8 billion, or just over 1 %, was from a financial institution with strong policies and risk management practices in place to tackle deforestation.[xii,266]

TABLE 5.10 Financial Flows into Forest-Risk Commodities for 75 Financial Institutions between 2010 and 2019 Disaggregated by Strength of Deforestation Policies and Commitments[267,268]

Score Band	Explanation	# Financial Institutions in Band	Financial Flows in Band (US $ millions)	% of Total Financial Flows
0	No commitment	16	10,340.51	14 %
1	Very weak commitment	24	15,066.04	21 %
2	Weak commitment	18	30,235.02	41 %
3	Average commitment	16	16,307.17	22 %
4	Strong commitment	1	1,078.36	1 %
5	Very strong commitment	0	0	0 %
All		**75.00**	**73,027.11**	**100%**

If we assume the strong policies and risk management practices in relation to deforestation equate to avoiding harm to biodiversity, then only 1 % of finance from those 75 institutions was not contributing to negative impacts to biodiversity. If all of the financial institutions were to increase their commitments to tackle deforestation or were to successfully implement any of the biodiversity risk management practices described in this section, the remaining US$ 71.9 billion of finance could be directed away from companies that engage in activities that cause harm to biodiversity and toward other companies that have sustainable practices.

the threat of divestment, and others. This is particularly important in the case of industries and sectors that pose the greatest threats to biodiversity such as agriculture, forestry, infrastructure, mining, and real estate.

While the use of ESG risk management has expanded greatly in the past decade, differences in the extent to which these risk management practices have been applied are enormous and vary across a variety of parameters including (1) subsector of the finance industry (banking vs. insurance vs. asset management), (2) type of financial product or service (e.g., project finance vs. corporate lending vs. securities offerings vs. M&A advisory), (3) geography (ESG risk management standards vary greatly between countries), (4) type of risk (with climate risk standing out as a risk attracting considerable attention, while biodiversity risk is still viewed by many as an emerging issue), among others. Nevertheless, greater awareness of the dependencies between sectors of the economy

[xii] This report's calculations are based on the 2019 Forests & Finance database and publicly available Forest 500 information.

CASE STUDY:

Reducing Impacts to Biodiversity from the Infrastructure Sector

Even though most global infrastructure projects incorporate biodiversity impacts into their planning processes, biodiversity conservation has been frequently omitted from the meaningful sustainability standards for these projects.[269] In 2020, a review of the pipeline for renewable energy projects alone found that there were 922 large wind, solar, and hydropower projects that overlapped with important conservation areas and could have significant impacts on biodiversity.[270]

Financial institutions, especially multilateral development banks (MDBs) and development financial institutions (DFIs), can leverage their financial contributions to infrastructure projects to demand better practices with regards to projects' impacts on biodiversity. In 2017, around 17 % of global infrastructure projects were financed through private investment, while 83 % were financed through public investments.[271] It is worth noting that 55 % of private investment was actually financed by non-private sources such as public banks, bilateral sources of finance, and multilateral sources of finance.[272] In developing countries where financial requirements for infrastructure are substantial and greater than the public sector's financing capacity,[273] MDBs and DFIs can play an important role in mainstreaming biodiversity-related risk mitigation.[274] These institutions increasingly have a mandate for responsible and sustainable investing, and many have integrated forms of biodiversity-related ESG risk management that safeguard against risks to biodiversity.[275] Project sponsors that receive a portion of their financing from a DFI with stringent standards on biodiversity-related risks will have to demonstrate that project construction and operations are compliant with the DFI's standards.

Currently, DFI- and MDB-funded projects can still improve their biodiversity risk analysis frameworks. In a 2017 monitoring report, the World Bank Group Compliance Advisor/Ombudsman (CAO) flagged "ongoing concerns that the International Finance Corporation (IFC) does not, in general, have a basis to assess FI clients' compliance with its environmental and social requirements."[276] Moreover, a total of 38 complaints raised to the CAO by communities affected by IFC projects were related to land pollution and/or biodiversity, equivalent to 26 % of all eligible complaints from 2000 to 2014.[277] These issues are unlikely to be unique to the IFC and require greater collaborative effort on behalf of MDBs and DFIs, which can influence future infrastructure construction and operation practices.

Private financiers, who have no affiliation to multilateral or development institutions, of infrastructure must also play a greater role in minimizing infrastructure assets' impacts to biodiversity. Of the US$ 1.5 trillion of private investment that the Overseas Development Institute (ODI) estimates was channeled to financing infrastructure in developing countries between 2008 and 2017, "standalone" private financiers, those without public or multilateral co-financiers, accounted for 78 % of private infrastructure flows.[278] Given their role in providing such a significant proportion of infrastructure financing in these countries, these firms could play a critical role in enforcing environmental stewardship standards for financed projects.[279] This is particularly crucial for financial institutions that invest in greenfield projects that involve construction on previously undeveloped sites due to the dependencies on and risks posed by biodiversity to those investments.[xiii]

[xiii] As opposed to brownfield project sites, which have previously been developed where biodiversity would likely already have been degraded to some degree.

Private financial institutions must also improve their biodiversity risk management practices for their infrastructure portfolios. As of mid-2020 more than 100 financial institutions and nearly 40 countries are signatories of the Equator Principles, which are the most common environmental and social risk management framework.[280] While these frameworks ostensibly inform actions in several financial institutions, the principles have been criticized as insufficient to enable meaningful action to meet environmental goals.[281]

An example of best practice of ESG risk management in private infrastructure financing is Meridiam, an investor that manages over €6.2 billion of assets and specializes in developing, financing, and managing infrastructure projects.[282] Meridiam was named Sustainability Infrastructure Investor of the Year by Infrastructure Investor in 2019, due to its efforts to not only reduce its environmental footprint but also to improve positive impacts to the environment and society.[283] Meridiam has an "Approach for a Responsible Management of ESG Issues and Sustainable Development Goals," which is an integrated approach to responsible investment and ESG risk management. The approach involves screening against more than 200 ESG criteria, which includes "impacts on nature protection areas and biodiversity," and positive SDG screening to identify investments' associated positive impacts and performance indicators that will be monitored during the development of the project.[284]

and biodiversity, and the extent to which many industries rely on ecosystem services, are driving a growing interest in understanding these risks and incorporating them into business decisions. Greater standardization of biodiversity risk management practices, agreement on key performance indicators and metrics (since biodiversity does not have a simple, universal metric as the area of climate does in the form of metric tons of CO_2-equivalent), and increased data collection will, in the coming years, facilitate the incorporation of biodiversity risks into investment decisions.

Due to the fact that there are many uncertainties surrounding the future development of biodiversity-related investment risk management, as well as to the limited availability of information about ESG risk management practices, which is held closely by individual financial institutions, projections on future capital flows for this mechanism, unlike for the eight other mechanisms discussed in this report, have not been developed. However, given the amount of capital flowing through the financial markets, the importance of financing to many of the industries with the greatest impacts, on biodiversity, investment risk management practices applied rigorously to biodiversity hold huge potential to slow down deforestation, habitat degradation, and species loss, and potentially to increase capital for activities that have net-positive effects on biodiversity.

E. Obstacles and Enabling Conditions

While progress has been made on the integration of ESG considerations into financial risk management, the assessment of environmental matters has focused primarily on climate risk, with comparatively little attention paid to biodiversity risk.[285] The fact that financial institutions and investors, in general, do not yet view biodiversity loss as a material risk is due to a variety of factors, but prominent among them is the fact that the science of biodiversity loss is not as well understood and is more complex than that of climate change. Climate also benefits from having a simple set of metrics, since the cumulative risk can be measured in metric tons of

CO_2-equivalent (which are distributed globally), and the direct consequences can be measured in average global temperature increases in degrees Celsius. Biodiversity loss is more difficult to evaluate, since the immediate consequences of habitat degradation are local or regional, and the import of a species extinction is hard to put into context—indeed, experts do not even have a clear idea of how many species there are on Earth, so losing one species means little to most people. Ecosystems are nonlinear systems that change over time and respond to extraneous influences in ways that leave even the most experienced ecologists nonplussed, and the knock-on effects of damaging one part of an ecosystem on another are almost completely unpredictable.

Viewed from the vantage point of business, the climate crisis may appear universal in its impacts as well as in its root causes: dramatic temperature increases and more frequent extreme weather events could affect all major industries and may be the result of the near-universal reliance within business on fossil fuels for transportation and electricity. On the other hand, as sweeping in its effects as the biodiversity crisis appears to many observers, for some it may be easy to become complacent and assume that the biodiversity crisis will touch fewer lives, that it results from the activities of a small number of industries (agriculture, forestry, fisheries, and a few others, perhaps exacerbated by the use of fossil fuels), and that it will also negatively impact fewer industries (those mentioned above plus pharmaceuticals, tourism, and related industries). However, this narrow view of biodiversity loss fails to recognize the evidence from several researchers and observers that has been recently summarized in a report by the World Economic Forum[286] that argues convincingly that the biodiversity crisis may not, in fact, touch fewer lives than the climate crisis.[287]

Financial institutions may be better able to account for biodiversity loss, and its associated risks and costs, with better data collection methodologies with which they can analyze environmental and portfolio-level biodiversity impacts.[288] Investors frequently refer to data availability as one of the key barriers to effective biodiversity stewardship, with the data gap relating both to a lack of current and projected environmental data as well as corporate asset-level and supply chain data. For example, companies releasing their land bank data and location of company assets would be a key enabler for investors who wish to better understand their exposure to unsustainable palm oil. Recent initiatives, such as the ENCORE Tool,[289] that seek to map and facilitate access to natural capital datasets, and the Spatial Finance Initiative,[290] which aims to integrate geospatial data and analysis into financial practices, are breaking ground in the area of biodiversity data.

To act on this data, firms also need more mature risk assessment and reporting methodologies, accompanied by standardized frameworks and metrics that support these outputs. Although the development of metrics to assess biodiversity impacts at the company/investment level is underway, portfolio-level analyses and data collection on biodiversity risk management are at a very early stage, which could prevent the adoption of these practices among financial institutions. Should portfolio-level risk management tools become available for financial institutions, investors will have a clearer picture of their portfolio's overall risk to biodiversity, as well as its impact. Initiatives such as the Species Threat Abatement and Recovery (STAR) Metric (formerly known as the Biodiversity Return on Investment Metric, or BRIM) by IUCN,[291] the Cambridge Institute for Sustainability Leadership's "healthy ecosystem" metric framework,[292] as well as the Business and Biodiversity Offsets Program (BBOP)[293] have all attempted to address this issue. While in existence, these initiatives have yet to be meaningfully incorporated into frameworks used by private investors and their investees.

In recognition of the current lack of mainstream benchmarks for biodiversity-related risks, four leading French asset managers created their own tool to analyze their investments' impacts on biodiversity.[294] In the long term, this tool will enable the creation of a database where investors can keep track of companies' biodiversity impact metrics, as well as their exposure levels to biodiversity-related risks. While noteworthy, these efforts would not have been possible without the introduction of supporting legislation. Thus, a combination of private sector interest, data collection, and regulatory support must enable the creation of standardized frameworks for understanding biodiversity risk.

Broadly speaking, there has yet to be a global regulatory system that integrates biodiversity into financial institutions' risk management processes. Currently only 11 % of the world's 75 largest asset managers have policies that require their portfolio companies to minimize harmful impacts on biodiversity.[295] For investment risk management to become a mainstream risk analysis tool, more investment managers and banks need to adopt it into their regular practices. Financial institutions such as Natixis and HSBC have begun to lead the way for other institutions through creating concrete pledges to safeguard natural capital.[296] More financial institutions should implement similar policies to mitigate risks for their portfolios and for society. Without a broad consensus on the need for biodiversity risk management, firms will not have the economic incentive to potentially limit their revenue opportunities by limiting banking or investment activities conducted with high-risk companies.

The final barrier, which relates to investors specifically and which applies to ESG matters broadly, relates to the fiduciary duties that investors owe to the beneficial owners of the assets they manage. Acting in the "best interests" of the asset owner has traditionally been viewed from a purely financial perspective. Legal analysis conducted over the course of the last decade on why addressing environmental, social, and governance matters in investment analysis may indeed be consistent with their fiduciary duties have strengthened the argument for making such factors a part of investors' decision-making process, but this broader understanding of fiduciary doctrine has not yet become generally accepted.

The Fiduciary Duty in the 21st Century program has sought to clarify investor obligations and duties in relation to the integration of environmental, social, and governance (ESG) issues in investment practice and decision making. The final report resulting from this program, including key findings and recommendations, was issued in October 2019.[297]

F. Recommendations

Financial institutions should take a lead role in understanding and avoiding harm to biodiversity from the deployment of private investment capital. They should recognize the reputation, regulatory compliance, and investor demand risks from continuing to operate under the status quo, as well as the potential revenue opportunities from proactive biodiversity risk management. They should manage these risks through systemic changes to internal structures, incentives, policies, and metrics to ensure that biodiversity conservation is integrated into all investments.

- In anticipation of potentially growing reputational risk, all financial institutions should utilize screening tools, standards, and internal policies to avoid investments that are harmful to biodiversity.
- In anticipation of potentially growing government regulation of the financial industry (regulatory risk), financial institutions should collaborate between themselves and work with appropriate government agencies to develop common

frameworks and metrics for assessing and managing their potential impacts to biodiversity.

- Financial institutions should also recognize the public momentum behind financing biodiversity-positive investments and take proactive steps to align their investment strategies to both reduce investment impacts on biodiversity and move toward investments that have positive biodiversity results.

Financial institutions should disclose the biodiversity impacts of their investments via appropriate disclosure frameworks and require the same of companies in their investment portfolio.

- Investment management firms should use disclosure frameworks to evaluate existing portfolio assets and companies as well as future investments for biodiversity risk. Those with the capacity to engage either directly or through shareholder activism should leverage their positions with those companies where biodiversity risk is material to their operations, profitability, and reputation.
- Financial institutions should require that companies in their investment portfolio openly disclose their biodiversity-related risk and previous and current impacts on biodiversity. Financial institutions should lead on collaborative efforts to identify and agree on key biodiversity-related risks and identify the relevant sectors and geographies that drive these risks; these can subsequently inform the creation of biodiversity risk management frameworks.
- Those institutions who are signatories to the UN Global Compact should increase their adherence to the precautionary principle in relation to how their actions can result in harm to biodiversity.

Financial institutions should build their capacity to assess how investment decisions can lead to biodiversity loss and manage the associated biodiversity risks.

- Financial institutions must invest and develop their internal capacity, across all sectors and geographies, to integrate research on biodiversity related risk into their investment decision-making processes. This increased understanding and utilization should be driven learning opportunities and new internal performance metrics.
- Market research firms that produce research material for financial institutions should begin to keep track of biodiversity risk performance for their covered companies.
- Chief risk officers (CROs) at major financial institutions should be well-versed in biodiversity-related risks, especially if their overall portfolio is significantly exposed to high-risk sectors and/or regions. CROs, with the support of their respective financial institutions, should also lead the integration of biodiversity risk management into business-as-usual risk analysis.

Financial regulators and fiduciaries should adopt a broader understanding of fiduciary duty that is not narrowly limited to maximizing short-term economic returns, but that also accounts for the positive and negative collateral effects of investments upon those to whom a fiduciary duty is owed. A revised understanding should allow for consideration of nonfinancial benefits to clients, including the value of biodiversity, as proper components of the fiduciary's analysis of the merits of competing investment choices.

- Regulators should clarify the materiality of biodiversity risk for financial institutions and the potential of those risks to impact

future returns.

- Regulators should take the position that environmental factors may have a direct relationship to the economic and financial value of an investment, and that a fiduciary may and should consider such factors when evaluating an investment on behalf of a client.
- Regulators should state that deploying capital on behalf of an investor in a manner that negatively impacts the investor's long-term interest in living in a safe, healthy, and prosperous society could constitute a breach of fiduciary duty even if the investments represent attractive short-term investment opportunities.
- Governments should help build institutional capacity in countries where resources to integrate biodiversity management are currently lacking.

Governments should develop and implement policies and legislation that require financial institutions to implement and report on biodiversity risk disclosure frameworks.

- Governments should require financial institutions to assess and report on investments that impact on biodiversity using a common framework and metrics.
- Regulations should also require financial institutions to take actions to better understand and avoid harmful impacts to biodiversity from their investments.
- Governments should provide policy support for these frameworks by creating and protecting compliance standards for incorporating biodiversity-related risk analyses into public and private investment processes.
- Frameworks that result from such an analysis can mirror the Task Force on Climate-related Financial Disclosures, which covers a company's assessment and management of climate risks, climate governance structure, climate risk management strategies and opportunities, and reporting of metrics and targets.

International organizations, financial institutions, and NGOs (including academia) should develop metrics, methodologies, and platforms for sharing data on the impacts of investments on biodiversity.

- Experts across academia, financial institutions, research organizations, and international institutions should identify, develop, and make publicly available methodologies for collection of data pertinent to understanding and measuring biodiversity-related risk and risk exposure. Data collection should account for the short- and long-term impacts on biodiversity and may therefore necessitate investments in new types of data analyses, such as geospatial analyses and related spatial finance decision-making tools.
- Governments can play a greater role in standardizing financial institutions' biodiversity-related risk data collection through supporting and incubating open-source or affordable platforms where biodiversity data is available in a format appropriate for the needs of the financial sector.

5.3 Biodiversity Offsets

A. Background

Biodiversity offsets are actions that compensate for developments adverse impacts to wildlife, habitat, and other ecological values through the restoration, enhancement, and protection of equivalent resources elsewhere.[xiv,298] The intent is for nature to be retained or restored in net terms. Offsets are a component of the environmental policies and standards of many governments, financial institutions, and corporations.[xv,299,300,301,302] The aim is for development projects, such as those in the energy, mining, infrastructure, and commercial agriculture sectors, to internalize the costs of their adverse biodiversity impacts, as those costs are otherwise borne by nature and society.

Offsets are just one component of mitigation programs, which require or encourage development projects to first avoid and minimize impacts and then provide compensation for remaining unavoidable impacts. Together, these steps—avoidance, minimization, restoration, and compensation or offsets—are referred to as the mitigation hierarchy (Figure 5.3). Impact avoidance is the first and most important step. The goal is to avoid and minimize biodiversity impacts so that offsets are not needed. Offsets are the last step—actions taken when residual impacts remain after avoidance and minimization measures. The 195 countries that are Parties to the UN Biodiversity Convention have specifically endorsed and recommended the use of the mitigation hierarchy as the key to mainstreaming biodiversity in the energy, mining, and infrastructure sectors.[303]

The goal of offset programs is to deliver net gain or at a minimum no net loss of biodiversity by fully addressing the residual biodiversity losses caused by development project impacts.[304] Net gain outcomes leave biodiversity better off following the development activity, compared with a clear reference scenario.[305] Implementing biodiversity offset programs to achieve these goals is challenging. The key challenges include

- Problems establishing governance and enforcement measures to ensure that development follows the mitigation hierarchy;
- Difficulties in accounting for losses and gains to deliver no net loss or better outcomes given the differences in biodiversity values, uncertainties, and risks; and
- Practical and technical obstacles to designing and implementing offsets that deliver long-term ecologically successful outcomes.[306]

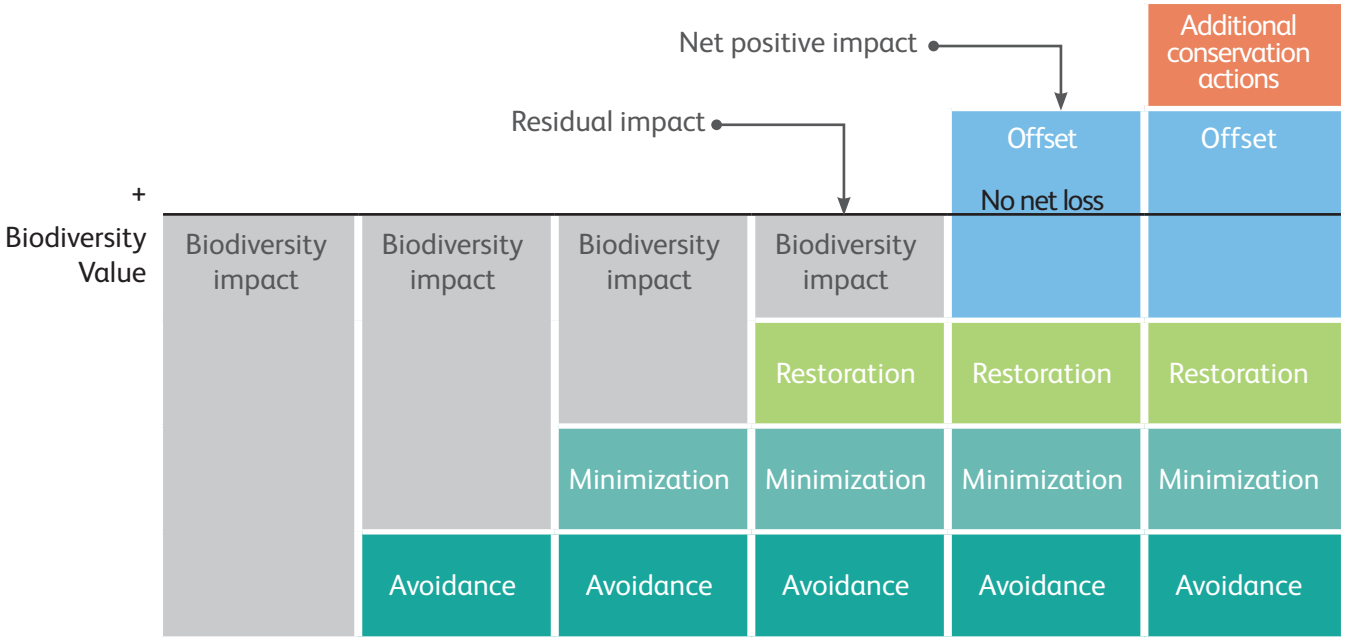
Projections show that development pressures on lands and waters will grow,[307] especially from the agriculture, energy, and infrastructure sectors, with trillions of dollars in project investments on the horizon.[xvi, 308,309] Currently, the majority of development projects with adverse biodiversity impacts go forward without sufficient impact avoidance and little to no offsetting actions. To halt global biodiversity losses and support sustainable development, stronger application of the mitigation hierarchy is needed to avoid and minimize adverse biodiversity impacts and increase compensatory conservation actions.

[xiv] Performance Standard 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources defines biodiversity offsets as "measurable conservation outcomes resulting from actions designed to compensate for significant, residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization, and restoration measures have been taken." Similar definitions are used by other development and conservation organizations including the Business and Biodiversity Offsets Program (BBOP), International Council on Mining and Metals (ICMM), Cross Sector Biodiversity Initiative (CSBI), The Nature Conservancy, and World Conservation Union (IUCN).

[xv] Policies, standards, and guidance include: (1) IUCN: World View—A Snapshot of National Biodiversity Offset Policies; (2) The Equator Principles; (3) Biodiversity Offsets: A User Guide; and (4) Biodiversity Offsets: Effective Design and Implementation.

[xvi] For example, infrastructure investments are projected to be between US$ 79 trillion and US$ 94 trillion through 2040. Total global energy investments were US$ 1.8 trillion in 2018.

FIGURE 5.3 Applying the mitigation hierarchy for no net loss or a net gain of biodiversity



Source: UN Global Compact and IUCN, 2012.[310]

B. Description of Mechanism

Biodiversity offsets are implemented in response to (1) government policy requirements, (2) financial performance standards, and (3) voluntary corporate policies.[311] Each of these drivers is discussed below.

Government Policy Requirements

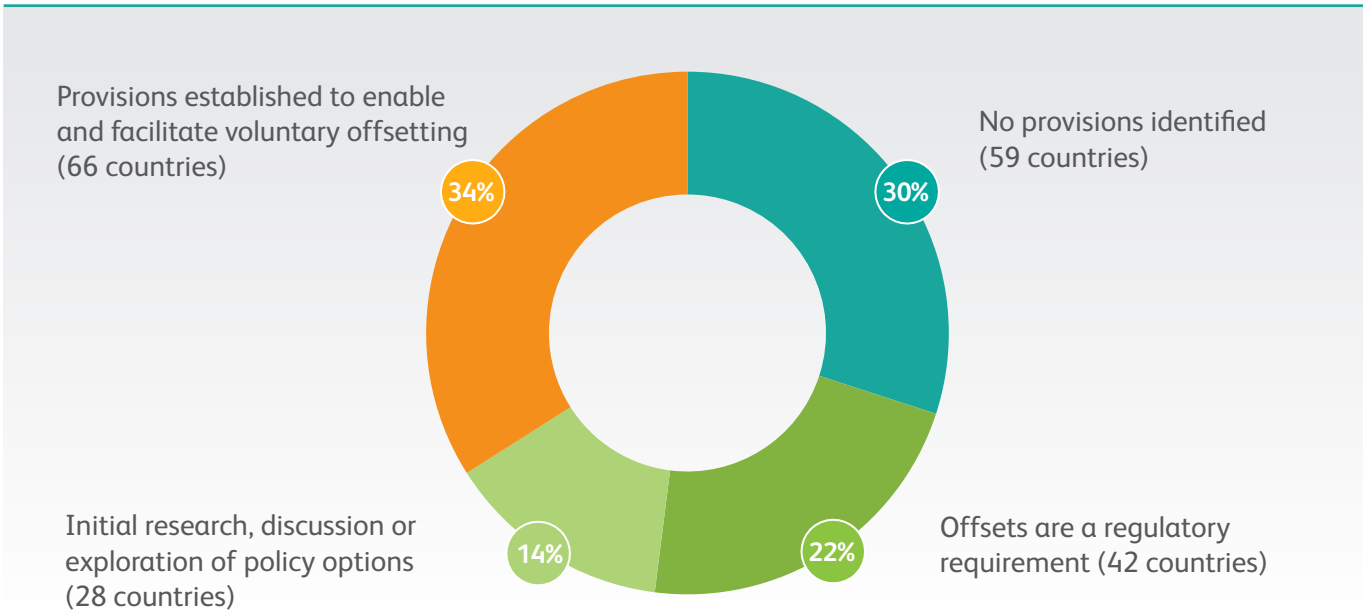
Policies for mitigating environmental impacts are often rooted in legislative or regulatory requirements that mandate application of the mitigation hierarchy. These policies may be part of an environmental impact assessment (EIA) policy or other regulatory program that requires avoidance, minimization, and compensation for impacts to specific habitat types or species. The purpose of an EIA is to ensure that decision makers consider the potential environmental impacts of a proposed project, as well as project alternatives, when deciding whether or not to proceed with a project. For projects that go forward, the policy may require development, approval, and implementation of an offset plan designed to compensate for residual project impacts.

Of the 195 countries tracked in the Global Inventory of Biodiversity Offset Policies (GIBOP), offsets are a regulatory requirement in 42 countries (22 %).[312] Countries with these policies generally are also those with high levels of development activity, representing over 70 % of global GDP.[313] An additional 66 countries (34 %) have established provisions to enable and facilitate voluntary offsets, while 29 countries (14 %) have undertaken initial exploration of offset policy options, and the remaining 59 countries (30 %) have no identified provisions for offsets (Figure 5.4).[314] Most low- and middle-income countries do not have regulatory requirements for biodiversity offsets.

Offset implementation mechanisms—the vehicles by which offsets are delivered—fall into two broad categories: permittee-responsible offsets and third-party offsets. These approaches differ in how they treat liability for carrying out successful offset projects.

- Permittee-responsible offsets are those undertaken by the project proponent (developer/permittee). The defining element

FIGURE 5.4 Global progress on offset policy adoption worldwide



Source: IUCN. Global Inventory of Biodiversity Offset Policies.

of this mechanism is that the permittee is responsible for, and retains all liability for, the offset. This includes identifying the site, securing approval for the offset plan, implementing the plan, carrying out monitoring and reporting, addressing any necessary remedial measures, and providing for the long-term management of and financing for the offset. An estimated 97 % of offsets worldwide are implemented through permittee-responsible approaches.[315]

- Third-party offsets are those that are carried out by a third party—such as a conservation organization or a private company—and liability for the success of the project transfers to the third party. The two best-recognized examples of third-party offsets are mitigation banks and compensation funds.
  - Mitigation banks: A mitigation bank is a site identified, restored, protected, and managed by an entity other than the project proponent. Banks are established independent of specific impact projects. Once they have demonstrated ecological performance, "credits" are released and can be sold to developers.
  - Compensation funds: A fund established and managed by a third party that accepts payments for impacts based on an established fee structure, also known as in-lieu fee programs. Credits are sold to developers and projects are carried out once sufficient funds have been collected, which generally means there is a lag time between project impacts and offsets. The compensation fund approach allows for offsets to be directed to landscape-level biodiversity conservation priority areas.

Financial Performance Standards

Financial performance standards (also referred to as safeguards or performance requirements) are intended to guard against unforeseen risks and impacts, improve financial and operational performance, and support a social license to operate.[316] Clients seeking financing that is subject to such standards must provide information regarding the environmental and social risks and

impacts of their proposed projects. The financial institution then assesses these risks and impacts against its standards as part of its due diligence process and decision making.

Financial performance standards apply to the projects of borrowing companies, even if the projects are located in countries without regulatory requirements for applying the mitigation hierarchy and implementing biodiversity. This makes financial performance standards a potentially powerful global driver for biodiversity offsets. As noted above, regulatory requirements for biodiversity offsets have only been established in 42 countries, and the majority of these programs are not yet being fully implemented. For most of the world, including most of the biodiversity-rich countries, financial performance standards are the only mechanism for requiring offsets.

The performance standards of the World Bank Group's International Financial Corporation (IFC) are generally considered to be the leading global standards, including Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources), which states:

> *For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied. A biodiversity offset should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats.*[317]

Similar performance standards have been adopted by most multilateral financial institutions, including the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank, New Development Bank, and other segments of the World Bank. Export credit agencies have adopted comparable performance standards for environmental and social due diligence.[xvii]

In addition, more than 100 of the world's leading financial institutions have adopted the Equator Principles, which require compliance with the International Finance Corporation (IFC) Performance Standards and World Bank Group Environmental, Health and Safety (EHS) Guidelines.[318] These financial institutions are based in 38 countries and cover more than 80 % of project finance transactions in emerging markets.[319] The Equator Principles apply globally to all industry sectors and to four financial products: (1) project finance advisory services, (2) project finance, (3) project-related corporate loans, and (4) bridge loans.

Voluntary Corporate Policies

By definition, voluntary corporate policies do not compel companies to implement biodiversity offsets; they are, therefore, far less of a driver for offsets than policy requirements and financial performance standards. However, there are a small number of international companies that have established goals for no net loss of biodiversity as part of their corporate sustainability policies. At least 32 companies have set public, companywide no let loss or net positive impact goals, with most of these companies in the mining (13 companies), energy (5), and manufacturing (4) sectors.[320]

Financial performance standards have been an important driver for companies to adopt voluntary corporate policies for no net loss of biodiversity. Some companies have determined that they will comply with performance standards for all of their projects as part of their corporate sustainability policy. This approach supports greater access to finance,

[xvii] See for example: OECD Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence (the "Common Approaches"), which was adopted on 28 June 2012 and revised by the OECD Council on 6 April 2016 (OECD/LEGAL/0393).

as all projects have the potential to seek loans from lenders that have adopted performance standards. Such voluntary corporate leadership can benefit a company in several other ways, including increasing its influence when engaging on environmental legal and regulatory issues; improving its social license to operate and reducing the risks of project delays, costs, and biodiversity liabilities; and building its reputation so that it can be a preferred operator and/or strengthen its brand and staff loyalty.[321]

C. Why Is It Important to Biodiversity?

Strengthening the application of the full mitigation hierarchy represents one of the most important opportunities worldwide for stemming the biodiversity crisis and addressing the funding gap for biodiversity conservation. Currently, biodiversity offsets only address a small fraction of development impacts globally. The vast majority of biodiversity impacts occur without any corresponding compensation being carried out. Figure 5.5 shows how halting the biodiversity crisis will require applying the mitigation hierarchy to reduce future impacts of development while increasing compensation for the impacts that do occur. Effectively offsetting all residual development impacts to biodiversity is needed to achieve the global no net loss of biodiversity.

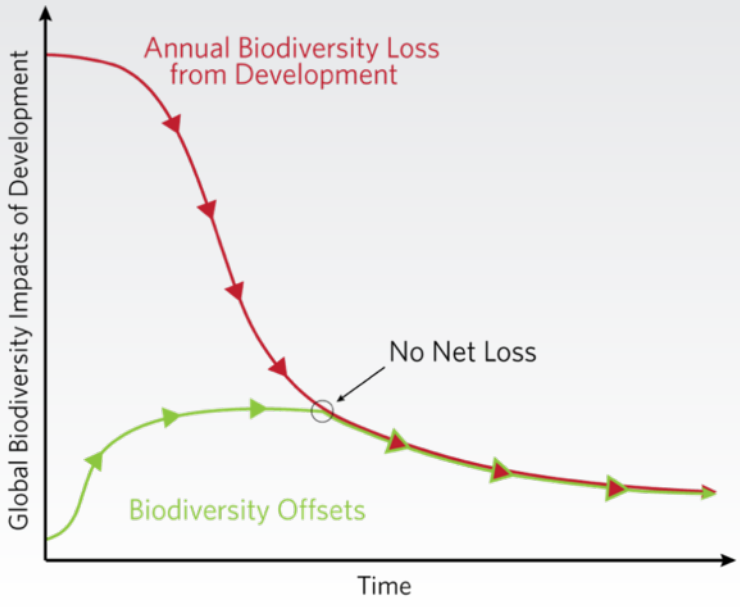
D. Financial Impact: Current and Future

Current State

The current annual level of conservation funding generated by biodiversity offsets is estimated based on a review of (1) offsets required by government policies, (2) offsets required to meet financial performance standards, and (3) voluntary corporate offsets. Based on the available information (described below), the annual level of offset expenditures is approximately **US$ 6.3–9.2 billion**.

Offset expenditure data has been referred to as

FIGURE 5.5 Halting the biodiversity crisis: applying the mitigation hierarchy to achieve no net loss of biodiversity from development impacts



Strengthening the application of the mitigation hierarchy to avoid and minimize the biodiversity impacts of development reduces annual biodiversity losses from development over time (red line declining) and increases biodiversity offsets to compensate for the residual biodiversity impacts of development that do occur (green line increasing). No Net Loss for the biodiversity impacts of development is achieved when the level of annual biodiversity loss equals the level of annual gain from biodiversity offsets. Avoidance and minimization measures continue to drive a decrease in biodiversity impacts from development over time, with offsets fully compensating for losses.

the "dark matter" of conservation funding due to the dearth of available data, especially for offsets implemented directly by permittees.[322] Of the 42 countries with regulatory requirements for biodiversity offsets,[323] nine countries have implemented a significant number of offsets, defined here as more than 100 offsets.[324] The other 33 countries have implemented a limited number or no offsets.

Offset expenditure data were identified for five of the nine countries that are actively implementing offsets—Australia, Brazil, Germany, Mexico, and the United States (Table 5.11; see methodology section for details on estimates for each country). Offset policies in Germany and the United States were established four decades ago and account for almost all of the annual offset expenditures. Estimates were not readily available for the other four countries with active offset programs: Canada, France, the Netherlands, and Spain.

Few offsets have been implemented to meet financial performance standards or voluntary corporate standards. Although these standards have been in place for more than a decade for many financial institutions and companies, only 22 offsets have been implemented to meet financial performance standards, and 20 offsets implemented on a voluntary corporate basis, in the history of the standards.[325] It is notable that the offsets implemented to meet financial performance standards and voluntary offsets have often been associated with large-scale projects[326] and likely involved significant offset expenditures. However, sufficient empirical data was not readily available to include these projects in our estimate of offset expenditures. As a result, the estimate of current offset expenditures only reflects offsets implemented to meet policy requirements, and is therefore likely to be an underestimate.

TABLE 5.11 Current State of Biodiversity Offsets Expenditures (2019)

Country and year of the estimate	Annual offset expenditures (US$ bn/year, adjusted to 2019)
Australia (2017)	0.007
Brazil (2016)	0.004
Germany (2010)	1.4–4.4
Mexico (2011)	0.08
United States (2007, 2017)	4.8
Total	**6.3–9.2**

Note: The methodology behind these figures is presented in Appendix A.

Future State

To determine the potential annual level of conservation funding from future biodiversity offsets, an upper bound can be established by estimating the compensatory funding needed to offset all adverse residual impacts of development worldwide. Developing this estimate involves projecting the total annual development footprint worldwide that would require offsets, and then estimating the corresponding costs to implement offsets to address the footprint. See Appendix A for detailed information on the approach.

The total future development footprint that would require offsets is estimated to be 3.60 million km^2 from 2019 to 2050. This is driven by agricultural expansion (~40 % or 1.52 million km^2), energy and mining (~33 % or 1.20 million km^2), and urban expansion (~27 % or 0.95 million km^2). Assuming a linear average over the time frame from 2019 to 2050, the average annual area requiring offsets is 116,000 km^2 or 11.6 million hectares (see Appendix A).

By applying a one-to-one impact-to-offset ratio to this area and multiplying by an average offset cost per hectare, the potential upper bound of conservation funding from future biodiversity offsets is estimated to be as high as US$168 billion/year.

If the same approach is only applied to the 42 countries with regulatory policies requiring offsets and the 66 countries with established provisions for voluntary offsets—countries that are better positioned to expand biodiversity offset implementation to address all adverse residual impacts of development—the potential conservation funding from future biodiversity offsets is estimated to be as high as US$ 162 billion annually.

Based on these two approaches, potential conservation funding from future biodiversity offsets is estimated to be as high as US$ 162–168 billion/year (Table 5.12). Current offset funding of US$ 6–9 billion represents only a fraction—about 5 %—of the funding needed to compensate for the annual impacts of development to biodiversity.

It is important to provide some caveats and context regarding the estimate of potential offset funding. First, the estimate is an upper bound. Achieving this level of offset funding depends on adoption, effective implementation, and full compliance with mitigation policies and financial performance standards worldwide. While there is promise in the increasing adoption of mitigation policies and standards globally, offsets still only address a small fraction of biodiversity impacts; there remains a large gap between the upper bound estimate and current offset practice.

Second, the upper bound estimate for offsets should not be viewed as a goal for compensation. As noted above, impact avoidance is the first and most important step of the mitigation hierarchy. The goal is to avoid and minimize biodiversity impacts so that offsets are not needed (as illustrated in Figure 5.5). Offsets are the last and most expensive step of the mitigation hierarchy—a "last resort" taken when residual impacts remain after avoidance and minimization measures. The estimates in Table 5.12 are made assuming that development in key biodiversity areas is avoided, but impact is not minimized or restored, that is, all developments require offsets.

Third, although offsets provide a "trade" of compensating conservation actions for development impacts, expanding offsets has tremendous potential to increase conservation. This is because the current baseline for most of the world is one in which project impacts are occurring without compensation. Implementing offsets in these places would represent an increase in conservation funding compared to the current lack of compensation.

TABLE 5.12 Future State of Annual Biodiversity Offsets (2030)

Category	Potential Annual Expenditures for Offsets (2030) US$ bn / year
Biodiversity Offsets	162.0–168.0

Note: The methodology behind these figures is presented in Appendix A.

E. Obstacles and Enabling Conditions

Policy requirements and financial performance standards are the most effective drivers for increasing the application of the mitigation hierarchy and implementation of biodiversity offsets. The barriers to moving toward implementation and policy requirements are many-pronged.

The largest issue with policy is the absence of mitigation and offset requirements in 87 countries. Without regulatory requirements driving offsets, they will generally not be implemented. Even in countries where programs are established, there are many weaknesses in offset programs and the implementation of offset policies. In the 108 countries where policies do exist, implementation and governance have largely lagged behind the goals and requirements of the policies themselves. In many cases, this is because the necessary offset program components are not in place or there

are weaknesses in compliance and enforcement.

Other issues include challenges with offset program design and implementation. Offset programs require several technical components, such as the loss/gain methodology, appropriate offset actions, and offset mechanisms for delivery. Programs must balance the need for a rigorous approach that ensures biodiversity losses are effectively addressed, with a practical approach that can be implemented efficiently despite potential institutional capacity and technical challenges. This challenge has been referred to as the "precision trap."[327]

Even where policies may be established and functioning, there is still a lack of transparency. Most mitigation programs lack transparency regarding impact locations and trends, offset locations and trends, and administrative and ecological performance of offset programs and projects. Transparency supports the development of robust, successful mitigation markets by providing the public with information on supply and demand, supporting continuous improvement to offset practices, and allowing the public to play a role in ensuring compliance.

Separately, significant barriers also exist for the development of financial performance standards to support biodiversity offsets. While most multilateral financial institutions and more than 100 financial institutions who are signatories to the Equator Principles have committed to financial performance standards, there remain some financial institutions who have not committed to performance standards. This provides an avenue for project developers to obtain financing without subjecting their projects to performance standards that would require applying the mitigation hierarchy and addressing residual project impacts with offsets. Of the many institutions that have adopted financial performance standards and who invest trillions of dollars in large-scale projects around the world, most do not appear to be implementing their biodiversity-related performance standards effectively. Only 22 biodiversity offsets have been implemented to meet financial performance standards over the history of the standards.[328]

As with the implementation of policies, there is often a lack of transparency regarding the implementation of financial performance standards. Current disclosure and reporting on project investments do not provide sufficient means for assessing the extent to which projects have applied the mitigation hierarchy, avoided and minimized impacts to critical and natural habitat, and, where necessary, implemented offsets for residual impacts.

F. Recommendations

Governments with existing biodiversity offset and mitigation hierarchy policies should strengthen enforcement using supporting tools such as regulation, planning processes, and legislation. Governments without existing policies should immediately develop, implement, and enforce them to, first, avoid and minimize impacts to critical natural habitat and, second, to implement biodiversity offsets to achieve no net biodiversity loss or, where possible, net gain.

- For the 108 countries that currently have biodiversity offset policies and provisions in place, national and subnational governments should evaluate their offset programs, determine barriers to implementation, and undertake action plans for full and effective implementation.
- For the 87 countries without biodiversity offset and mitigation hierarchy policies and provisions, national governments should commit to adopting mitigation and offset policies with a net gain goal for biodiversity. Bilateral and multilateral

agencies should provide technical and financial assistance to support the development of these policies.

National and subnational governments should conduct (and make public to authorities, developers, and communities) spatial landscape planning to identify areas of critical habitat, made publicly available, to influence development planning processes and underpin the effective application of the mitigation hierarchy.

National and subnational governments should require project developers to conduct long-term monitoring and reporting on biodiversity offsets to ensure they are achieving the desired outcomes.

- Governments should mandate long-term monitoring and reporting on biodiversity offsets to allow for verification that the offset is functioning as desired and is providing the requisite amount of biodiversity offset to the harm from development.
- Governments should establish a recourse mechanism to hold developers to account for an increasing amount of biodiversity offsets should the monitoring and reporting indicate that the existing offset is insufficient or ineffective.

Financial institutions should strengthen the implementation of biodiversity-related performance standards within their investments and mandate that projects they invest in should demonstrate, via reporting and verification, no net loss of biodiversity or, where possible, net gain. Investments should be designed to allow adequate funding for long-term monitoring of the offset after the development has been completed.

- Consistent with biodiversity-related performance standards and the first step of the mitigation hierarchy, financial institutions should not invest in projects that have detrimental impacts on biodiversity.
- Financial institutions should more rigorously enforce requirements for offsets to fully address unavoidable adverse impacts to biodiversity from their investments.
- Financial institutions should improve the public disclosure of information regarding how project investments comply with financial performance standards. This should include summary information on the number of project investments with impacts to critical and natural habitat, the anticipated adverse residual project impacts to biodiversity, the number of projects implementing offsets to address the residual impacts, and the mitigation and offset plans for addressing impacts, including estimated costs and expected biodiversity gains.
- Financial institutions should support rigorous third-party audits and verification of their compliance with biodiversity-related financial performance standards. Given the long-term nature of offsets, post-project auditing procedures, similar to social impact and climate resilience audits, should be mandated to monitor compliance with biodiversity offsets requirements.

5.4 Domestic Budgets and Tax Policy

A. Introduction

To reverse the downward trend of global biodiversity loss and scale up the other mechanisms described in this report, all governments need to take responsibility and exercise their full authority to protect their respective biodiversity assets for the current and future well-being of their citizens and their economy. Whether this protection is through the establishment of protected areas, enforcement of environmental laws, using taxes to reduce harmful activities, or allocating increased budgets to ecological restoration, governments need to find the political will to pass strong laws and regulations, vigorously and effectively enforce these laws and regulations, and support these actions by securing long-term funding to sustain these efforts.

One of the most important means that governments have to promote the protection of biodiversity is the use of domestic budgets and tax policies. Fiscal policy choices can result in increased government revenue, for example, through taxes and penalties, or can direct government spending on selected activities or initiatives, for example, through subsidies or support to public services. Through a judicious exercise of the power to tax and to spend, governments can raise significant new revenue and spend it in a manner that achieves socially beneficial outcomes while influencing corporate and individual behavior. Thoughtful use of taxes, fees, and fines, combined with carefully targeted spending, can help governments greatly advance their national biodiversity protection efforts.[329]

The use of fiscal policies to fund and influence biodiversity protection is the oldest source of funding for conservation, dating back more than 100 years with the advent of dedicated park entrance fees, park concession taxes, and other forms of fees and charges used to support new park systems in the United States and Europe. Used to supplement what countries allocate through their annual budgeting process, the fiscal policies described in this section produce, in the aggregate, several billion additional dollars annually for biodiversity protection. Crucially, these fiscal policies have the potential to be increased several times over.

In line with how this report addresses the closing of the biodiversity financing gap, fiscal policies can both increase the revenue flowing into biodiversity protection and reduce the need for biodiversity financing by reducing the incentives for economic activity that is harmful to biodiversity.[330]

In addition to the normal budgeting process, through which an amount of funding is allocated annually to biodiversity protection, governments can create and administer a number of additional financing mechanisms that support the protection and management of their biodiversity. The most important of these mechanisms are:

1. Establishing innovative new tax, fee, and other revenue streams, which, when earmarked, can be used to cover additional costs of conservation not funded in core domestic budgets. This section of the report is primarily devoted to this area of fiscal policy and government action.
2. Subsidizing activities that benefit biodiversity and reforming those that are harmful to biodiversity in economic sectors such as agriculture, fisheries, and forests (those that are harmful to biodiversity are discussed in detail in the Harmful Subsidies Reform section of this report).
3. Making targeted payments for the delivery

of public goods, such as clean water, through programs such as natural infrastructure investments in watershed, coastal, and other ecosystems that deliver valuable ecosystem services (which are discussed in detail in the Natural Infrastructure section of this report).

4. Setting regulatory policies to control resource use and also penalize resource abuse. Governments can design these policies to create the enabling conditions for new market and investment opportunities (examples are carbon finance and biodiversity offsets, both of which are covered in other sections of this report).
5. Issuing green financial instruments such as green bonds or creating enabling conditions conducive to investment through favorable tax policy or through blended finance (which are discussed in detail in the Green Financial Products section of this report).

Governments collect taxes and manage budgets that, in most cases, allocate public funds to cover the costs of establishing and managing parks and other protected areas, as well as other forms of natural resource protection. Total government funding devoted to biodiversity conservation is discussed in Chapter 3 of this report and in Section D of this chapter. Of all the financing categories tracked by this report, government budgets are the largest source of current funding for biodiversity.[331] Nevertheless, given the many demands on government budgets and the challenge of raising tax revenues from traditional sources such as VAT and income tax, no country has been able to allocate all the funding needed to sustainably manage its biodiversity for the long term.

For reasons discussed in Chapter 2, dominant economic and market systems fail to adequately value biodiversity, thereby diminishing the amount of attention given to the impacts on biodiversity of decisions made on the use of key resources. This results in the persistent failure by governments to appropriate sufficient funding in their budgets for long-term biodiversity protection. While nature is regarded as a public good and is recognized as providing essential services to the economy from which all tax revenue is derived, many of the "services" that individuals and businesses rely on, such as clean air and clean water, are not paid for. Furthermore, individuals and businesses whose actions degrade natural ecosystems routinely externalize those costs.

As the benefits from nature and biodiversity are increasingly recognized by governments, a broader range of innovative dedicated taxes, fees, charges, fines, and other mechanisms are being used to boost funding and stimulate actions to protect biodiversity. Fiscal policy tools for biodiversity can either address the need to increase revenue or can be utilized to incentivize or disincentivize practices that impact biodiversity. These fiscal policies include the following:

1. Taxes, fees, tariffs, royalties, and charges that generate revenue for nature. These can be further broken down into measures related to access or usage that is not negative and that produces revenue, and measures related to a penalty or disincentive for bad behavior, also resulting in revenue.
2. Tax policies such as tax credits that are aimed at incentivizing good behavior and practices (or that are aimed at creating a disincentive for harmful behavior) but that do not necessarily produce available revenue.
3. Government subsidies that are aimed at supporting or influencing a particular practice, and in the case of biodiversity protection, are designed to incentivize good behavior.
4. Government-established and sponsored programs such as lotteries that are voluntary in practice but when used at a country level can produce significant levels of revenue.
5. Government programs that utilize tradable permits as a means to protect and enforce biodiversity protection (e.g., tradable fisheries quotas).

6. Debt relief by government (debt reductions that are converted into payments for conservation).

This section is devoted to government fiscal policies that produce revenue (fees, taxes, charges imposed by government) and also government policies that incentivize or disincentivize certain practices that impact biodiversity (taxes, fees, fines, and royalties imposed by government).

Government subsidies, in particular those subsidies that harm biodiversity, are covered in a separate section in this report. The government's role in both issuing and securing public and private investment capital is also covered in a separate section. Certain of the noted programs above, such as debt relief (debt swaps) and tradable resource use quotas, are not covered at all in this report, given the small scale of their usage and the limits on their potential scaling as related to the global need to protect biodiversity.

B. Description of Mechanism

This report utilizes a general framework developed by the OECD for the purposes of describing and classifying the broad range of biodiversity-related taxes, fees, charges, and related fiscal policies. The framework differentiates between taxes, on the one hand, and fees and charges on the other. The OECD defines a fee or a charge as a "requited payment to general government, meaning that the payer of the charge gets something in return, more or less in proportion to the payment made," whereas it defines a tax as a "compulsory unrequited payment." OECD tends to use the terms *fee* and *charge* interchangeably.[332, 333]

Table 5.13 is a comprehensive summary of the more common tax and fee mechanisms in use today, all of which are commonly used around the world. Almost every one of these fiscal policy instruments has the potential for be scaled up, including in biodiversity-rich countries.

In all the examples listed in Table 5.13, government fiscal policies create, impose, and enforce the fee or tax. In most situations, the taxes, fees, and fines collected are put into the central government treasury and managed and allocated through the government budget. For these funds, some may be used for conservation projects, but often these funds are used by the government for other budgeted uses not related to conservation. This has proven to be a challenge in many countries, ranging from large developed economies like the United States to smaller, biodiversity-rich nations.

To rectify this situation, some governments have placed restrictions on the funds collected to ensure that the fees and taxes raised are allocated only for their intended conservation purposes. This practice is often referred to as "earmarking," for example, when revenues raised through access fees to certain parks are earmarked in the government's budget and restricted for use to support only that park.

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TABLE 5.13 Examples of Various Fiscal Policies and Tools in Use to Benefit Biodiversity

Category	Examples
B1. Biodiversity-Relevant Fees and Charges designed to generate revenue to support protection of biodiversity	National, state/provincial, or local park and protected area entry or usage fees • National, state/provincial, or regional airport entry or exit fees • Cruise ship or tour bus ticket fees, added to the cost of tickets • Special resource use licenses and fees such as fishing, hunting, photography, diving, boating, hiking, trekking, climbing, camping, or other special uses • Hunting or fishing conservation stamps, on top of regular license fees • Negotiated payment for resource usage, such as hydropower usage payments based on water utilization, percentage of revenue, or percentage of operating expenses or capital expenditures • Tariffs charged to users of water supplies or septic treatment facilities • Tariffs assessed on users to provide financing for natural watershed or infrastructure protection and maintenance
B2. Biodiversity-Relevant Fees, Charges, Fines, and Penalties designed to disincentivize harmful behavior that may negatively impact biodiversity	• Mitigation fees such as compensatory mitigation in-lieu fees or infrastructure fees, assessed one time or annually, and assessed based on the land/water/species affected, or against project revenue or total project capitalization • Development impact fees assessed on developers of commercial or residential developments, as a condition of receiving a development permit • Environmental damage fee assessment and risk mitigation revolving funds (assessed, for example, on oil transport activities for oil spill risk mitigation) • Penalties, fees, or fines assessed for environmental damages or violation of regulations and laws set up to protect water, air, wildlife, fish, or other resources
B3. Biodiversity-Relevant Taxes designed to produce revenue to support protection of biodiversity	• Taxes on park and conservation area concessions including hotels and other businesses • Dedicated taxes on goods and services to secure funding for conservation purposes, such as taxes on sporting goods, recreational vehicles, fuel use, and transportation • Resource use royalties placed on certain extractive industries such as oil and gas, mining, or extractive forestry • Royalties assessed on the use of species for bioprospecting or biomedical purposes • Taxes on the sale or trade of wildlife, where legal • Real estate transaction taxes (such as sales or transfer taxes) • License plate registration taxes • Aquaculture levies or taxes
B4. Biodiversity-Relevant Tax Policies designed to incentivize positive behavior and protect biodiversity	• Tax credits for project developers or investors as incentives to protect working forests or other biodiverse habitats • Tax credits for project developers or investors as incentives for job creation or other social and economic benefits • Tax credits for landowners or project developers to promote conservation practices such as best management practices (BMPs), outright gifts of conservation lands, or donations of land development rights and conservation easements
B5. Biodiversity-Relevant Taxes designed to disincentivize harmful behavior that may negatively impact biodiversity	• Taxes assessed against harmful practices, such as pesticide usage taxes • Taxes on carbon usage to provide financing for climate resilience, climate-smart energy production, or other environmental purposes • Fish catch and service levies or taxes (as distinct from quotas and catch shares)

CASE STUDY:

Ecotourism Fees and Taxes

Of the many types of fees, charges, and taxes listed in Table 5.13, some of the most widespread are linked to national or regional programs that promote sustainable tourism or ecotourism. The goal of sustainable tourism is to make the practice of tourism and travel more sustainable and, in so doing, make tourism a viable tool for natural resource conservation and community support. Ecotourism is a form of sustainable tourism that generally involves travel to natural areas that provides the traveler with access to and appreciation of natural resources while helping to protect the environment.[334]

As a part of building a strong ecotourism or sustainable tourism sector, a number of countries impose fees and taxes on travelers that generate significant revenue for the protection of their parks and other biodiversity resources. For example, airport and cruise ship entry fees in countries such as Ecuador and Costa Rica raise millions of dollars for protection of local terrestrial and marine protected areas every year.

Mumbo and Domwe Islands, which are within Lake Malawi National Park, offer another example. In 1996, the private company Kayak Africa was granted a concession by the Malawian government to operate tourist camps on both Mumbo and Domwe Islands, where they have built low-impact ecolodges that provide high-quality accommodation and designed to leave a minimal footprint in the event of their removal. Starting with a basic service offering and few visitors, Kayak Africa has reinvested profits and improved its infrastructure substantially since its start.

This form of ecotourism, combined with a renewable concession from a government that closely regulates the operator's footprint and ensures the impacts of its semi-permanent structures are minimized, is able to generate substantial revenue for biodiversity protection while creating jobs and other income streams for local communities.[335]

C. Why Is It Important to Biodiversity?

As noted previously, the various economic instruments and fiscal policy measures described in this section are designed to either raise revenue for conservation activities or to discourage harmful activities. All of these instruments and measures can greatly enhance countries' annual budgets for conservation and thus generate a significant biodiversity benefit.

Costa Rica offers a compelling example of the use of innovative fee and tax systems to support its national forest and biodiversity conservation goals. Costa Rica is a small country with a developing economy, largely supported by resource extraction, agriculture, and tourism. To fulfil a national mandate to protect its unique biodiversity assets, the Costa Rican government established a National Forestry Financing Fund (FONAFIFO) and national cost-share program that provides regionally managed reforestation and water capture incentives for farmers and landowners to protect and restore forest cover and to safeguard watersheds and natural water supplies. This program is supported in part by a national 3.5 % fuel tax that generates US$ 12–15 million per year to support the country's forest and watershed protection.[336]

To date, Costa Rica's National Forest Financing Fund and fuel tax has paid more than US$ 500 million to protect 1,250,000 hectares of forests or farmland being restored to forest cover. This is roughly one fourth of Costa Rica's territory.

The policy has dramatically reversed a decades-long pattern of forest clearing (primarily for agriculture) and habitat degradation in Costa Rica that consumed much of the country's forest cover. This protection in turn has helped reduce the country's dependence on unsustainable agricultural practices and has helped move the country to greater reliance on the tourism sector, which contributes over 8 % of Costa Rica's GDP, while agriculture contributes under 6 %. Additionally, many tourism and ecotourism lodges in Costa Rica now charge a conservation fee of US$ 25 per person per stay, which provides additional revenue to support local biodiversity conservation.

Domestic fees and taxes can also be used to fund programs that are intended to produce desirable social or public health outcomes, such as forest or water supply programs, which may in turn also generate tangible benefits for biodiversity. For example, the city of Lima, Peru, has established a national watershed protection program to ensure the city's water supply year-round. Lima, the second-largest desert city in the world after Cairo and one that relies on water not only for public use but also to generate the hydropower on which the city runs, added a small charge to the base tariff applicable to all water users, which generates approximately $120 million annually. This new funding is being channeled into watershed management activities including reforestation, improved agricultural practices, and renovation of historic Incan-era water catchments called amunas. Reforestation initiatives and better agricultural practices will improve water capture, increase water availability, and improve water quality while increasing forest cover and providing habitat to benefit endemic birds, mammals, and other species.[337]

D. Financial Impact: Current and Future

The current levels of financing secured through various domestic fiscal policies is summarized in Table 5.14. Domestic budgets for biodiversity protection consist of many budget items, some of which represent revenues, such as taxes and fees and charges, and some of which represent expenses, such as subsidies that benefit biodiversity. Table 5.14 presents information that is compiled by the OECD on total domestic budget spending.

The OECD provides the most recent estimate of domestic spending on biodiversity from 80 countries as US$ 67.8 billion per year. In addition to the 80 countries examined by OECD, data points were identified where domestic government spending on biodiversity is available, and these were Chile, Peru, Argentina, Saudi Arabia, Sudan, and Mozambique. These data points, along with country GDP data, were used to predict biodiversity spending for the remaining countries not captured by external sources. The sum of estimated and evidenced biodiversity flows is the global estimate presented in Table 5.14. Further detail on the calculation of these estimates is in Appendix A.

TABLE 5.14 Current State (2019)

Category	Lower estimate US$ bn/year (2019)	Upper estimate US$ bn/year (2019)
Total domestic budget spending on biodiversity in 2019	74.6	77.7

Note: The methodology behind these figures is presented in Appendix A.

The future levels of revenue potentially generated by a range of domestic fiscal policies are shown in Table 5.15. The lower limit assumes that the 2019 government expenditures on biodiversity included in Table 5.14 as a proportion of total government budgets will remain constant through 2030, and global GDP numbers in 2030 are taken from long-term OECD forecasts. The upper limit represents a doubling of existing flows from government budgets to biodiversity. The methodology is further described in Appendix A of this report.

TABLE 5.15 Future State (2030)

Category	Lower estimate US$ bn/year (2030)	Upper estimate US$ bn/year (2030)
Domestic fiscal policies	102.9	155.4

Note: The methodology behind these figures is presented in Appendix A.

E. Obstacles and Enabling Conditions

The development of a national budget and the use of fiscal policy instruments are at the core of the policymaking process, and they reflect the choices made by decision makers about the government's priorities for the country. Decisive government action is needed to protect biodiversity, and this is best achieved if governments are equally decisive in implementing biodiversity-relevant fiscal policies and delivering the financial resources to fund their biodiversity protection efforts. The use of innovative and impactful taxes, fees, and related measures have the potential to deliver significant new amounts of funding to support biodiversity protection measures while creating incentives for individuals and businesses to consider their impacts on a country's natural heritage.

Fiscal policy is often the purview of finance and economics departments within governments, and the role of these agencies in developing fiscal policy tools designed to support biodiversity conservation is crucial. However, given that the expertise required to deliver conservation benefits resides in other parts of government (notably, environmental, agricultural, and natural resources agencies), a close collaboration between parts of government that do not regularly communicate and do not share the same professional culture must occur if an effective portfolio of such fiscal policies are to be designed and implemented.

The scale of the biodiversity funding gap illustrated in Chapters 3–4 means that, given the many demands on scarce public financial resources, the generation of new funding is a critical condition to long-term protection of biodiversity. However, to succeed in this, governments must recognize the value of protecting nature and muster the political will to do so even in light of competing demands.

An additional challenge in establishing workable fee and tax structures to support biodiversity conservation is the need for potentially affected businesses to be competitive. Policies may have adverse impacts on competitiveness by causing firms to incur higher production costs that create competitive disadvantages compared to countries with lower environmental standards.[338] In addition, asymmetries in national tax regimes are a key factor companies consider when selecting a location for expansion or deciding to relocate to a different jurisdiction. This can lead to decreasing tax revenues. To counter this risk of capital flight, governments can either design fiscal policies to be revenue neutral or they can work with the private companies to acknowledge the longer-term benefits of these fiscal policies. Additionally, governments should recognize that where a company would suffer financial losses from the enactment of biodiversity-relevant fiscal policies, it is likely to be one that is externalizing its harmful impacts.

For these fiscal policies to work fully, they need to be designed such that they disincentivize harmful activity, and established in a way that earmarks and/or restricts their use to the specific conservation budget, program, or activity for which that fee or tax revenue was established to support. Taxes and fees that target harmful activity should be set such that they reflect the environmental and social damage caused by the harmful activity.[339] Ensuring that taxes are delivered to conservation projects through earmarking or restrictions is a necessary step to fiscal policy implementation, since it is too easy, and common, for governments to siphon off new revenue for entirely unrelated purposes, negating the purpose for which the fiscal measures were

put in place. Even when funds are used for biodiversity conservation purposes, tax revenues are not always used in the most effective or efficient way, there is a failure to adequately monitor or track the effects of the funds, and there is little oversight of impact once revenues have been distributed.[340]

While a number of finance ministries, bodies such as the International Monetary Fund, and economists oppose earmarked or restricted taxes, this report takes the position that such opposition is based on primarily on theory rather than evidence on the ground. These entities argue that all taxes and related revenue should be part of a government's overall budget and be available for that jurisdiction's best uses as determined by competent authorities. However, this view of earmarked or restricted taxes fails to account for market failures to value and protect biodiversity, particularly in government decision making.[341]

A widely used alternative to government budgeting and earmarking involves channeling fee and tax revenue to either dedicated government funds or externally managed conservation trust funds, in effect bypassing centralized government finance and budgeting functions. This practice can be especially useful in jurisdictions where the rule of law is weaker and government corruption may be a concern.

Finally, governments can utilize innovative fiscal policies to leverage private investment capital for conservation activities. While still an emerging area of practice, there are a number of examples of the use of fee and tax mechanisms to leverage private investment. Some examples of this important government role are in the section on Green Financial Products. In one such case, certain US firms involved in rural forest restoration and management have capitalized on the availability of a federal tax credit (the New Market Tax Credit), created to reward investors for the generation of new jobs in rural and low-income areas, to lower risk and increase returns to private investors.[342]

F. Recommendations

Governments should develop and implement new fiscal policies or increase the effectiveness of existing ones that increase domestic spending on biodiversity conservation and disincentivize activities that are harmful to biodiversity. Such policies should be designed and supported by, and embedded within, multiple departments of government—particularly finance, environment, and natural resource ministries and other government agencies.

- By the year 2030, at least, every country should ensure that the amount and proportion of funding in their annual country budget for biodiversity conservation and restoration is larger than what was budgeted in the previous year.
- Every country regardless of size and economic condition is in immediate need of new resources with which to restore and protect their biodiversity. All countries should seek to immediately enact and put in place at least one or more new tax, fee, or other fiscal mechanisms, many of which are highlighted in this section, through which they can secure and use new revenue to pay for biodiversity restoration and protection.
- These new forms of fees, taxes, charges, or other revenue sources should be restricted for their intended use through earmarking or other fiscal policies.
- Governments should green any economic recovery measures to directly support natural infrastructure and sustainable agriculture and thereby signal private capital markets to invest in similar initiatives.

National and subnational governments must improve the efficiency, effectiveness, tracking, and reporting on the deployment of revenues raised for biodiversity conservation.

- Governments should increase efficiency in the procurement and use of country funding, incorporating techniques such as pay-for-performance contracting, granting, or similar methods that link payments to verified ecological performance.
- Countries should also see public payments as catalytic and use them strategically to create the enabling conditions needed for greater private investment in biodiversity conservation (see Green Financial Products).
- Finally, national and subnational governments should increase both the quality and quantity of monitoring and reporting associated with the ecological results of their biodiversity funding.

International finance institutions (such as the World Bank, IMF, and others) should increase financial support for biodiversity and lend their support to countries' efforts to establish taxes and fees whose revenue is allocated to conservation activities.

- The IMF and other global institutions should provide confidence and support to national governments who wish to enact such fiscal policies to support biodiversity.
- MDBs and DFIs should start and, where already underway, continue to mainstream biodiversity into their operations that heavily influence fiscal policymaking in countries around the world.

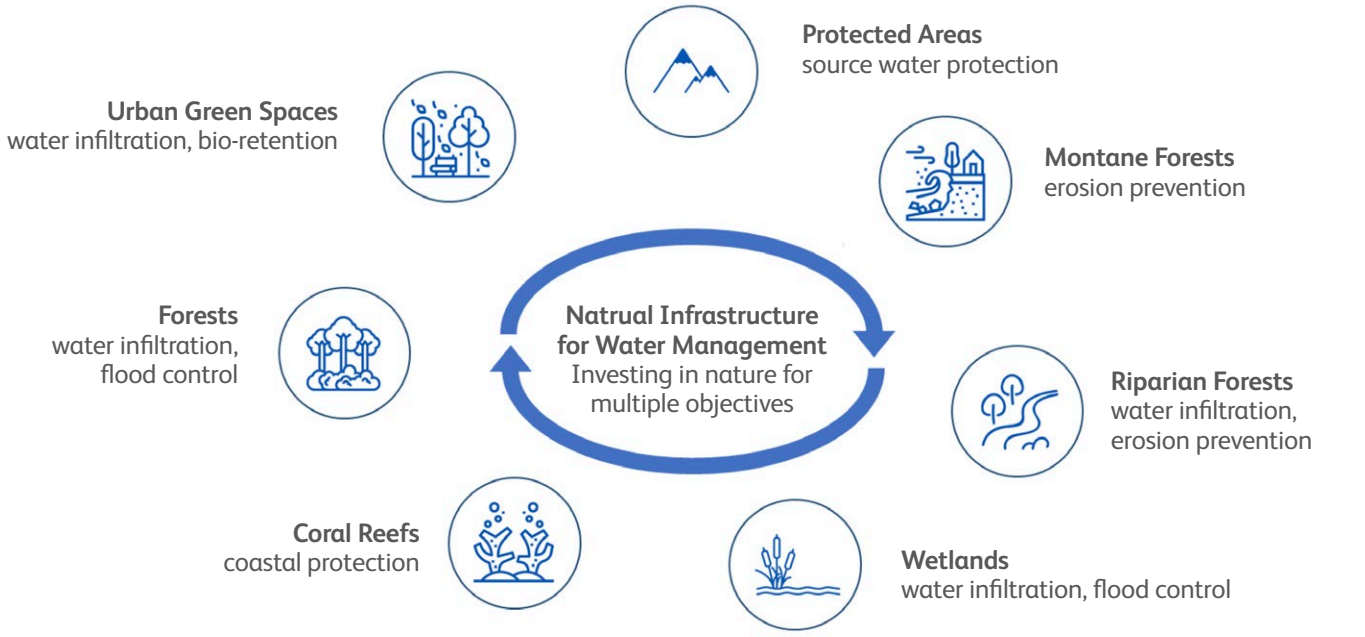
5.5 Natural Infrastructure

A. Background

Natural habitats are vital to both conserving biodiversity and meeting human needs, due to the essential ecosystem services they provide. Natural habitats include, but are not limited to, forests, riparian buffers, mangroves, grasslands, wetlands, and other such areas if they have not been materially degraded; some or all of these may be found within a single watershed. These areas support human needs in a variety of pathways, such as increasing coastal resilience and regulating the quantity and quality of water available for human use, and at the same time providing a variety of benefits to biological systems.

Natural infrastructure, as described in this section, refers to the networks of land and water bodies that provide ecosystem services for human populations, which produce similar outcomes to implemented gray infrastructure. The Nature Conservancy's "Beyond the Source" report finds that investments in natural infrastructure, such as source water protection, can help local governments avoid additional gray water infrastructure expenses.[343] Regulating nonpoint source water pollution (described later on in this section), for example, can lead to lower operation and maintenance expenses, as well as a reduced quantity of energy inputs for water treatment plants.[344] Figure 5.6 illustrates the various habitats that can contribute to watershed health through providing flood control, nutrient or sediment pollution filtration, soil infiltration, erosion, and coastal protection services.[345] IUCN is currently involved in mainstreaming investments in natural infrastructure to conserve habitats such as the ones depicted in Figure 5.6, which address societal and environmental challenges.[346]

FIGURE 5.6 Natural infrastructure and the delivery of ecosystem services



Source: Adapted from IUCN Water (2014). Natural Infrastructure for Water Management[347]

Conservation of watersheds is greatly facilitated by the existence of positive partnerships between the stakeholders present within the watershed, particularly downstream beneficiaries (those who benefit from watersheds' ecosystem services) and upstream ecosystem managers (who make land-use decisions that impact said watersheds but can also be beneficiaries of productive landscapes). As water becomes a scarcer resource, the public, private, and nonprofit sectors will need to find new and innovative ways to pool funding and scale existing watershed conservation practices. With adequate rights and governance frameworks in place, the land-based nature stewardship contributions of Indigenous Peoples and local communities can play an important role in the development of natural infrastructure conservation practices.

This section will focus primarily on natural infrastructure finance associated with watersheds, since recent investments in natural infrastructure has focused primarily on watershed resources. Watershed conservation and the financial tools used in these activities represent useful models that are generalizable to other forms of natural infrastructure, even if each type of natural habitat is unique and its conservation requires innovations in protection plans and financing structures in addition to those described for watersheds.

From riparian forests to wetlands to montane grasslands, essentially all land on earth is within a watershed. Watersheds are areas of land where all precipitation falling within the watershed boundaries drains into the same body of water, such as a stream, river, or lake.[348] Watersheds are often classified by their drainage area and range from mini-watersheds (1–100 hectares) to macro-watersheds (>50,000 hectares),[349] with smaller units often found nested within larger ones.

Healthy watersheds are crucial to both surface water and groundwater security, and positively impact drinking water supplies, the agriculture and manufacturing sectors, recreational activity, and habitat provision.[350] The health of a watershed is determined by the ecological integrity of the area, the level of pollution it is exposed to, and the condition of riparian systems and the biodiversity that inhabits them, among other factors. Watersheds provide myriad benefits to economies and biodiversity, all while regulating the hydrology of natural habitats. However, threats to water quality and quantity, such as increased urbanization, are increasing the burden that conurbations place on surrounding ecosystems. By 2050, for example, two thirds of the world's population will be dependent on urban source watersheds that represent only one third of the earth's land surface, making their long-term conservation critically important.[351]

Current trends in water management point to the need for source water protection. Threats to water quality result from point source (i.e., there is a discrete pollution source) or non-point source (i.e., there is no discrete polluter) pollution. Non-point source pollution resulting from agricultural practices is of particular concern for watershed health in North America, Asia, and Europe, wherein agricultural practices might result in moderate to high levels of sediment pollution, or nutrient pollution resulting from fertilizer and pesticide usage.[352] Global agricultural irrigation practices, which account for 90 % of water consumption in water-scarce areas, are also threatening water quantity. Water scarcity is defined as overconsumption of water relative to renewable sources of water derived from rain or snow, and it threatens the water security of cities, food systems, and plants and animal species.[353] Currently 11 % of global river basins are categorized as chronically depleted and 21 % are episodically depleted.[354]

As of 2015, public and private investments in the conservation and protection of key watershed ecosystems totaled US$ 26.9 billion.[xviii, 355]

[xviii] In 2019 US$.

With 40 % of the world's watersheds showing moderate to high levels of degradation, there is a clear need for greater investment.[356] The majority of funding allocated to watershed conservation currently comes from national or subnational governments or official development assistance (ODA). However, there is room for greater private sector involvement, specifically by private utilities and their investors, as well as other private entities who stand to gain security, or avoid costs, from the benefits of watershed protection.

B. Description of Mechanism

There are four broad categories that connect watershed conservation projects to financing: (1) public subsidies for watershed protection, (2) user-driven watershed investments, (3) water quality and trading offsets, and (4) buybacks and water rights programs.[357] The taxonomy used in this section and others is based on Forest Trends *State of Watershed Investments 2016* report, which identifies watershed investment sources through analyzing 378 fully active watershed programs across the world.[358] Funds for these programs can be allocated to projects that target land protection, revegetate natural habitats that watersheds rely on, restore riparian zones, establish agricultural or ranching best management practices (BMPs), enact fire risk management, restore and/or create wetlands, and create road BMPs that reduce the environmental impacts of road networks.[359]

Given that the benefits of watershed protection are closely tied to those who rely on the specific watershed's resources, transactions and program management tend to be local.[360] The local nature of watershed investments, compared to other mechanisms in this report, places greater responsibility on subnational and local governments compared to national governments. For example, while central government and/or international development funding plays an important role in the ways in which these programs raise funds, it is often the subnational and local governments who regulate land use practices within their designated watershed boundaries. As of 2015, most project funding was allocated via public subsidies. Among the other categories, the public sector has played a central role through setting policies for water users and collective action funds, creating and regulating offset markets, and providing policy guidelines for water quality standards and water rights programs.

Public subsidies for watershed protection programs involve governments either paying land users for making sound environmental decisions or compensating land users for not engaging in economic activity that would otherwise be detrimental to watersheds.[361] The majority of past and current programs in this area have been implemented at a national scale, except under the EU's Common Agricultural Policy (CAP), for which budgeting was allocated from a supranational capital pool.[362] Use of these programs has increased by around 15 % per year, driven largely by China's biodiversity and eco-compensation programs.[363] While these programs have received a significant amount of funding, the numbers are small relative to the aggregate subsidies provided to farmers (refer to the Harmful Subsidies section of this report for more detail on this topic). Such farmer support still incentivizes or enables agricultural practices that result in environmental degradation and may reduce the resilience of watersheds.

User-driven watershed investments represent the second-most important category of watershed protection financing. Although significantly smaller in size than public subsidies, these investments are growing at an annual rate of around 14 % per year between 2013 and 2015. Delivering funding to watershed managers using user-driven investments involves aggregating fees from users, and then distributing these fees to relevant stakeholders. A public or private sector entity, or partnership between the two, charges water users according

CASE STUDY:

China's Sloping Land Conversion Program—Direct Public Subsidies at Work

China's Sloping Land Conversion Program (SLCP), which was launched in 1998 in response to widespread flooding in China, targets farmland along the upper watershed of the Yangtze River and Yellow River basins and implements agricultural best management practices (BMPs) that seeks to control soil erosion and sediment loading.[364] The program focuses on rehabilitation of forests and grasslands and on large-scale planting of commercial tree species to support farmer livelihoods. The current (fourth) phase of the SLCP, which began in 2015, aims to increase the amount of land to be converted into forest and has incorporated social objectives into the program implementation. The program currently covers 15 million hectares of land across 25 provinces. It has the twin objectives of ecological restoration and poverty alleviation in the form of farmer support.[365]

The Chinese Ministry of Finance funds the program from the central government budget, with funding of US$ 69 billion between 2002 and 2012.[366] The State Forestry Administration manages the program, distributing payments to provincial governments that, in turn, allocate funding to local governments. Local governments typically use a village-based approach for payments and land conversion ensuring that farmer participation is maximized.

Between 1994 and 2004 payments were made in cash and in-kind with grain. Differences between payments for each river basin reflected the difference in average yields for households within the Yellow and Yangtze Rivers (the Yangtze River yield per hectare was higher resulting in higher payments to these households).[367] During this time, one-off payments have also been made in the form of a seed and planting subsidy. After 2004, payments switched to solely being in cash, as the country no longer benefitted from a gain surplus.[368] Payments are made if trees have a 85 % or higher survival rate, with survival rates being monitored by local authorities once a year.[369]

As with other natural infrastructure conservation programs, monitoring the SLCP has proved to be a challenge. Annual evaluations have utilized a variety of methodologies to assess program success, resulting in a lack of comparability between data sets. While the Chinese government adapted the program to a range of environmental and social needs in the region, its strategy will be more effective in the long term if it is able to implement a consistent monitoring and evaluation system.

to their consumption. Public entities may implement water tariffs, taxes, or transfers that pass on the cost of watershed conservation to consumers.[370] Private entities, on the other hand, may charge user fees for the provision of clean water. Payments are then channeled to landholders or other stakeholders that implement watershed and land management practices that deliver public benefits in exchange for resource conservation. Payments can come in the form of bilateral agreements or collective action funds.[371] The former describes a contractual agreement between watershed decision makers and users to protect key water sources, while the latter describes pooled contributions that are then allocated to watershed protection.[372] Depending on the context of these investments, fund distribution may be carried out by either governments, nonprofit entities, or private sector partners.

As a permanent governance, investment, and source water protection implementation mechanism, water funds provide the framework for collective action, connecting land stewards in rural areas and water users in urban areas to share in the value of healthy watersheds (Table 5.16)

CASE STUDY:

Investments in Water Funds

Water funds are a type of user-driven watershed investment that allows municipalities and conservation practitioners to connect watershed managers in rural areas with water users in urban areas through convening water users to innovatively mobilize sources of funding and invest in upstream habitat protection.[373] Regional governments, municipalities, and/or public or private utilities can channel user-financed funding to pay for watershed protection or restoration activity. A study by The Nature Conservancy (TNC) has reported that a total of 41 such funds have been created, and few of these funds have been able to estimate the value of the cost savings resulting from their activities.[374]

Currently, conservation organizations are refining cost-savings methodologies that funds can use to better understand the financial impact of their pooled investments. These calculations seek to estimate the avoided operational or capital improvement costs associated with investing in natural infrastructure, as well as to estimate social and environmental co-benefits. TNC, for example, has analyzed water treatment return on investment (ROI) for 4,000 cities in a source watershed model and found that only 690 cities maximized their ROIs by investing in water treatment.[375] Others could realize healthy co-benefits from source water protection (such as climate change mitigation benefits) through introducing source water protection into their utility plans.[376]

These funds share a number of features, prominent among which are science-based plans, multi-stakeholder approaches, key funding mechanisms, and implementation capacity. As described below, municipalities can and do play a significant role in either financing these funds or in collecting and distributing capital.[377]

TABLE 5.16 Noteworthy User-Driven Natural Water Supply Investments

Name | Location | Start Year	Major Funder | Additional Stakeholders	Land Use Changes	Protected Area (Hectares)	Initial Costs / Funding Amounts (US$ million)	Relevant Cost Savings (US$ million)
Watershed Protection and Partnership Council | New York City, New York | 1997[378]	New York City | Catskills Watershed Corporation (represents upstream farmers), federal EPA	• Improves waste management along the watershed • Landowners compensated to not develop on forests • Controls for agricultural runoff	28,328	US$ 1,400–US$ 1,500 or US$ 167 annually from the City of New York's Budget	Cost savings from not investing in a water filtration plant: $US 4,500–US$ 4,600
Edwards Aquifer Protection Program | San Antonio, Texas | 2000[379]	The City of San Antonio (sales tax) | San Antonio voters, TNC	• Purchase properties within the aquifer's most sensitive areas and protect land within the aquifer recharge zone	2,651 in 2000 36,438 in 2005 20,670 in 2010 5,078 in 2015	US$ 45 from sales tax in 2000, US$ 90 from sales tax in 2005, US$ 90 from sales tax in 2005, US$ 90 from sales tax, US$ 10 from budget in 2015	N/A
Fund for the Protection of Water (FONAG) | Quito, Ecuador | 2000[380]	Quito's Water Company (annual budget) | municipality of Quito, electricity companies of Quito, TNC, public, private, NGO watershed actors	• Restores grasslands and forest areas • Established hydrological monitoring program to communicate outcomes	40,000	US$ 10 endowment US$ 2 annual budget	N/A
Upper Tana-Nairobi Water Fund | Nairobi, Kenya | 2015[xix, 381, 382]	Nairobi City Water and Sewerage Company, national utility companies, water and agriculture management authorities, food and beverage MNCs, The Global Environment Facility (GEF), TNC	• Changing farming practices to reduce deforestation, erosion, and sediment runoff	33,290	US$ 4 from voluntary contributions US$ 7 from the GEF	Cumulative benefits for farmers, water and electricity utilities, and agriculture and food and beverage companies: US$ 21.5 over 30 years
Aquafondo Water Fund | Lima, Peru | 2015[383, 384]	Peruvian water regulator (SUNASS) and Lima's water authority (SEDAPAL) tariff structure | Aquafondo, Forest Trends	• Revised tariff structure in Lima will channel money earmarked for natural infrastructure investments and climate adaptation through Aquafondo • Funding allocated to agricultural practice changes, tree planting, and Amuna restoration in watersheds surrounding Lima	1,605	US$ 3	N/A

[xix] Funding as of 2017—the goal size for the fund endowment is US$ 15 million. Fund cost savings are based on TNC business case estimates.

Users of ***water quality trading and offsets markets*** vary by the type of credit offered and the types of regulations in place. In these markets, certain entities, such as corporations or farms that have yet to adopt wastewater discharge practices that meet the standards of state or regional water-quality compliance regulations, are allowed to purchase credits, or offsets, that pay for a specific type of water-quality management activity undertaken by a separate organization that has operations that impact on the same water body.[385] These activities typically occur offsite, away from the point at which pollution is affecting the watershed, and are most often carried out by sewage treatment plants. Although there are a range of potential credits that water users can buy, the majority of credits relate to nitrogen and phosphorus ("nutrient") reduction in water bodies. Other types of credits include storm water retention, thermal loading, and saline discharge outcomes.[386] Credits are used to implement sustainable agricultural management, riparian planting, or onsite discharge reductions.[387] Water offset markets are smaller compared to other funding tools for watershed protection largely because they require both local policy support and market infrastructure. Having said this, certain American states such as Pennsylvania and Virginia have seen growth in programs where the private sector has played a larger role in administering trading platforms and taking the burden of these administrative costs.

Buybacks and water rights programs aim to replenish surface water or groundwater portions of watersheds through instream buybacks or groundwater mitigation programs. Instream buybacks allow conservation organizations or government entities that cannot afford to purchase water rights to lease these rights from private owners and engage in conservation activities during the terms of these leases.[388] Groundwater mitigation programs require new groundwater users to mitigate their environmental impacts, typically through the use of offsets in environmental markets. In most cases, these markets are the result of property owners seeking to comply with basin-wide caps on groundwater withdrawals or minimum flow requirements for river systems.[389] Such programs are active in countries and regions where the right to divert water is legally separated from land ownership, and where government-regulated trading markets exist to purchase these rights.

Several groundwater mitigation programs do not necessarily contribute to biodiversity, as they involve non-nature-based human interventions to replenish aquifers. For the purposes of this report's discussion of natural infrastructure, nature-based solutions to groundwater replenishment are favored as they can have collateral benefits on biodiversity conservation.

C. Why Is It Important to Biodiversity?

Natural infrastructure within watershed ecosystems support a wide range of habitats of high conservation value, including forests, grasslands, and riparian areas. The strength and stability of these ecosystems directly support biodiversity conservation. In turn, the quality of watershed ecosystems services could be significantly reduced by habitat degradation. For example, water infiltration, which leads to groundwater recharge as surface water is absorbed and filtered by soil, is negatively affected when soils are compacted or subject to erosion; if surface water is unable to infiltrate it may end up in the nearest river or stream and be lost to the local area. Conversely, healthy soils that are protected by standing vegetation and organic debris on the ground, all of which are indicators of higher levels of biodiversity, facilitate higher infiltration rates and retention times. While these conservation outcomes apply to watersheds, the conservation of other types of natural infrastructure ecosystems, such as those offering coastal resilience ecosystem services (refer to the coastal resilience case study below), can also have benefits for biodiversity.

CASE STUDY:

Protecting Natural Infrastructure Assets That Provide Coastal Resilience Habitats

As the frequency of climate events, and flooding damages related to these events, has increased in recent years, so has the importance of conserving habitats that ensure coastal resilience. Despite their importance, however, funding information and data for these initiatives is relatively limited compared to existing research and activity on watershed protection.

Nevertheless, conservation activity in and around these ecosystems poses an attractive opportunity for future funding. Natural infrastructure relevant to coastal resilience includes the conservation and restoration of mangroves, coral reefs, oyster reefs, saltmarshes, and sea grasses. In Chapter 4 we have estimated that the annual costs of conservation and restoration of these coastal ecosystems, to historical baseline levels by 2050, is US$ 27–37 billion per year. At a base level, these habitats are important for aquatic or coastal species and may also generate revenues for the tourism, food, and commodities industries. However, recent research on the environmental services they provide has shown they can serve as natural breakwaters that provide more dynamic responses to sea-level rise, storm surge, or other intense wave activity, than comparable human-created breakwaters, such as seawalls or levees.[390]

Data reported to the Deltares', the World Bank, the Global Facility for Disaster Reduction and Recovery, and the Program for Forests' Natural Hazards—Nature-based Solutions database includes 27 coastal resilience projects with estimated costs of US$ 315 million between 2015 and 2017.[xx,391] These numbers, however, only represent reported information and are therefore likely to be an underestimate of global funding for coastal resilience. As a result, key funding sources, such as the United States' National Oceanic and Atmospheric Administration (NOAA) Coastal Resilience Grants program, have not been captured. NOAA funding and associated matches for the same period total US$ 36.1 million, although these numbers also include non-oceanic coastal resilience projects.[392]

In addition to funding coastal resilience through funds set aside for these habitats' conservation or nature-based solutions, governments can also set aside funds aimed to address pre-disaster risk mitigation and post-disaster recovery.[393] Much of the funding has come from public coastal management expenditures and national and international disaster management authorities or development banks, typically in the form of grants, intergovernmental transfers, or debt.[394] However, as responses to climate adaptation become more sophisticated, so do the ways in which the private sector can be involved.

The Ocean Risk and Resilience Action Alliance (ORRAA) offers an example of how the private sector can participate in coastal resilience protection efforts. The organization was founded in 2017 as a multisector collaboration between conservation groups and private sector partners that harnesses members' expertise in the financial sector to reduce ocean-related risk. The organization calculates that US$ 300 billion has been paid out by insurers over the last 10 years for coastal storm damage.[395] They have identified US$ 163 billion of underinsured coastal assets in need of protection that would benefit from the introduction of innovative financing mechanisms.[396]

In 2017, AXA XL, together with ORRAA, launched the Ocean Risk Initiative. This initiative works to build literacy around coastal and marine ecosystems and their protection, and partner with other

[xx] The number of projects and costs allocated to them are based on the database's project list. Projects were filtered based on whether their intended outcomes were related to building coastal resilience or whether the nature-based solutions used leverage coastal habitats for climate adaptation. These numbers are illustrative, however, as the database gathers information from reported data, which means it either might not include projects or aspects of project costs.

insurance and conservation experts to create insurance products. It is hoped that these efforts will result in the creation of new climate risk calculation methodologies to fully understand the benefits of healthy coastal natural infrastructure assets.[397]

An existing class of financial products that could be used to cover risks associated with such assets are catastrophe bonds. These insurance-like products can protect public and private entities against losses through the issuance of bonds in the capital markets. Bond investors are paid returns over the term of the bond into an escrow fund and receive interest payments, similar to insurance premiums.[398] If a covered loss occurs, the fund is liquidated to pay for the damages.[399] Investors assume the risk of losing part or all of their investment in the event of a loss in exchange for returns that are attractive compared to most fixed-income investments in the event there is no loss.[400] Catastrophe bonds are just one example of the kind of innovative financial products that can meet investors' needs while protecting coastal ecosystems.[401]

CASE STUDY:

US Army Corps of Engineers—Engineering with Nature and Coastal Resilience

In 2010, the US Army Corps of Engineers (USACE) launched its Engineering with Nature (EWN) initiative, which seeks to implement sustainable practices in water resource management. Thus far, the initiative's projects have focused on maritime and riverine navigation, flood risk management, and the maintenance of ecosystem services.[402] EWN's projects have focused heavily on coastal areas and have involved partnerships with a variety of local governments, US federal agencies, and independent conservation organizations.

The initiative's projects seek to achieve positive social outcomes as well as to support biodiversity conservation outcomes. For example, EWN collaborated with the Sonoma Land Trust and with Ducks Unlimited to launch the Sears Point Restoration Project near San Francisco in 2015. The US$ 18 million project is working to mitigate flood risk by restoring 1,000 acres of wetlands, which, combined with marsh mound construction, has provided valuable climate adaptation services to the area, in addition to revitalizing habitats for Federal Trust species and other at-risk aquatic, avian, and terrestrial wildlife.[403, 404] Now, the area is part of the US Fish and Wildlife Service's San Pablo Bay National Wildlife Refuge in California.[405]

EWN's combination of nature-based solutions and natural infrastructure protection has led to the recreation of a historic barrier beach. In 2016 and 2017, EWN launched the Braddock Bay Restoration Project, which restores the bay's wetlands and revitalizes surrounding habitats. USACE implemented a stone breakwater with nature-based features that mimicked the Bay's historical natural beach barrier.[406] To achieve these outcomes, EWN has partnered with the Town of Greece, New York, and the New York State Department of Environmental Conservation.[407] As with the Sears Point restoration initiative, the project provides the dual benefits of improving coastal resilience and improving habitat for wildlife and commercial fish species.

In the future, EWN seeks to expand its current capabilities by focusing on three key objectives, or "waves," namely broadening and deepening partnerships, expanding capabilities, and expanding applications and communications.[408] Future projects include nature-based shoreline stabilization and the integration of habitats into engineering processes.

Investing in biodiversity conservation for the sake of natural infrastructure protection offers co-benefits of ensuring the delivery of ecosystem services, biodiversity protection, and avoiding the environmental impacts to which the introduction of gray infrastructure can lead. Gray infrastructure, aside from being a more costly alternative to providing services such as clean water in some cases, can have negative impacts on biodiversity because it can inflict negative impacts on ecosystems through extracting resources that alter their natural functions and through fragmenting previously undeveloped land.[409] Conservation activity, on the other hand, can restore landscapes, help recover individual species, and make habitats and the human communities near these ecosystems more resilient to climate change, all in addition to providing ecosystem services such as water quality and quantity regulation.[410] Where there is sufficient data on the benefits of conservation, and where investments make economic sense, using the tools described in this mechanism to generate funding for conservation projects can allow communities to benefit from natural infrastructure through implementing solutions that are better aligned to long-term conservation goals. Furthermore, mainstreaming natural infrastructure protection into business as usual evaluations of infrastructure investments can push governments, investors, and infrastructure developers to consider infrastructure solutions that have dual benefits of service provision and conservation, which in turn can achieve more sustainable land use outcomes.

D. Financial Impact: Current and Future

Current State

Based on a survey of 378 programs for which program details and information on financing mechanisms were provided, Forest Trends has estimated that a total of US$ 26.9 billion[xxi] was invested in watershed programs.[411] Much of this funding (US$ 25.8 billion or 96 %) was in the form of public subsidies, which account for 139 of the surveyed programs and grew at an average rate of 14.6 % between 2013 and 2015, driven by China's accelerating sustainability efforts as well as green agricultural reform in the EU.[412] Despite accounting for more than half of active programs, user-driven watershed investments only made up 2.7 % of total investments, or US$ 715.8 million. These programs, however, grew at a two-year average rate of 14.1 %, showing that they have potential to be scaled once program design, implementation, and monitoring becomes more sophisticated.[413]

Both water quality trading and offsets markets as well as buybacks and water rights programs have attracted significantly lower amounts of funding. As of 2015, there were 22 operational water quality trading and offsets markets that generated US$ 33.9 million, and 20 buybacks and water rights programs that generated US$ 101.7 million. Of the several reasons for why these programs have not been able to garner as much funding, the main reason these programs have not yet attracted substantial investment is that both rely on specific regulatory frameworks and policies that only exist at this point in parts of North America and Oceania.[414]

The numbers below are based on Forest Trends' 2015 survey estimates. While these numbers likely underestimate the current number of programs and associated funding, this survey is the most comprehensive and recent analysis of watershed investment programs.

TABLE 5.17 Current State of Watershed Investments (2020)[415]

Category	Estimated Funding, US$ billion/year (2019)
Public and private watersheds investments	26.9

Note: The methodology behind these figures is presented in Appendix A.

[xxi] All figures in this section are based on 2020 US$. Real values (2015 US$) of funding per Forest Trends' 2015 Survey are as follows: public subsidies – US$ 23.7 billion, user-driven watershed investments – US$ 656.7 billion, water quality trading and offsets markets - US$ 31.1 billion, buybacks and water rights programs - US$ 93.3 billion.

Future State

The future state of watersheds investments, assuming an average of growth rates between 2012 and 2015 for our lower limit and a 2012–2015 compounded annual growth rate, falls in the range below for combined public and private investments in 2030.[416]

TABLE 5.18 Future State of Watershed Investments (2030)

Category	Lower Estimate, US$ billion/year (2030)	Upper Estimate, US$ billion/year (2030)
Public and private watershed investment	104.7	138.6

Note: The methodology behind these figures is presented in Appendix A.

E. Obstacles and Enabling Conditions

A fundamental impediment to scaling watershed investments is the lack of available data on the performance of existing programs, which, in turn, negatively affects future program design and investor appetite for these programs. Specifically, these knowledge gaps make it difficult for program designers to develop informed estimates of the quantity and quality of natural infrastructure investments needed. Without information on whether or not actions taken to protect watersheds and generate sustainable sources of funding have been successful, governments and the private sector cannot efficiently invest, nor can they design, monitor, and evaluate programs with assurance that their investments will see a return.

This calls for, at the least, national standards that are used by regional governments and private sector actors to monitor and collect data on their respective watershed programs' progress. Better data will not only enable program designers to implement changes that make watershed investment activity more impactful, but it may also allow other governments to replicate aspects of specific programs in their own countries. Being able to leverage past experiences and best practices will also help designers of watershed or natural infrastructure programs avoid implementing project designs that have previously led to negative outcomes, such as afforestation with nonnative species that can later lead to the introduction of invasive species.[417]

Another set of obstacles to the growth of watershed investments result from policies that impede, or do not go far enough to enable, the participation of public and private utilities in watershed conservation. In the case of utilities, justifying watershed investments and related tariffs or taxes to ratepayers has proven to be a major challenge.[418] Certain public utilities also face restrictions to pooling funds with non-public sector actors, lowering their ability to set aside or distribute payments from a collective action water fund.

Public and private utilities, like the municipalities they serve, must incorporate source water management into the delivery of utility services. By understanding how and where they can invest to lower future costs, they can clearly articulate their investment objectives to water users, as well as define the quality and cost reduction benefits that such investments can lead to.[419] In addition, governments should reassess the ways in which public utilities are managed and regulated, and consider empowering them to act as both collectors and distributors of funding for watershed protection programs. Governments should also ensure that their watershed protection compliance standards and policies are consistent with other legislation.

Stable legal systems within which property rights are enforced are prerequisites to watershed investments, as are the governance structures that allow the efficient transfer of funding between natural infrastructure managers and beneficiaries. These systems must support continued and growing investment in natural infrastructure and also address policies that

incentivize degrading ecosystems that would otherwise provide infrastructure-like service. Governments should especially consider the environmentally harmful agricultural subsidies that they provide to citizens (as described in the Harmful Subsidies chapter of this report).

Finally, for any program to work, there needs to be an ongoing effort at building capacity at the level of local governments who enforce laws and may regulate water markets, governance bodies that can distribute payments and pass on best management practices to watershed decision makers, and organizations that can address some of the challenges inherent to sustainably managing watersheds, given that they often transcend administrative boundaries. Scaling investments to conserve ecosystems requires concerted effort to engage diverse stakeholders with the objectives of conservation so as to secure their commitments to these programs. To gather consensus and meet conservation objectives, conservation projects can engage civil society organizations such as watershed alliances that work with communities across watersheds to promote sustainable watershed management.

F. Recommendations

National, subnational, and local governments should require the evaluation of natural infrastructure alternatives in all infrastructure projects and, where feasible and cost-effective, require its use in public and private development projects through contracts and concessions, procurement processes, and by regulation.

- Governments should develop and enforce regulations that require, at the least, the consideration of natural infrastructure in developments as part of the planning and project approval process. Where large infrastructure developments exist, governments should incentivize a minimum percentage of the development to use natural infrastructure.
- Governments should establish a set of natural infrastructure cost analysis and valuation tools that are used, as part of regulation, by developers in their assessments of natural infrastructure. This would set a comparable baseline for use in cost-benefit analysis during feasibility stages of new developments.
- Contracts such as concession agreements and procurement arrangements should mandate that parties involved with the development of physical assets consider the cost savings and nonfinancial benefits of nature-based solutions.

Private sector corporations operationally dependent on water should, along with national and subnational governments, participate in developing, financing, implementing, and maintaining natural infrastructure for the watersheds they operate in.

- Companies and governments should analyze and publish the risks and costs to operations that stem from upstream and downstream watershed health as well as the potential benefits and costs savings from investing in natural infrastructure and source water protection.
- Governments should coordinate the multiple stakeholders in the watershed to ensure that natural infrastructure developments are equitable, designed with community participation, and do not disadvantage minority or marginalized groups.
- Governments should establish baseline values for ecosystem services in watersheds that can then be used by other entities to create and employ screening tools that allow businesses to contextually value the benefits of ecosystems and compare nature-based alternatives to brown or gray infrastructure solutions.

Insurance companies and financial institutions should incorporate the benefits of ecosystem services provided by natural infrastructure in their risk modelling. The results should be factored into decisions about capital costs and be reflected in premiums that incentivize the use of natural infrastructure in line with risk modelling as well as international and national standards and processes.

- Risk modelling should incorporate the risk reduction from natural infrastructure while also factoring in the increasing risk reduction over time as natural infrastructure matures.
- Insurance companies and financial institutions should work with NGOs and academia to establish a robust evidence base around the risk reduction benefits of different natural infrastructure interventions by recording and sharing data on the costs, performance, and benefits of natural infrastructure within their portfolios.
- Insurance companies should increase awareness of the benefits of natural infrastructure to clients who wish to benefit from reduced insurance premiums and risk exposure while benefitting biodiversity.
- Insurance companies should develop and implement insurance mechanisms that weigh operational and health risk, based on the quality of surrounding watersheds, thereby incentivizing corporations and governments to invest in improving the health of their surrounding ecosystems.

International organizations, such as research institutions, NGOs, and standard setting bodies, should develop robust evidence on the costs and performance of different forms of natural infrastructure. This should be carried out in tandem with the process of developing international standards, tools, metrics, and data collection processes for natural infrastructure.

- Develop model methodologies for assessing watershed conservation and natural infrastructure costs and relative benefits that seek to optimize funding distributions and maximize program outcomes.
- Coordinate and support the costs of the collection and sharing of data on natural infrastructure costs and benefits.
- Develop key performance indicators based on intended program outcomes so that regional and/or local governments can adapt them for their specific contexts while also maintaining the ability to report to national and global level indicators.

Entities engaged in curriculum development, professional certification, and continuing education of engineers, planners, and other professionals should require appropriate training that builds awareness and capacity of how to assess both the cost effectiveness and the environmental benefits of designing, developing, and maintaining natural infrastructure projects to meet human needs.

- Develop and implement natural infrastructure curricula for engineers, hydrologists, contractors, and urban planners, leading to academic centers of excellence on natural infrastructure that fulfil roles of research and policy advice, as well as development of methodologies and decision support tools. These should be routinely updated with the latest research on effective best practice for natural infrastructure protection and management.

5.6 Green Financial Products

A. Background

In recent years, green finance has grown from a niche investment opportunity to one that is attracting considerable attention from investors and governments around the world. A number of tools have been developed to support asset owners and asset managers looking to evaluate the merits of these investments and understand their nonfinancial impacts, including sustainable finance taxonomies, reporting and disclosure frameworks, investment principles (both general and product-specific), and industry screening criteria. The growth of this field has been driven by an accumulation of evidence showing that investments in sustainable financial products can meet (and in many cases exceed) the risk-return expectations of investors and the market returns of comparable investments not viewed as sustainable. Increasingly, many otherwise reluctant institutional investors have been moving into the green finance space to manage reputational risk and improve public perception of these institutions. Also, a growing realization on the part of individual and mission-driven investors of a lack of alignment between the values they profess and the industries and companies they are invested in has led many of them to seek greater alignment. Given growing concerns about biodiversity loss, climate change, and public health risks, in the context of the COVID-19 pandemic, organizations such as the IMF and the European Union (EU) have encouraged national governments to use green financial products to address these risks as an important part of green recovery plans and more sustainable economic growth strategy.[420]

Demand for green financial products is expected to continue to grow at a rapid pace over the coming decade, spurred in part by the need of national governments to meet internationally agreed emissions and conservation targets and by corporations seeking to reduce environmental impacts to comply with regulations and protect reputations. The development of new national and supranational standards and classifications, such as the EU Taxonomy on sustainable finance currently under development, will help investors more reliably identify and assess the impacts of sustainable investments. Over time, these should replace many of the voluntary standards and commitments that have proliferated in the industry. In addition, a new generation of high-net-worth (HNW) and ultra-high-net-worth (UHNW) individuals, estimated to inherit US$ 30 trillion over the next 25 years, will boost demand as they seek investment opportunities that offer attractive returns coupled with environmental and social returns.[421]

As illustrated in Chapters 2–4 of this report, the economic cost of managing a healthy mix of protected natural areas, productive landscapes, and sustainable urban environments for the future is much greater than all the funding that can reasonably be expected to be mobilized by public entities and philanthropic organizations alone. Efforts to bridge the global biodiversity financing gap must therefore look elsewhere, and some of the most promising solutions that have been proposed recently are products and services designed to access and deploy capital for conservation from the global financial markets. While private, return-seeking capital has shown a growing interest in green financial products, the availability of products that have competitive risk-return profiles and clear environmental benefits has not always kept up with the potential demand. Many of the innovative green investments that have reached the market in recent years are bespoke transactions that are modest in size and not easily replicable. But to effectively address both market requirements and environmental

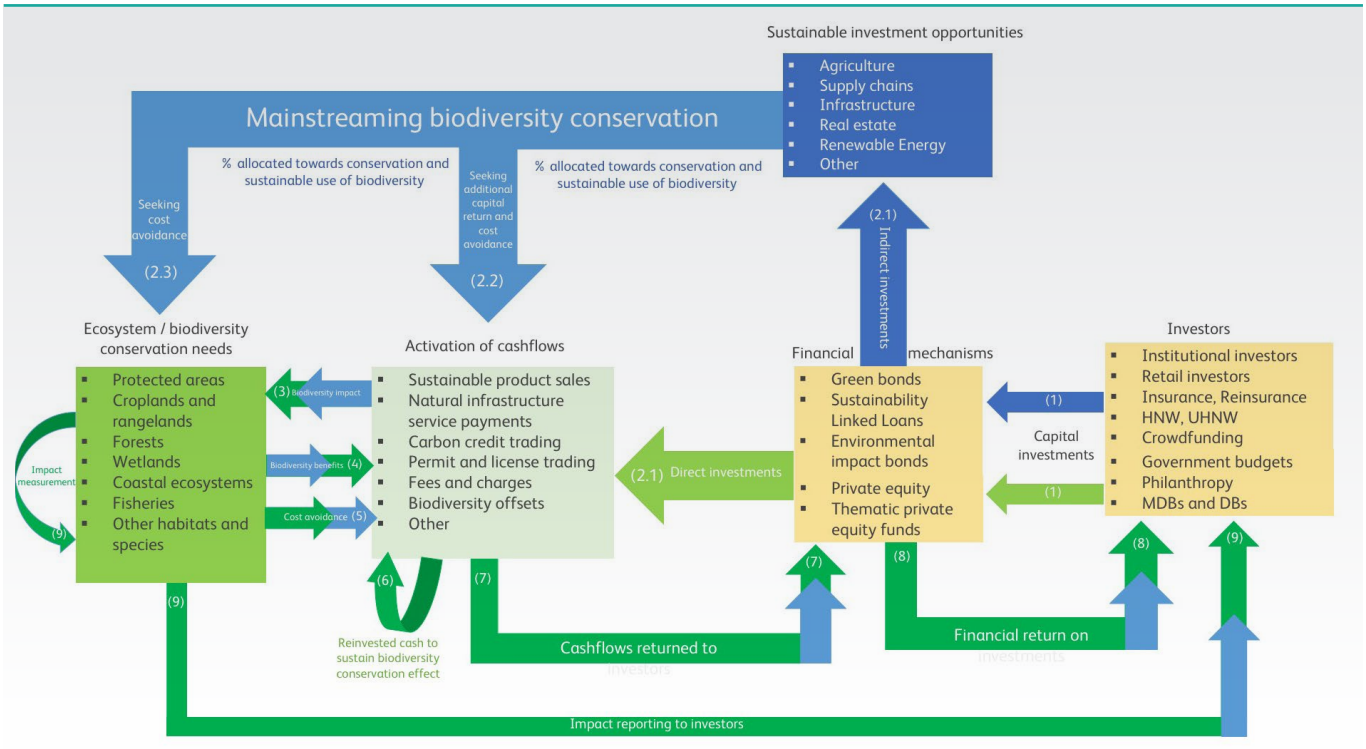
needs, green financial products have to be able to channel large amounts of capital toward high-impact conservation activities.

Recent evidence suggests that the transition from pilot phase to mature market may currently be underway in the green investment area. By one estimate, in 2018 there were US$ 30.7 trillion in institutional assets under management globally, in the form of green debt products,[422] real assets, and public equity ESG focused funds.[xxii]

The sheer variety of investment products in the green finance market, spanning the risk spectrum and proposing to generate a variety of environmental benefits, is one of its most notable features. At one end of the spectrum, green bonds, green loans, and sustainability-linked loans are well understood by the markets, are liquid, and represent lower-risk investment opportunities. At the other end, green private equity funds offer more attractive returns and appeal to investors with a strong risk appetite. Other financial products and services, such as insurance, guarantees, and blended finance structures, can also play an important role in de-risking investments and improving the risk profile of investments.

Nevertheless, these products' application to reducing biodiversity conservation has been small in comparison to the amount of capital channeled toward transitions to clean energy sources or sustainable construction and infrastructure. Of the US$ 271 billion in green bond issuances, less than 0.7 % of green bond issuances were allocated toward biodiversity conservation in 2019.[423] Similarly, only US$ 2.3–3.0 billion (<0.5 %) of social and environmental impact investments were allocated toward biodiversity.[424] In both cases, the majority of financing or investment was channeled toward the energy sector.

FIGURE 5.7 Green investment framework for biodiversity conservation



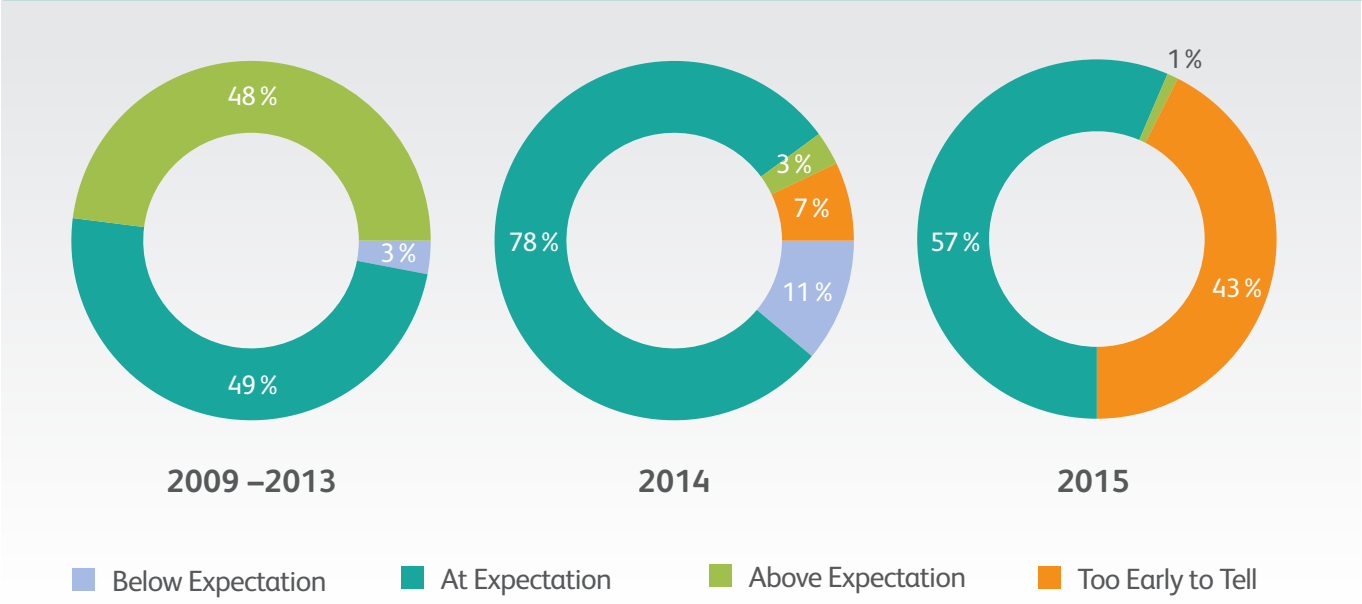
Source: Adapted from Huwyler et al. (2014a). Conservation finance: Moving beyond donor funding toward an investor-driven approach.[425]

[xxii] The chapter on Biodiversity Risk Management describes the potential role of ESG screening and ESG integration for investments in biodiversity conservation. Despite large institutional investors having committed to integrate ESG factors into their investing, there is limited rigorous reporting on the positive environmental and social impacts of ESG-focused investments, reflecting both limited impact measurement methodologies and the cost and difficulty of collecting data on these nonfinancial returns.

Figure 5.7 shows how investors place capital into financial mechanisms and structures (such as green bonds or private equity funds) to directly invest in biodiversity conservation projects with positive cash flow generation potential[xxiii] that in turn allows for biodiversity conservation impact on targeted ecosystems.[426] The cash flows generated by this investment serve to sustain conservation activities and provide investors with a financial return. Figure 5.7 also shows how investors can allocate capital into mechanisms (such as green bonds or sustainability-linked loans) to mainstream biodiversity conservation through investment in other assets, such as renewable energy infrastructure. Mainstreaming biodiversity conservation in renewable energy investments can potentially provide additional capital returns and cost avoidance measures to investors. For example, green bond investors in solar photovoltaic projects can allocate a percentage of the green bond proceeds toward natural infrastructure investments or biodiversity offsets for wetlands and grasslands protection. The cash flows generated by this additional investment could provide disaster risk or climate resilience cost-avoidance protection, serve to sustain conservation activities, and provide mainstream investors with additional financial returns.

Where the right market and regulatory conditions exist, direct private investment in conservation is increasing the amount of economic activity in areas that have net positive benefits on biodiversity. Recent work by Forest Trends demonstrated that between 2004 and 2015, the private sector invested US$ 8.2 billion of private capital into habitat conservation, sustainable food and fiber, and water quality (US$ 0.2 billion in 2004 to US$ 2 billion in 2015), with most conservation commitments financially performing as expected and sometimes exceeding return expectations (Figure 5.8).[427]

FIGURE 5.8 Realized internal rate of return (IRR) to date by conservation category



Source: Hamrick (2016). State of Private Investment in Conservation 2016: A Landscape Assessment of an Emerging Market.
Note: Realized IRR based on 16 organizations with previous conservation investments and Projected IRR based on 47 organizations with conservation commitments for each of the conservation categories, respectively.[428]

[xxiii] Biodiversity finance cash flow activation mechanisms come in a variety of forms, from public fees and charges to hunting licenses and permit trading. Some require policy leadership and regulatory frameworks to incentivize public-private natural infrastructure services payments, forest carbon markets credit trading, or biodiversity offsets payments. Others are more innovative and show promise but remain untested at a large scale by the private sector, including sustainable commodities product sales.

B. Description of Mechanism

A variety of financial products and services can be used to raise capital for projects or companies that deliver biodiversity returns in addition to financial returns for investors. Among the most visible are green bonds, green loans, and sustainability-linked loans, which represent green alternatives to traditional forms of lending. Equity investments are also used to deploy capital in a manner that delivers financial and biodiversity returns, notably through a variety of thematic private equity funds, incubators, venture capital firms, and exchange-traded funds (ETFs).

The green financial products market is growing rapidly, both in terms of the variety of ideas being piloted and the amount of capital entering the market, and it is likely that the market will continue to produce innovative solutions to environmental challenges in the coming years. However, most green investment products with the potential to absorb and deploy large amounts of capital and deliver biodiversity returns are in the early stages of development, while those that are mature have been used in a comparatively small number of transactions that result directly in biodiversity benefits.

Although the variety of green financial products illustrates the amount of activity and interest that this field has attracted, this report focuses on a small number of products that appear to have the greatest potential to attract substantial amounts of investment capital while also generating positive biodiversity returns. This report categorizes this wide array of products as (i) green debt products, (ii) green equity products, and (iii) other green financial products.

Green Debt Products

This category includes a variety of fixed-income investment products that deliver financial returns and positive environmental impacts. In the past decade in particular, there has been a dramatic increase in the amount of private investment capital deployed into environmentally beneficial debt instruments, led by the green bonds market. For those seeking to leverage the investment markets for conservation, two of the key features of the debt market are its scale and its growth rate. The size of the global bond markets, for example, increased from US$ 87 trillion in 2008 to more than US$255 trillion in 2019, driven by the growth of bond issuance in the public and private nonfinancial sectors, primarily in emerging markets.[xxiv, 429] Of this, green debt represents a small (<0.5 %) but growing segment of the bond markets. The debt crisis derived from the COVID-19 pandemic and linked economic downturn demands a critical global economic response, but it also represents an opportunity to support the issuance of biodiversity-related green debt products by developing countries, with the integration of biodiversity targets into new debt agreements, reducing the cost of capital and ensuring the protection of natural assets.[430]

What follows is a discussion of some of the debt products that appear most scalable and most likely to generate substantial positive environmental impacts.

Green Bonds

Bonds are debt instruments issued by either public or private organizations to raise capital in the domestic and international capital markets (public offering) or placed privately with a limited number of investors (not listed on a public exchange). Bonds, particularly those issued by certain sovereign countries, cities, and highly rated corporations, are generally considered safe, "plain vanilla" products that attract risk-averse investors. In 2007, the first labeled green bond was launched by the European Investment Bank and the World Bank, which was an equity-indexed bond that was sold in 27 markets in

[xxiv] In contrast, deleveraging has brought the share of bonds issues by financial institutions to below 40 % from over 50 % in 2009, as of mid-2019.

the European Union.[431] Green bonds are similar to ordinary bonds except that investment proceeds are restricted to finance green projects and assets (rather than for general purposes). Also, green bonds are designed to deliver environmental returns with lower risk, and at greater scale, than most other green products.

Like with traditional bonds, governments, or firms in need of financing for green projects, issue green bonds, in which institutional investors and individuals may invest. Investors receive full repayment of the bond issuance amount (the "principal") in addition to interest payments on outstanding principal amounts (the "coupon payments"). The determination of whether a bond is actually "green" is left to issuers and investors. Sovereign green bonds are issued by national governments for investing green projects and assets. In 2018 and 2019, sovereign green bonds represented 13 % of the green bond market issuance and are one of the most prolific and fastest-growing categories for financing land use (25 %), renewable energy (25 %), and transport sectors (25 %) green projects.

The Green Bond Principles, developed by finance industry actors in collaboration with the International Capital Markets Association (ICMA), is a set of voluntary principles designed to ensure greater standardization in the market, including on reporting requirements and third-party certification.[432] In addition, the Climate Bonds Initiative has issued industry-specific criteria that provide more detailed guidance to issuers and investors on green investments.[433] No such specific standards exist for investment in biodiversity-related activities.

TABLE 5.19 Examples of Water Management and Sustainable Land Use Green Bonds

Instrument type / Sector	Issue / Size (US$ million)	Project	Expected environmental impact
Municipal green "century" bond (water management)[438]	Washington D.C. US$ 350	Proceeds will support the funding for the construction and 100-year lifetime costs of a tunnel that will transport storm water and sewage to a wastewater treatment plant.	• Reduction of sewage outflow to major waterways • Improved water quality • Climate resilience / flood mitigation • Waterway restoration and recreational use • Biodiversity improvement from nitrogen and phosphorus removal
Municipal green bond (sustainable land use)[439,440]	Louisiana Local Government Environmental Facilities and Community Development Community US$ 5	50-year US$ 50 billion Coastal Master Plan—coastal erosion prevention project on the Cameron Parish Gulf shoreline in Louisiana	• Will replace natural granite rock off the coast of the Cameron Parish Gulf Shoreline • Prevents the effects of coastal erosion
Forest Bond (sustainable land use)[441,442]	The International Finance Corporation (IFC) of the World Bank, Kenya US$ 152	The IFC issued the first forests bond in 2016 to support conservation of forests in Kenya. The bond, which raised US$ 152 million, paid returns to investors in either cash or REDD+ carbon credit	• Promotes forest and biodiversity monitoring by funding community wildlife scouts, forest patrols, social monitoring, and carbon inventory monitoring

Issuances in the biodiversity-related green bond market have mostly been in clean water and sustainable land management projects. The water management sector accounted for 8 % of the total climate-aligned bonds (US$ 101 billion) or 10.1 % of the green bonds (US$ 17 billion) in 2018, with proceeds used for improving the climate resilience of water assets.[434] Green projects with biodiversity conservation targets include nature-based and hybrid systems for water collection and waste management, storm water management, flood protection, and drought resilience, among others. The sustainable land use sector accounted for just over 3 % of the climate-aligned bonds (US$ 37.3 billion) or 2.5 % of the labelled green bonds (US$ 4.3 billion) in 2018, with proceeds used for protecting forests, sustainable agriculture, and land conservation and restoration.[435] Svenska Cellulosa AB was the first green bond issuer to allocate part of the deal's proceeds to sustainable forestry projects in April 2014, and nine more issuers have come to market since then.[436] The Agricultural Development Bank of China is the single largest issuer, accounting for over a third of green bonds, with proceeds allocated to sustainable land use, forestry, and climate adaptation.[437] Table 5.19 provides example of bond issuances within each sector.

Of the US$ 271 billion green bond issuances in 2019, only US$ 1.6–3.3 billion (<0.7 %) of investments were allocated toward biodiversity conservation whereas 31 % went into energy, 30 % into buildings, and 20 % into transportation.[443, 444] In fact, 50 % of the cumulative green bond capital invested between 2014 and 2019 has been invested in renewable energy infrastructure,[445, 446] which may even have a negative impact on biodiversity.[447]

CASE STUDY:

The Conservation Fund Green Bond (Public Offering)

In September 2019, The Conservation Fund publicly issued US$ 150 million in green bonds as part of its strategy to mobilize funding to fight forest loss by tapping into the capital markets. Goldman Sachs served as the sole underwriter for the public bond offering.[448] The Conservation Fund is a US-based environmental nonprofit that has at its mission to protect biodiversity and provide economic vitality through conservation initiatives. Proceeds from the bond issuance will be used to scale the work of the organization's Working Forest Fund, which aims to conserve 2 million hectares of high conservation value forests.[449]

The Working Forest Fund protects at-risk forests from further degradation through acquiring, managing, conserving, and reselling its purchased land.[450] The fund purchases at-risk land and develops a sustainable forest management plan, in addition to a wildlife and habitat restoration plan. The aim of such activity is to conserve the habitat while maintaining forestry jobs in the area surrounding the forests.[451] Simultaneously, the fund secures a permanent conservation easement to ensure that the acquired land will never be fragmented or commercially developed.[452] After the easement is secured, the fund resells the land to a public or private entity and recoups its invested capital.[453] As of November 2019, US$ 500 million of the proceeds had been invested to protect 675 thousand secured acres (273 thousand hectares) of forest in the United States.

CASE STUDY:

France Green Sovereign Bond—Mainstreaming Biodiversity (Public Offering)

Sovereign green bonds account for more than 10 % of the global green bond volume and are among the key drivers of green bonds issuance for greening public infrastructure and public services.[454] The Agence France Trésor (AFT) manages the French state's finances, a mandate that includes the issuance and repayment of French sovereign debt. To issue debt internationally for public market investors, the AFT issues OAT (*Obligations Assimilables du Trésor*) bonds. In January 2017, the AFT utilized this same type of mechanism to issue the first French sovereign green bond backed, like other French OATs, by the French state.[455] For this transaction, a green framework for sovereign OAT bonds was created to provide guidance to investors on the use of proceeds and type of information to be reported.[456] The creation of the green OAT framework laid out the foundation for future green sovereign issuance by France.

The 2017 green OAT bond was a 25-year issue with a principal amount of €7 billion.[457] At the time, this was the largest green sovereign finance bond. Since then, there have been multiple follow-up issuances of green OATs, where new notes with the same characteristics are sold to the capital markets, increasing the total amount of capital raised through this mechanism to €25.3 billion as of April 2020.[458] The proceeds from these bonds have financed eligible expenditures in the French state budget, with the capital raised being allocated toward four objectives (climate mitigation, climate adaptation, biodiversity, and pollution reduction), that are invested in through six sectors (buildings, living resources, transportation, energy, climate adaptation, and pollution reduction).[459] Between 2017 and 2019, France allocated €3.13 billion of the proceeds of this issuance to activities directly supporting its biodiversity conservation objective.[460, 461, 462]

Green OATs are aligned with the Green Bond Principles and, prior to their issuance, disclose procedural guidance on evaluation, monitoring, and reporting. In 2019 the AFT allocated 15 % of the Green OAT funding in 2019 (€5.9 billion) toward its biodiversity conservation objective. Investments in the "living resources" sector, which totaled €974 million in 2019, channeled funding to biodiversity conservation through investments in research, sustainable forest management, the country's Landscape, Water, and Biodiversity program, and incentive schemes for organic agriculture.

The impact of these expenditures is reviewed through periodic assessments focusing on individual programs. As of 2020, two environmental impact assessments have been issued analyzing the biodiversity impacts of subsidies provided to the French Waterways Authority, concluding that the program has had positive impacts on biodiversity beyond regulatory baselines. The AFT is considering launching a second green sovereign bond in 2021, considering the success of its first green OAT bond.

CASE STUDY:

The Seychelles Sovereign Bond

In 2018, the World Bank supported the government of the Seychelles' issuance of the world's first sovereign green bond designed to support sustainable marine conservation, sustainable fisheries, and coastal ecosystems (sometimes referred to as a "blue bond"). Seychelles is a small island nation in which the fishing industry ranks second in economic importance only to tourism, and this blue bond is intended to help build a sustainable blue economy, assisting in the transition to more sustainable practices, and protecting ocean biodiversity.[463]

The Seychelles' blue bond, which was issued by the central government, was a bond private placement of US$15 million, with Calvert Impact Capital, Nuveen, and Prudential acting as investors. The 10-year bond has a coupon of 6.5 % and will be redeemed in three equal installments in 2026, 2027, and 2028.[464] A grant by the World Bank provided a guarantee on the bond repayment, and the Global Environment Facility (GEF) provided concessionary funding to support the Seychelles' coupon payments, effectively decreasing the interest rate from 6.5 % to 2.8 % and saving the Seychelles over US$8 million in interest payments.[465] The government will pay bondholders from its central budget, with an anticipated increase in tax revenues from the fisheries sector and user fees from the tourism sector.

The bond proceeds are intended in part to provide grants to support improved fisheries management activities and loans to encourage investment in areas such as post-harvest value-added enterprises and jobs in the protection of ocean resources.[466] The proceeds are also intended to fund the Seychelles Marine Spatial Plan for its exclusive economic zone.[467] Allocation of funds for individual projects (either grants or loans) will be through the Blue Grants Fund and Blue Investment Fund, managed by the Seychelles Conservation and Climate Adaptation Trust and the Development Bank of Seychelles.[468]

This blue bond transaction shows the potential for mobilizing the private sector to support marine conservation and sustainable fisheries, representing a model for island and coastal nations. Blue bonds have also been issued by Fiji (through a US$50 million sovereign bond with support from the IFC in 2017)[469] and by the Nordic Investment Bank (which issued a SEK 2 billion blue bond in 2019 to finance wastewater and flood prevention projects to protect the Baltic Sea ecosystem).[470]

Green Loans

Green loans serve a similar function to green bonds, although they come in the legal form of a traditional lending product rather than a security. In a typical green loan, a private borrower obtains credit from a bank in return for specific commitments (in addition to customary loan commitments) to use the proceeds to finance green projects and assets that deliver positive climate and biodiversity outcomes. Like ordinary loans, and unlike green bonds, green loans do not tap into the capital markets directly but rather are syndicated by lenders, and they tend to have a shorter maturity than green bonds. Pricing on green loans can be attractive to borrowers compared to a traditional loan on the basis that a green asset may be more economically efficient than a traditional asset. For example, a green building may have lower heating and cooling costs associated with its maintenance compared to a conventional building, resulting in a reduced risk of default on the part of the green borrower and therefore lower borrowing costs.

The green loan market has benefited from the development of the Green Loan Principles by a working party of the Loan Market Association (LMA), the Loan Syndications and Trading Association (LSTA), and the Asia Pacific Loan Market Association (APLMA).[471] Application of the principles is voluntary, and it is recommended that adherence is verified by a third party. Similar to the green bond market, no specific set of principles exists for loans related to investments in biodiversity conservation.

Sustainability-Linked Loans

Like green loans, sustainability-linked loans (SLLs) are loan products provided by lenders in return for sustainability commitments assumed by the private borrowers and agreed between borrowers and lenders. In a number of cases, SLLs have included sustainability targets that, if met, result in interest-rate reductions. In general, the proceeds from SLLs are used for general corporate purposes rather than for specific green projects or assets. The SLL market is informed by the Sustainability Linked Loan Principles, a voluntary set of guidelines issued by the LMA, LSTA, and APLMA. SLLs can have a positive impact on biodiversity if their sustainability targets are linked to conservation.[472] This approach has already been tested through the issuance of SLLs with key performance indicators related to biodiversity conservation. For example, in 2020, Finnish pulp maker UPM borrowed €750 million from BNP Paribas through a 5-year SLL that ties interest rate reductions to performance indicators demonstrating a net-positive biodiversity impact in the forests managed by the company in Finland and 65 % reduction in CO_2 emissions from fuels and electricity by 2030.[473]

Credit Facilities

These facilities, which often act as independent vehicles created through multi-stakeholder partnerships, pool investment capital with the goal of disbursing loans that support a specific overarching sustainability goal or objective. Credit facilities serve as intermediaries between the capital markets, from which they raise capital, and sustainability-aligned projects, to which they provide loans. Loans provided through credit facilities must fulfill criteria set forth in the relevant documentation, which often includes geographical restrictions, performance standards, and alignment with specific objectives.

One notable facility of this kind that supports biodiversity conservation outcomes is the Tropical Landscape Finance Facility (TLFF), which consists of a lending and grant fund platform to provide funding to sustainable agriculture and renewable energy projects in Indonesia. Under the Lending Platform, long-term loans issued by TLLF are securitized through a medium-term note program arranged by BNP Paribas. The facility aims to unlock private capital to channel investments toward agriculture, ecosystem restoration, and renewable energy.[474] The Grant Fund provides technical assistance and seed funding supported by grants from philanthropic organizations.

In 2018, the facility closed its inaugural financing, lending US $95 million to a joint venture by the French Michelin Group and Indonesian Barito Pacific, and a second tranche of US$ 120 million is expected in 2020.[475] TLFF is seeking to plant 34,000 rubber trees across 88,000 hectares of concession lands in Indonesia with the sale of sustainable products derived from the rubber trees being used to repay the loan.[476] This investment will result in the protection of 9,700 hectares of wildlife conservation area and provide an estimated 16,000 jobs for local communities.[477] To fund this transaction, the facility uses a blended finance structure of multiple capital sources including market rate capital, concessionary loans, and risk mitigating guarantees by development organizations.[478] The TLFF plans to replicate this type of transaction with other projects that are aligned with its environmental impact objectives.

Equity Products

This category includes a number of financial products, including thematic equity funds with specific investment strategies in areas such as sustainable forestry, carbon finance, and mitigation banking as well as more broadly diversified sustainability-focused funds that are invested in publicly traded shares across a portfolio of companies. Some of these equity funds do not have a specific focus on environment or biodiversity but include these in their investment orientation. Other of these funds have a narrow focus on certain areas of biodiversity use or impacts. What follows is a discussion of some of the green equity products that appear most likely to deliver positive biodiversity impacts at scale.

Private Equity Funds

Private equity funds are investment vehicles that raise private capital from accredited investors, to purchase equity stakes in private companies, and in some cases to acquire control of public companies, in exchange for a financial return and an appropriate level of risk.[479] It is worth noting that while private equity funds' investments are equity investments, funds often utilize debt, loans, or hybrid forms of finance that possess the features of both equity and debt that enable them to make higher returns on their investments. With regards to biodiversity conservation, private equity funds can make an impact through direct investments in conservation or ecosystems, or through using their equity stakes to direct their portfolio companies toward more sustainable business practices.

This report's analysis of the private equity sector is based on private equity investments related to impact investing. Impact investing is a form of sustainable investing that also focuses on the nonfinancial benefits of investments when looking at investment returns. GSI Alliance estimates that it represents 1.5 % of capital invested in sustainable and responsible investing (SRI), or US$ 30.7 trillion in assets under management, in 2018.[480] The Global Impact Investing Network's (GIIN's) Annual Impact Investor Survey estimates that impact investments were primarily channeled to the energy (16 %), financial services excluding microfinance (12 %), forestry (10 %), and food and agriculture (9 %) sectors.[481] The survey estimates that, as of 2020, less than 2 % of impact investing assets were allocated toward biodiversity conservation of which US$ 2.3–3.0 billion (<0.5 %) were private equity investments in the forestry, food and agriculture, and water sectors.[482]

Sector-specific private equity funds invest in various types of companies, natural assets, and projects to generate positive financial returns and biodiversity impact. Firms wishing to invest in biodiversity can invest in real assets, such as sustainably managed timberland, or in environmental markets through investing in mitigation banking and carbon offset trading. For these equity funds, positive biodiversity impacts are a direct result of the value provided by the assets or services in which the funds invest. For example, The Nature Conservancy's private equity-style fund, NatureVest, raised more than US $70 million in equity capital from 27 investors, US $40 million in debt, and US $20 million from the proceeds of carbon offset sales to purchase 102 thousand hectares of forestlands in the Central Appalachian region of the United States for its Cumberland Forest project.[483] With this acquisition, the fund seeks to generate attractive risk-adjusted returns for its investors from revenues generated from sustainable forestry, carbon capture, and recreational leases.[484]

A characteristic of the more general equity funds is the level of influence that funds have over investee companies. Due to the substantial holdings a fund may have in investee companies, and these communities' immunity from stock reactions to engaging in more sustainable and expensive (in the short-term) business

CASE STUDY:

Ecosystem Investment Partners

Ecosystem Investment Partners (EIP) is a private equity firm specialized in acquiring, entitling, restoring, and sustainably managing lands with potential to generate wetland, stream, and endangered species mitigation bank credits in the United States.[485] To generate a return on investor capital, EIP issues mitigation credits that are purchased by public and private developers to offset the environmental impacts of their construction projects. Mitigation credit proceeds are then used to repay the private investors, who have financed the restoration work in advance.[486]

EIP's work illustrates how a private equity firm can capitalize on a growing regulatory market, which was made possible by the Clean Water Act of 1972. Section 404 of the act regulates land use around wetlands to avoid, minimize, or compensate for potential impacts of human activities on wetland ecosystems.[487] The act introduces compliance costs that forces construction activity to internalize what were previously negative externalities.[488]

Since 2007, EIP has raised nearly US$ 1 billion from private investors in the United States and internationally for its four private equity funds, including its latest EIP IV fund of US$ 454.5 million in 2020.[489, 490] EIP has allocated its funds in 44 projects across 12 states, covering 44,000 acres of wetlands and 176 miles of streams.[491] Additionally, EIP undertakes restoration investment projects through pay-for-success (PFS) contracts by delivering large-scale restoration projects at a fixed cost to private and public customers.[492]

transformations, funds can use their position to implement management practices expected to maximize returns on their investment at the time of sale or exit from the position. In this case, biodiversity impacts are a direct result of the value provided by the assets in which the funds invest.

Public Equity Funds

Public equity funds focus on the ownership of shares of publicly listed companies. The more diversified public equity funds are invested across a large number of sectors and geographies, and as such mitigate some of the risks of investing in equity securities through diversification, while other such funds are more narrowly focused on certain industries, geographies, or market segments. As companies in these funds are public, they tend to have relatively large market capitalization and are subject to regulatory oversight and regular, substantial disclosure requirements. In addition, these funds offer liquidity and long-term returns that make them attractive compared to many other investments.

Over the past half-century, and beginning with faith-based organizations, an increasing number and variety of investors have sought to reconcile their investment portfolios with their personal or institutional values. This generated demand for public equity funds tailored to particular investor segments, including those supporting environmentally responsible practices. However, the potential impact of large flows of capital into public equity funds supporting particular objectives such as biodiversity conservation may be limited by the fact that most transactions through these funds occur in the secondary markets and therefore do not direct additional capital to the underlying companies' operations. Nevertheless, increased demand for companies with a positive environmental footprint can increase share prices and, in turn, reduce their cost of capital, but the impact of these changes on a company's biodiversity conservation efforts is indirect. Therefore, increases in capital

flows into these funds (and, similarly, direct investments in shares of companies with strong environmental records) are likely to make a relatively minor contribution toward closing of the biodiversity financing gap, even if this indirect impact may be offset by the magnitude of capital inflows into the public equity markets.

Other Green Financial Products

Environmental Impact Bonds

An environmental impact bond (EIB), like a social impact bond (SIB) or a development impact bond (DIB), is a mechanism through which a beneficiary party (or "outcome payor"), often a governmental entity, enters into a contractual relationship with a group of risk investors to procure a needed service or intervention on a pay-for-success (PFS, also known as pay-for-performance or PFP) basis. The outcome payor benefits from the fact that it is not required to repay the investors unless predetermined metrics (which indicate the service or intervention has been successful) are achieved. Given the conditionality of the returns, it is in the investors' interest that competent service providers are hired and that these service providers deliver strong results that satisfy the predetermined metrics.

In an impact bond structure, repayment (or not) of investors is normally a binary outcome, such that, if the predetermined metrics are achieved, the investors receive their full principal and returns, while if they are not achieved the investors lose their entire investment. Returns on some impact bonds are graduated to reflect different success levels of the intervention or service provided; in such cases, a baseline return is agreed with investors, which may be enhanced (or reduced) by agreed amounts depending on the success of the intervention. Impact bonds can be structured in a number of ways but, in spite of their name, most impact bonds are contractual relationships between the parties rather than bonds or other form of security. While the first impact bond transactions were SIBs addressing prison recidivism in England, the principles underlying impact bonds have by now been applied in a variety of contexts. The first few tests of impact bonds in the environmental area have been completed since 2016, and the number of transactions has so far been small. (See the Washington, DC, and Atlanta case studies described below.)

The execution of impact bond transactions generally involves the following steps: (i) private investors fund the initial costs of a project after all parties agree on the impact bonds' parameters; (ii) service providers, also known as implementation partners, use this investment capital to execute projects or finance interventions; (iii) an independent evaluator (e.g., a consultant, a research entity, or some other neutral third party) assesses the project's performance relative to metrics agreed on by the parties; and (iv) beneficiaries or outcome payors repay investors dependent on the outcomes delivered.

While there are a number of factors that could make EIBs difficult to scale up, such as a lack of replicability between transactions, high legal costs, and regulatory hurdles, EIBs may hold considerable potential. In particular, EIBs appear to be well suited to situations in which a particular intervention in the short term may result in a larger avoided cost in the future but where, due to lack of political will or short-term funding, the outcome payor is unable to fund the short-term intervention. Especially when the future avoided cost can be accurately estimated but the success of the proposed intervention is uncertain or untested, EIBs may represent a scalable mechanism for deploying risk capital in return for competitive risk-adjusted returns.

Securitization

Securitization is the practice of pooling assets (such as mortgages, credit cards, loans, or other

CASE STUDY:

Innovative Debt Mechanisms—Environmental Impact Bond (EIB) for Atlanta Department of Watershed Management and District of Columbia Water and Sewer Authority

Environmental impact bonds (EIBs) are structured using a pay-for-success (PFS) mechanism that ties payment for service delivery to the achievement of measurable outcomes. Performance pay-outs (repayment of the original investment with interest) are contingent on the achievement of preestablished environmental outcomes. PFS contracts secure capital from private investors for initial project costs. In return investors require a commitment from project beneficiaries to pay for project outcomes according to the benefit they receive. So, upfront investors are repaid based on the magnitude of the outcomes achieved, thus incentivizing investors to support interventions that will generate desirable results. This structure has been utilized by two government departments, the District of Columbia Water and Sewer Authority (DC Water) and the City of Atlanta Department of Watershed Management (DWM), to finance projects that manage storm water runoff.

In 2016, DC Water issued the first EIB in the United States. The US$ 25 million issue was a private placement with a three-tiered payment system based on storm water volume control performance metrics.[493] Proceeds of the EIB funded the testing of green infrastructure projects to improve water quality, reduce burden on water treatment, mitigate and prevent residential flooding, and strengthen climate change resilience. The performance-tiered system specified that if the green infrastructure underperforms expectations and the storm water runoff reduction is less than an agreed-on threshold, then investors will make a US$3.3 million risk share payment to DC water.[494] If it performs as expected, the bond would pay at a market rate. However, if the project outperforms expectations and the storm water runoff reduction is above a predetermined threshold, then DC Water will make an additional US$ 3.3 million performance payment to the investors.[495]

In January 2019, Atlanta DWM issued a public, two-tiered PFS EIB for US$ 14 million.[496] The repayment structure includes a base case and high-performance scenario. The proceeds are intended to finance the implementation of six green infrastructure projects in underserved neighborhoods to address various environmental needs, including managing storm water runoff, reducing local flooding, and improving water quality. The US$ 14 million investment is expected to generate an estimated US$ 18 million in benefits in terms of flood reduction and water quality as the base case. If the metrics in the base case scenario are reached, the EIB will pay investors a below-market return.[497] However, if a high-performance outcome is reached, as measured in volume of storm water captured, a pro-rata additional US$ 1 million payment to investors will be triggered. Any additional payment by the beneficiary is offset by the reduction in costs to the beneficiary associated with the increased amount of storm water captured, and results in an above-market return for investors. Using a weighted average of the probabilities and return profile of the bond, the expected return on the EIB was similar to that of comparable municipal bonds at the time of issuance.[498]

receivables) and selling their cash flows packaged as securities. Securitization can be of use when there is a need for sustainable investment to be scaled up through the aggregation or pooling of smaller projects into larger pools of assets that represent attractive investment opportunities for investors. Bundling small sustainable agriculture and forestry projects enhances these projects' ability to access capital compared to those projects trying to do so individually without the benefit of scale.

In 2018, securitization products represented 24 % of the total green bond market.[499] Securitization green bonds are collateralized by one or more eligible green project and asset, including asset-backed securities (ABS) and mortgage-backed securities (MBS). The only source of repayment is the cash flows generated by the assets. Securitization green bonds have been primarily used in energy efficiency projects. By the end of 2019, Fannie Mae was the largest green bond issuer in the global green bond market, with more than US$ 22.8 billion MBS green bonds to primarily reduce energy or water consumption in the multifamily properties that it lends to through its Green Rewards Loan.[500] Between 2012 and 2018, Fannie Mae's MBS green bonds have contributed to saving an estimated 4.3 billion kilo British thermal units (kBtu) of source energy annually, 5.9 billion gallons of water annually, and reduce greenhouse gas emissions by 287,000 metric tons.[501] On the other hand, ABS can be used to bundle smaller revenue streams (agricultural credit rights) and use them as collateral for green ABS bonds sold to domestic or international investors.

Structured Notes

A structured note is a security that combines debt and equity characteristics, as it has many of the features of a debt security but returns are tied to the performance of an underlying asset, stock, or index. As such, a structured note contains an embedded derivative component.

As an example, a note could raise debt through the public markets and invest the raised capital into some type of sustainability index while it searches for biodiversity-related investment opportunities.[502] Investors would therefore be able to earn returns through income from these investments. Once conservation projects are prioritized, the investments could be liquidated and the proceeds reinvested into biodiversity conservation funds that realize returns from conservation activities that generate revenue streams (for example, through producing carbon credits).[503]

Through this model, investors would be exposed to (i) impact investing fund returns from their direct investments in profit-making sustainable biodiversity conservation projects, and (ii) a portfolio of selected green bonds listed and offered in secondary markets. Such a structure would usually involve the creation of a special purpose vehicle (SPV) to issue the structured notes and to raise funds from investors. The funds raised may initially be invested into some form of green financial products with high liquidity, such as a portfolio of green bonds or tied to a green index such as the Bloomberg Barclays MSCI Green Bond Index. As investments into profit-making conservation projects are made, the investment in green bonds or index funds can be liquidated and the funds reinvested into a private equity impact investing fund. The benefit of such a structure is that structured notes make it possible to match the supply of biodiversity conservation projects with the diverse investment risk profiles of private investors, thereby enabling investments in biodiversity conservation that might not have occurred but for the investment opportunity in a structured note. The flexibility of structured notes provides for-profit investors with risk-adjusted market rates of returns and time horizons that are difficult to find with other investment products.

C. Why Is It Important to Biodiversity?

According to Huwyler et al. (2014b), direct investments in biodiversity conservation can be sorted into three general categories:

- Investments in underlying ecosystems, such as forests or freshwater habitats, or rights pertaining to their use (such as conservation easements)
- Investment in the infrastructure and sustainable management of ecosystem services, such as ecotourism lodges and trails, and goods derived from sustainable economic activities such as sustainable agriculture and forestry
- Investments in ecosystem market mechanisms and regulatory arbitrage, such as financial instruments, intermediaries active in ecosystem markets, biodiversity offsets, or carbon markets[504]

Like other investment opportunities, capital invested in green financial products relies on an expectation that the investment will generate a return on the investment, whether in the form of interest (in the case of a fixed-income product) or of an increase in the value of the asset and the distribution of future returns (in the case of most equity investments). In direct investments into conservation, the revenue streams that make these returns possible vary depending on the kind of conservation project.

Green financial products can also play a critical role in mainstreaming biodiversity in investments of other sectors such as renewable energy, agriculture, and infrastructure. By including biodiversity conservation in projects of other sectors, a portion of the investments can be channeled into a biodiversity aspect of the project.

Given the size of the biodiversity financing gap and the scale of private capital markets, these products are a crucial lever in meeting the 2030 needs of biodiversity financing. An increase in the number of investable projects combined with these products' ability to incentivize achievement of nonfinancial, biodiversity-related performance metrics could redirect vast quantities of capital toward projects and investments that support critical biodiversity habitats.

TABLE 5.20 Current State (2020)

Mechanism	Total market size US$ bn (2019)	Allocation toward biodiversity (%)	Allocation toward biodiversity US$ bn (2019)
Green debt—green bonds	$271.0	0.5 %–1.0 %	$1.4–$2.7
Green debt—green loans	$89.6	0.1 %–0.5 %	$0.1–$0.4
Green debt—sustainability-linked loans	$121.5	0.03 %–0.05 %	$0.04–$0.1
Green Debt—credit facilities	$0.1	50 %–75 %	$0.06–0.09
Green equity—private equity	$715.0	0.3 %–0.4 %	$2.3–$3.0
Other green debt—environmental impact bonds	$0.6	5 %–25 %	$0.03–0.15
TOTAL (2019)	**$1,197.8**	**0.3%–0.5%**	**$3.8–$6.3**

Note: The methodology behind these figures is presented in Appendix A. For mechanisms described in the section above and not shown in this table, either no significant transactions occurred in 2019 or no data was available.

TABLE 5.21 Future State (2030)

Mechanism	Total market size US$ bn (2030)	Allocation toward biodiversity (%)	Allocation toward biodiversity US$ bn (2030)
Green debt—green bonds	$1,120	1 %–4 %	$11.8–$44.8
Green debt—green loans	$48.9	0.2 %–0.6 %	$0.1–$0.3
Green debt—sustainability-linked loans	$502	0.1 %–0.5 %	$0.5–$2.4
Green debt—credit facilities	$2	50 %–75 %	$1–$1.5
Green equity—private equity	$2,742.6	0.4 %–0.6 %	$7.7–$12.3
Other green debt—environmental impact bonds	$106.2	5 %–25 %	$5.3–$26.5
TOTAL (2030)	**$4,522.0**	**0.7%–2.0%**	**$30.9–$92.5**

Note: The methodology behind these figures is presented in Appendix A. For mechanisms described in the section above and not shown in this table, either no significant transactions occurred in 2019, or no data was available.

D. Financial Impact: Current and Future

Current State

The current market size of green debt and private equity for biodiversity is given in Table 5.20.

Future State

The future state of the green finance markets assuming a business-as-usual scenario to 2030, as well as what this report estimates as the potential contribution of each product, are presented in the following Table 5.21 assuming the implementation of recommendations aimed at facilitating the growth of the market as described in the Recommendations below.

The projection of green debt and private equity allocated to biodiversity conservation in 2030 under the low ambition scenario is US$ 30.9 billion per year.

However, green debt and private equity for biodiversity conservation hold the potential to scale up far beyond this with an estimated US$ 92.5 billion per year flowing toward biodiversity by 2030 a high-growth scenario where allocations toward biodiversity conservation have significantly increased enabled by key policy actions.

E. Obstacles and Enabling Conditions

To date, investments focused primarily on the delivery of positive biodiversity impacts have attracted limited capital flows when compared to climate investments. There are a variety of reasons that explain this difference, but a critical one is that investments delivering climate benefits have clear cash flows associated with them, including renewable electrical power and sustainable timber production. Investments in climate mitigation are more accessible to investors because several investment opportunities, as with renewable energy, have similar structures to traditional investments in the energy or infrastructure sectors. In addition to having similarities to existing investment types, climate investments have benefitted from institutional support from governments and international institutions, both through their support of legal frameworks and economic policy that then incentivized

private financial institutions' participation. For biodiversity related green financial products to be scaled, a combination of cash flow generation mechanisms, investor education, and institutional arrangements from public institutions must be developed. Generating cash flows or monetizing avoided costs from the conservation of natural habitats, rather than extracting resources from or otherwise modifying those habitats, is much more challenging.

While private sector investment can make the most significant financial impact to address the biodiversity crisis, such investment will not be forthcoming unless it is profitable. Many institutional and private investors, entrepreneurs, and business leaders are philanthropic leaders in their own right. Firms also undertake corporate social responsibility initiatives, as long as these initiatives do not materially impact profitability. Deliberately investing at a loss—or even at subpar returns—is not a realistic business model, despite the long-term, widespread societal benefits they may have. To help realize the private sector's potential, it is incumbent on governments to put in place enabling policies—such as regulatory requirements, tax incentives, risk mitigation, and other mechanisms—to

De-risking Investments toward Biodiversity Conservation

Blended Finance

The term blended finance refers to the strategic use of public finance for the mobilization of additional private finance toward sustainable investments, often by combining public and philanthropic capital with private, return-seeking capital into the same financing deal.[505] An important feature of a blended finance transaction is that, by contributing public and philanthropic catalytic capital in the form of a concessionary loan or guarantee, a condition is reached where a private investor may achieve its investment objectives that might not have otherwise been achieved, thereby ensuring private investment capital is deployed, the project is implemented, and the anticipated positive environmental benefits are realized.[506]

Blended finance transactions have channeled an estimated US$ 3.1 billion to biodiversity conservation from 2000–2018.[507] Blended finance has enabled the allocation of private capital in multiple investments, including the Seychelles blue bond and the TLFF transactions described in this section. However, this represents a comparatively modest amount, considering that blended finance structures were used by public institutions to mobilize more than US$ 81 billion in private financing with most of the transactions focusing on renewable energy, financial services, and agriculture between 2012 and2015.[508]

Guarantees

Financial guarantees function as a promise by a public or private guarantor to a third-party lender or equity investor that in the event a borrower defaults on payments and/or an asset loss of value, the guarantor agrees to repay the lender the cost, either in full or in part, of the forgone capital invested. The use of guarantees can help attract private investment in biodiversity conservation by improving the risk-return profiles of conservation projects. Guarantees offer several advantages for the public sector, by (i) bridging the gap between perceived and actual risk (guarantees are only disbursed in event of payment default); (ii) allowing for capital efficiency for issuing public institutions (i.e., capital is only disbursed in the case of losses); and (iii) mobilizing local currency and investors resources. Recent work

by Convergence (2019) revealed that between 2016 and 2018 guarantees were utilized in 35 % of blended financing transactions and mobilized US$ 77 billion, the greatest amount of private capital flows, when compared to other blended finance mechanisms.[509]

In 2016, Althelia Ecosphere, an investment fund managed by Mirova Natural Capital, in partnership with USAID, Conservation International, and the Environmental Defense Fund, created the Sustainable Ocean Fund.[510] The fund aims to invest in sustainable seafood, circular economy, and conservation with the goal of supporting marine projects in emerging markets and small island nations. The fund's partnership with the USAID Development Credit Authority (DCA) allows it to provide loan guarantees to the projects in the portfolio, which reduces the downside risk of nonpayment to the fund investors.[511] In 2020, the Sustainable Ocean Fund closed its latest funding round with US$ 132 million of commitments.[512]

Insurance

Some insurance products such as risk pools and parametric insurance can be used to hedge against the risk of financial losses that may result from damages to the insured party from environmental loss or disaster events (e.g., degraded coral reefs and coastal flooding). Insurance products can also be used to hedge for liability for damage caused by the insured to a third party or resulting in biodiversity loss (e.g., wetland degradation or destruction). In addition to providing contingent resources for immediate remedial action in the event of an environmental disaster, insurance can prevent future expenditures and thus reduce financial risks. Extending such insurance products to natural ecosystems, such as coral reefs and mangroves, is only recently emerging.

Reefs and mangroves are of critical importance for coastal protection and disaster risk management. Mexico's Caribbean coast has an annual US$9 billion tourism sector that is at risk from natural disasters such as hurricanes.[513] In 2019, the government of the state of Quintana Roo in Mexico purchased a parametric insurance policy from a Mexican insurer company that would offer up to US$ 3.8 million to cover for potential hurricane damage to its coral reefs.[514] This parametric insurance product was developed by Swiss Re in partnership with The Nature Conservancy (TNC). In agreement with local hotel groups, insurance premiums will be financed through an existing tax paid by hotel group owners of coastal properties. An independent Coastal Zone Management Trust was established for the administration of the funding to protect the reef during normal conditions and to pay for the insurance premiums that will cover the reef against hurricane potential damages.[515] Similar insurance products to protect other natural ecosystems, such as mangroves in Southeast Asia, are under development.

In addition, insurance and reinsurance companies can directly invest in biodiversity conservation to lower future costs and risks related to severe financial losses from environmental loss or disaster events, or they can insure actual natural assets (e.g., coral reefs or mangroves). In cases where private insurance companies offer insurance for high-probability high risk events, national governments might provide financial guarantees to these companies to ensure that they will support them in paying debt obligations should the size of the event be significant. Guarantees in this context enable an entity to take on risk that either may be large or hard to predict, resulting in great uncertainties surrounding future costs.

induce the private sector to invest appropriately for nature. When implemented well, these incentives, by marshalling private capital, allow taxpayers' money to have a far larger impact through markets.

In certain instances, doing so may not be possible without government policies that commoditize the underlying benefits from nature and create environmental markets. For investment opportunities to exist, government policies that directly or indirectly facilitate the monetization of biodiversity benefits must be in place. The presence of ascertainable, quantifiable future cash flows or avoided future costs can strengthen the use case of biodiversity-related green financial products. Generating these cash flows may require strong regulatory enforcement mechanisms, rule of law and property rights, and long-term legal and political stability. Once the appropriate enabling conditions are in place, the funding and repayment schedule of green debt and equity products can be aligned to meet the needs of many biodiversity conservation projects. Examples of this are public fees and charges for public-private natural infrastructure services payments, forest carbon markets credit trading, and biodiversity mitigation requirements and offset payments.

Private capital and the use of the financial products described in this section will also benefit from regulatory frameworks that support and incentivize their large-scale deployment in biodiversity conservation projects. Doing so would involve introducing regulation that supports financial institutions that mainstream biodiversity financing, through direct or indirect investments in conservation projects, or government provision of incentives for businesses and financial institutions that support biodiversity mainstreaming. The United States, for example, could leverage its experience in creating opportunities for financial institutions and economic development corporations to lend to small businesses and civil society organizations in, and otherwise financially support the development of, low- and moderate-income communities. Taking from its experience in creating regulatory infrastructure for institutions and legislation such as the Community Reinvestment Act, the Low Income Housing Tax Credit, the New Markets Tax Credit, SBA lending, the creation of Fannie Mae and Freddie Mac, as well Community Development Financial Institutions (CDFIs), the country can begin to create an investment ecosystem for biodiversity conservation, and private investors that issue and use green financial products.

Despite the accelerating interest in private investment in conservation, biodiversity, as an investment opportunity, is behind other forms of environmental and social investing and is far from reaching its potential.[516] Current sustainable finance frameworks such as the Green Bond Principles are high-level, and the more specific criteria take minimal account of biodiversity. Additionally, there are no formal standards for private equity funds. Overcoming these shortfalls in metrics and guidance can potentially convince investors to redirect their investments into effective biodiversity initiatives. Notwithstanding these difficulties, efforts to address this gap are currently underway, with multiple standards and methodologies being developed to measure the biodiversity impacts of investments and provide clarity to the market. Norms such as the IFC Performance Standards, specifically IFC Performance Standard 6, provide guidance and objective criteria to measure biodiversity impact.[517] Furthermore, legal standards such as the European Union sustainable finance taxonomy seek to provide clarity to investors on the impact of financial instruments.[518]

Notwithstanding the existence of financial instruments to finance projects with a positive impact on biodiversity, a lack of agreed standards on how to structure and measure the positive impacts of investments related to biodiversity conservation may deter those

who lack the expertise or the resources to independently verify such claims. Metrics to compare biodiversity investments are elusive, as positive biodiversity impacts may vary from investment to investment, between geographies, and may have different time-lags until benefits are realized. Unlike the climate space, where there is a simple metric that can be applied across a number of different projects and systems (metric tons of CO_2 equivalent), the biodiversity space does not have such a metric and success in one project may look different and be measured differently from another, rendering comparisons difficult or impossible and increasing the uncertainty and risk present in such investments. Additionally, investor concerns about "greenwashing" and unsupported claims of environmental benefits may further deter capital flow to biodiversity projects.

The financial and technical resources to underwrite the structuring of deals and designing viable projects are key to scaling up green finance for biodiversity conservation. The transaction costs associated with structuring green finance deals can be prohibitive, especially if the projects are of small size or the deals are innovative, highly structured, or multi-jurisdictional. The availability of investment blueprints, standardized contracts, and projects, and a support system of financial and legal institutions capable of working with biodiversity conservation projects, are critical to the execution of green financial transactions focused in biodiversity conservation.

To facilitate the flow of private investment into conservation, therefore, it will be critical to develop a body of best practices, metrics, and monitoring tools that help investors evaluate the nonfinancial returns associated with potential investments.[519] In addition, much more work will need to be done to develop novel deal structures that are replicable and scalable and deliver clear environmental benefits while also delivering attractive risk-adjusted return to investors. The Coalition for Private Investment in Conservation (CPIC), a grouping of financial industry actors and environmental organizations committed to using the tools of finance to address the biodiversity crisis, is working to develop the necessary know-how and propose investment blueprints and pilot transactions that may help to attract larger amounts of private, return-seeking capital into conservation investments in a series of priority areas including forest conservation and restoration, coastal resilience, watershed management, and others.

Beyond the structuring process, it is also possible that many biodiversity conservation projects may not have a risk-return profile that is attractive enough for investors. Tools to de-risk projects by minimizing potential losses, such as an evidenced commitment from the government through guarantees, first-loss provisions, layered and syndicated structures, and insurance, can change this and make the difference between a transaction successfully closing or failing to attract investors. Furthermore, technical assistance can also reduce costs associated with transactions and support the provision of capital. It is worth noting, however, that while the inclusion of these measures might be helpful in scaling the use of green financial products, they might raise the transaction costs associated with these products' creation, making them less attractive to financial institutions who issue them or invest in them.

The scale required for most investors to consider an investment, and for most financial intermediaries to invest the time and effort to structure, execute, and close a transaction, is often misaligned to the average size of a biodiversity conservation project. Projects or portfolios of projects generally need to be in the order of tens or hundreds of millions of dollars before they can expect to be seriously considered by most investors and financial intermediaries, while impactful biodiversity conservation projects often operate at a much smaller scale. Therefore,

coordination and aggregation or bundling of biodiversity conservation projects by local or regional conservation organizations and financial institutions may be required to effectively tap into the national and international capital markets.

Finally, market efficiency barriers can lead to underinvestment in biodiversity. Geographic areas of greatest biodiversity value are often located in less developed countries where upfront costs are higher and capital markets are harder to access. To prevent green finance being raised and used only in the advanced economies, there needs to be a development in national capital markets in developing countries. Alternatively, international (bilateral and multilateral) support for raising capital for biodiversity projects in emerging and less advanced economies may be required to channel investment capital into these regions. Tools such as foreign investment, concessionary capital, and de-risking mechanisms can help further this goal. In parallel with this, there needs to be more long-term (or "patient") capital to match the payback period of many conservation investments stemming from a longer-than-normal cycle before revenue flows are realized. Greater maturity of the domestic capital markets and lowered country-level risk can lead to a lengthening of the term that investors are willing to invest for.

F. Recommendations

Governments should work with private investment organizations to develop, implement, and enforce clear guidance, incentives, penalties, and disclosure requirements that enable and encourage investments that protect biodiversity. Governments can do this through two pathways: first is by creating opportunities for new markets using policies, structures, and regulation; and second is through incentivizing flows of additional, new investment of private capital.

- Governments should develop and enforce guidance, standards, and regulatory systems that enable the creation of biodiversity markets. Policy environments that require or allow biodiversity services to be invested in and transacted such as biodiversity offsets create the basis for markets and generate investment opportunities.
- Governments should enforce specific biodiversity disclosure requirements.
- Governments and the private sector should collaborate to create opportunities for mainstreaming biodiversity conservation investments in sectors such as infrastructure, renewable energy, agriculture, forest management, and ecological restoration among others. Governments can do this through policies and incentives that de-risk private investments.
- Publicly sponsored financing facilities such as green banks should be expanded to directly provide capital for the development of biodiversity positive projects, particularly in sectors or regions where access to traditional capital is lacking or low.

National and regional governments should leverage their ability to raise capital from private markets, via issuance of green debt, as a way to increase the amount of upfront capital available for investment in biodiversity conservation.

- National, regional, and local governments that are able to issue debt should access private capital markets to increase their budget allocated to biodiversity projects using green bonds that specify use of proceeds tied directly to biodiversity conservation activities.

- National and subnational governments should also strengthen their pipeline of strategic investment opportunities in public projects and assets to incentivize investors looking for green debt and equity opportunities.

Investment organizations and private finance institutions should develop and enforce internal policies establishing internal performance metrics that incentivize the structuring, offering, and use of financial products with explicit benefits to biodiversity.

- Private finance institutions and investment companies should increase the number and variety of investments with green impacts that appeal to their investors' growing desire for mission-related or impact investments.
- Private finance institutions and investment organizations should develop and incorporate performance metrics for their employees and for their company performance to measure progress on the prevalence of biodiversity investments asked for and delivered to their investor base.

Governments and private financial institutions should, as a means to catalyze the flow of capital to biodiversity, develop and implement industry standards and mechanisms that ensure accountability, transparency, and verification for financial transactions that are meant to positively impact biodiversity.

- Financial institutions and governments can share information and work together to create and improve a range of screening tools, standards, and other systems that provide guidance and accountability to investors to understand both the impacts and benefits to biodiversity of their investments that can serve to attract investors focused on obtaining green or socially responsible returns. Private sector organizations should also develop mechanisms that enable aligning capital investments from multiple investors to reduce transaction costs and increase scalability of biodiversity projects.

Multilateral development banks, development finance institutions, and private foundations should provide early-stage, concessionary, or risk mitigating financing that catalyzes the development of projects and that complements local conservation efforts.

- Multilateral organizations should increase provisions of technical assistance and financial support to developing countries as a way to complement and motivate investment in biodiversity projects.
- Global and regional development banks, development finance institutions, and conservation NGOs should increase learning opportunities around investments in biodiversity conservation that provide both measurable biodiversity benefits and return on investment.

5.7 Nature-Based Solutions and Carbon Markets

A. Introduction

As countries respond to challenges created by climate change through reducing greenhouse gas emissions, a number of opportunities have opened up to address these challenges through expanding protections on forests and other natural ecosystems and, through these efforts, conserving biodiversity.

The 2015 Paris Agreement represented a remarkable shift in the status of climate change negotiations: since then, all ratifying countries are required to take action to reduce or eliminate greenhouse gas emissions, rather than imposing these requirements only on developed countries, as in past agreements such as the Kyoto Protocol. These pledges are encapsulated in countries' Nationally Determined Contributions (NDCs).

Land and forests are unique in that they can both be a source and a sink of carbon, that is, they can produce GHG emissions or store carbon. In its special report on Climate Change and Land, the Intergovernmental Panel on Climate Change (IPCC) estimated that nearly three quarters of the world's nonfrozen land has been altered by human activity,[520] resulting in increasing emissions and rapid biodiversity loss. Agriculture, forestry, and other land use activities make up nearly one fourth (23 %) of all anthropogenic emissions worldwide, a number that will only continue to grow if the current trajectory of high-emitting agriculture and forestry practices continue.

Despite these trends, land is currently a net-sink of emissions, as trees, soil, and other natural ecosystems sequester approximately 29 % of anthropogenic emissions.[521] If emissions are reduced and storage is enhanced above and beyond current mature carbon sinks, land could provide one third of global emissions reductions needed to meet 2030 goals.[522] This can be accomplished by a suite of nature-based solutions (NBS) for mitigating carbon emissions (also referred to as natural climate solutions [NCS]), a concept that incorporates more than 20 different activities focused on protecting natural ecosystems from degradation or deforestation by managing existing lands to enhance biodiversity and maintain economic livelihoods, and restoring forests, wetlands, and seagrasses.

The pathway for financing NCS to date has generally been through carbon pricing mechanisms. Currently, there are 57 carbon pricing initiatives operating at both the national and subnational levels, which have established (or are in the process of establishing) formal compliance programs to regulate greenhouse gas emissions through carbon pricing programs such as cap-and-trade systems and carbon taxes.[523] While these programs seek to reduce emissions across a number of sectors, only one country—New Zealand—has regulated the forestry sector to date, and no country regulates emissions resulting from land-use changes from agriculture.[524]

A growing number of carbon pricing programs have recognized a role for nature in mitigating the costs of compliance. Many carbon pricing programs allow regulated companies to purchase carbon offsets (also known as carbon credits), which represent emissions reductions or removals that occur outside of the program. Existing and new programs have the potential to scale up protection of forests, wetlands, and other land use activities that can have a dramatic, global impact on saving biodiversity.

B. Description of Mechanism

Climate Policies

Many emissions reduction policies, such as those

related to transitioning from fossil fuels, are both technical and costly to execute, and corporations and governments need time to implement these solutions at scale. In the meantime, nature can play a critical role in reducing emissions. For many less-developed countries, NCS offer the best pathway for meeting NDC targets while maintaining development goals.

Currently, two thirds of all countries have included NCS as a mitigation or adaptation strategy in their NDCs. However, NCS currently receives just 6 % of public climate mitigation funding.[525] Yet few included specific metrics or plans for accomplishing those goals—only 8 % of NDCs that mention forestry include an emissions reduction goal in metric tons of CO_2.[526]

A new study of tropical countries found that "cost-effective" (<$100/t$CO_2$e)[xxv, xxvi] NCS activities could halve their national emissions.[527, 528] If all 79 tropical countries implemented cost-effective NCS, they could reduce annual emissions by 6.6 $GtCO_2e$, approximately 12 % of global emissions in 2017.[529] In other words, the world is vastly underinvesting in the potential of natural ecosystems to sequester carbon and help solve the global climate challenge. Investing in natural climate solutions therefore presents a significant opportunity to finance biodiversity conservation and vice versa. There are several approaches countries could implement, which fall broadly into three main categories:

1. Removing subsidies for non-NCS, carbon-intense activities such as agricultural land conversion and cultivation or active forest production that threaten the conversion of forests and other ecosystems.
2. Providing economic incentives, such as a price on carbon, to support the protection, restoration, and management of forests, grasslands, and other natural systems that act as carbon sinks.
3. Setting of net-zero, or carbon neutral, emissions targets by companies and governments to reduce, offset, or eliminate carbon-intensive activities.

The forest and land-use sector poses a unique challenge and opportunity in addressing climate change, as it is the only sector with the potential to become a net sink of emissions. After the energy supply sector, the forest and land use sector are the second largest source of emissions (contributing to 23 % of global emissions),[530] and half of these emissions come from deforestation and forest degradation. Removing incentives and subsidies for harmful agricultural practices, in particular for key agricultural commodities like palm, cattle, and soy, is crucial to reversing this trend. Likewise, companies committed to reduce or eliminate deforestation in their commodity supply chains will have a positive impact in reducing GHG emissions and sequestering carbon. The topics of sustainable supply chains and harmful subsidies reform are covered in separate dedicated sections of this report.

Companies making carbon reduction goals can also use forests to achieve their targets. Corporations such as Microsoft and Amazon have respectively pledged carbon negative and carbon neutral commitments, both of which require investments in nature-based solutions, either directly through investments in forests and/or wetlands, or through managing their investments through offset programs.[531, 532] Microsoft has also partnered with Pachama, a startup that has developed technology to monitor offset programs in the Brazilian and Peruvian Amazon to ensure that their investments are meeting their carbon sequestration goals.[533]

Many countries also look to provide economic incentives for the protection, enhancement, and management of forests and other ecosystems. This is done through either

[xxv] The unit tCO_2e represents a ton of carbon dioxide (CO_2) equivalents, which is a standard unit for measuring carbon footprints because it expresses the measure of different greenhouse gasses in terms of the amount of CO_2 that would produce the same amount of warming.

[xxvi] Cost-effectiveness, per Griscom et al.'s 2020 study, is defin ed as the amount at which, for all sectors, the cost of holding warming below 2°C, the "mitigation cost," would be economically efficient. This cost, US$ 100 / tCO_2e, is the cost at which the mitigation cost is less than the cost of climate change to society.

domestic carbon pricing programs such as a cap-and-trade compliance program or a carbon tax, or through voluntary international carbon markets. Additionally, countries may apply UNFCCC guidance for REDD+ (reduced emissions from deforestation and forest degradation) programs to support conservation, sustainable management of forests, and the enhancement of forest carbon stocks. Countries may seek to address subnational or national deforestation and forest degradation by receiving compensation from the Green Climate Fund, World Bank funds, and other results-based payment programs.[534, 535, 536] New guidance on establishing a global market-based carbon trading program is also under development pursuant to Article 6 of the Paris Agreement, under which all countries may eventually trade NCS-based emission credits in an effort to cost-effectively achieve their global targets.

A growing number of countries and companies are committing to net-zero emissions by specific deadlines; in the case of certain countries, these commitments can be in addition to their respective NDC commitments. Meeting these net-zero targets will likely involve including the use of offsets. So far, Bhutan has achieved carbon neutrality; while Austria, Costa Rica, Denmark, the EU, Fiji, Finland, France, Hungary, Iceland, the Marshall Islands, New Zealand, Norway, Portugal, Singapore, Slovenia, Sweden, Switzerland, and the United Kingdom have either included this pledge in their Paris commitments, passed appropriate legislation, or otherwise taken on this goal as a policy position.[537]

Carbon Pricing

Policies and actions to create a price for carbon, through carbon taxes, cap-and-trade programs, and country climate programs, have led to the development of a single global carbon currency (tons of carbon dioxide-equivalent, or tCO_2e) and the ability to commoditize carbon and other greenhouse gases.

Most of the country and subnational carbon pricing programs take one of two forms:

1. A carbon tax or levy, which establishes a price on a measurable unit of greenhouse gas emissions, and taxes emitters a fixed amount per unit produced.
2. A cap-and-trade program, where the government sets a cap on allowable GHG emissions by sector and then allows companies in each sector to reduce emissions internally through the purchase of government-issued "allowances" to continue polluting[xxvii] and the sale of excess emissions reductions to other companies.

Many cap-and-trade programs and some carbon taxes also allow for the creation and trading of carbon offsets (also called carbon credits). Carbon offsets are emissions reductions representing one tCO_2e and occur in sectors or locations outside of the carbon pricing program, representing projects such as energy efficiency and alternative energy, sustainable fuel sources, capture of high-greenhouse impact gases such as methane, or reforestation. These reduction activities typically can be achieved at a lower cost than in-sector reductions and are used by regulated companies as a cost-containment measure.

Market systems for creating, selling, buying, and trading carbon offsets fall into two broad categories: compliance markets and voluntary markets. Compliance carbon markets act like commodities markets: regulated GHG emitters that require offset credits to meet their emissions caps have access to an open market for carbon offsets and, in general, tend to seek the lowest price per ton to minimize their costs of compliance. While there is considerable variation across the types of projects generating certified carbon offsets, buyers tend to purchase the

[xxvii] Governments typically establish auctions to sell allowances to the highest bidder (or allow trading of allowances on secondary markets), thus creating a carbon price. In many cap-and-trade programs, some or all industries receive a government-determined amount of free allowances, which while a benefit to the regulated companies, also has had the effect of disrupting or disabling the true free market functions of the cap-and-trade program.

CASE STUDY:

REDD+

Many countries, primarily tropical countries, have long been working on REDD+ programs at the national or subnational level. Until recently, most country activity was centered around building "REDD+ readiness" and was supported by multilateral and bilateral funds that provide technical assistance to countries to establish baselines and reference levels, develop protection systems for their forests, and put in place monitoring and verification systems to track forest-based emissions.

Few countries have begun to implement these REDD+ programs; only seven countries have reported REDD+ results via the Lima REDD+ Information Hub. Of the 6.5GtCO_2e reported, 94 % comes from a single country, Brazil. Additionally, only five out of these seven countries have been paid for these results, and often funding only covers a fraction of the total: the Amazon Fund has paid for 227.1MtCO_2e in Brazil, REDD+ Early Movers has paid for 34.6MtCO_2e in Colombia, and the Green Climate Fund has paid for 44.6MtCO_2e in Chile, Ecuador, Brazil, and Paraguay.[538, 539]

For national and subnational REDD+ programs to produce measurable and verifiable emissions reductions (ERs), there are generally five actions that countries must complete before producing credits from REDD+ programs:

1. Creating a national strategy or action plan.
2. Assessing forest reference emission levels and/or forest reference levels (FREL/FRL).
3. Creating a national forest monitoring system.
4. Providing a system of information on how the safeguards are being addressed and respected.
5. Monitoring, reporting, and verifying the results-based actions.

A survey of 55 countries found that 26 have completed their national strategy or action plan, 28 have completed FREL/FRLs, 19 have a national forest monitoring system, and 14 have addressed safeguards.[540] Most remaining countries have yet to complete these. While only 8 countries have submitted REDD+ results to the UNFCCC, many countries (25) expect to report these results in late 2019 or 2020 resulting in an estimated 3.16GtCO_2e achieved in 2014–2018.[541]

Additionally, several countries and subnational jurisdictions are exploring various approaches to encourage private sector, nonprofit, and community engagement in assisting REDD+ programs to accomplish on-the-ground activities. Many of these organizations have already engaged in work to avoid deforestation, and enhanced collaboration could unlock faster implementation, reduce the costs of mitigation, and improve monitoring and results. These ideas are currently being explored through various "nesting" REDD+ approaches, either directly within country REDD+ programs or through multilateral funds and standards like the World Bank's Forest Carbon Partnership Facility and Verra's Jurisdictional and Nested REDD+ standard (which is being updated in 2020).[542, 543]

There are also new potential funding streams for REDD+ results. Norway pledged \$10/tCO_2e—the first time a government has paid more than \$5/tCO_2e—for emissions reductions from Gabon that are generated under the 2020 REDD+ Environmental Excellency Standard (TREES).[544] Finally, many existing funding streams are still waiting to pay for results, including the World Bank's Forest Carbon Partnership Facility and the Green Climate Fund.[545] There may also be a new market for REDD+ offsets in the upcoming Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) market (further described in the CORSIA case study).

lowest cost units with little attention to project type or co-benefits.

In the absence of a legal requirement to set emissions reductions targets or offset GHG emissions, a number of companies and other institutions voluntarily set emissions reductions targets and purchase carbon offsets in the voluntary markets. Offsets purchased in the voluntary markets are unregulated and, in lieu of government oversight, third-party nonprofit standard-setting bodies establish practices and procedures for voluntary offsets. Similar to compliance markets, buyers in the voluntary markets can only claim the emissions reductions if they retire and remove the offsets permanently from circulation. However, unlike compliance markets, voluntary markets are more sensitive to project type, perceived value, and co-benefits. While still technically a commodity, these carbon offsets are more differentiated by the type of project that produced them and the perceived values and co-benefits those credits provide. Prices for similar projects in compliance markets tend to be higher than in the voluntary markets, in part due to greater demand resulting from regulation and in part to the use of price floors in certain compliance markets.

Relative to the overall size and scale of the working compliance markets in the world, the voluntary market is much smaller in terms of overall volume of greenhouse gas emission reductions or carbon offsets produced, including forest carbon offsets. Nonetheless, voluntary carbon projects exist in 83 countries around the world, and many of these are forest or land use carbon projects. Recently, demand for NBS projects has dramatically increased in the voluntary markets, where buyers and sellers reported 50.7 $MtCO_2e$ in transactions in 2018, a 264 % increase from 2016.[546]

Although there has been increased use of forest and other land use carbon offsets in both compliance and voluntary markets, the current extent of use of forest and land use credits in compliance markets is still relatively small as compared to the overall scope of carbon markets globally. Only a small subset of existing compliance markets allows offsets to be used that are generated from forest or land use projects.

Early carbon markets did not allow, or placed heavy restrictions on, the use of forestry and land use offsets. At the time, there was uncertainty over how to address unique challenges posed by these projects, such as how to ensure permanence and minimize the risk of leakage. However, innovations from voluntary markets are being transferred to new compliance markets including new carbon accounting methodologies for a greater number of forestry practices, for agricultural practices, and for protection of key carbon-sequestering natural systems including peat lands, grasslands, mangrove forests, and coastal wetlands. As such, both voluntary and compliance markets are likely to play an expanding role in the protection of forests and biodiversity in the coming years.

Additionally, the voluntary markets have served as the proving ground for other technical innovations that are being taken up by new and emerging compliance markets. These include the development of science-based methodologies for quantifying carbon storage and emissions reductions, required verification and certification procedures to ensure that emissions reductions are real, and registries and other market infrastructure to track and prevent double counting of GHG emission reductions.

Countries that have established, or are in the process of establishing, formal compliance programs that allow forest and land use offsets include Australia, Canada (the national Federal Carbon Pricing Backstop and the provinces of Alberta, British Columbia, and Quebec), China (the national cap-and-trade program as well as nine regional pilots in major cities and provinces), Colombia, Japan's Tokyo-Saitama program, Korea, Mexico, New Zealand, South Africa, as well as the California (ARB) and Regional Greenhouse Gas Initiative (RGGI) programs in the United States.[547]

CASE STUDY:

China's New National Program

China's new national program, which when fully rolled out will be the largest carbon market in the world, was launched in early 2018. While the program currently only applies to one industrial sector (power) and does not allow offsetting from any practices including forest or other land uses, over the next several years the program will scale up to cover as many as 7,000 companies in eight industrial sectors (power, petrochemicals, chemicals, building materials, iron and steel, nonferrous metals, paper production, and aviation).

China currently does not allow offsets (Chinese Certified Emission Reductions, or CCERs) to satisfy cap requirements for any of these sectors' businesses. However, CCERs were developed and tested under nine pilot programs, developed over the last several years in various Chinese cities and provinces, and were allowed to satisfy up to 10 % of compliance requirements in some of those pilots. Only one province allowed use of forest-based CCERs for up to 10 % of the overall emission reduction target.

Experts inside and outside of government in China anticipate that CCERs will be allowed for compliance use in the national program as it rolls out and expands to all other regulated sectors over the next few years. In the development of the provincial pilot programs, approximately 200 methodologies for different types of CCERs are in various stages of development. Although energy and industrial processes dominated these methodologies, four of the 200 under development are for forest carbon (two for forests and two for bamboo) and several others under development are targeted to changing agricultural practices and protection of grasslands, coastal wetlands, mangroves, park systems, endangered species, and urban ecosystem restoration.

The Chinese Ministry of Ecology and Environment (MEE), through its Climate Change Department, oversees the development and roll-out of the new cap-and-trade program. MEE will determine if, when, and how much to use CCERs in the program, including forest- or land-based CCERs. It appears likely that China will eventually allow forest and land use CCERs for three reasons: (1) as the program grows, there will be demand for cost-efficient CCERs to use in meeting compliance requirements, and nature-based solutions are cost-effective (and often come with additional co-benefits); (2) China is seeking to promote their economic development as being sustainable and their stated goal is to become an "ecological civilization," which in all likelihood will require promoting the use of forest and other land protection CCERs; and (3) a number of think tanks, NGOs, and experts are promoting the use of forest and land use CCERs with the MEE Climate Change Department.

One example is Colombia's carbon fuel tax that allows regulated businesses to purchase offsets developed by voluntary standards instead of paying the tax. Countries can create their own methodologies for producing and utilizing forest carbon offsets, but another option is for countries to allow the use of currently existing voluntary offset methodologies that have been developed and tested for forest or other land use carbon offsets. For example, California allowed eligible voluntary carbon projects to transfer into the state's cap-and-trade program via its "Early Action" initiative ensure there was a tradable supply available at the program's start. In addition, many of the protocols used in California's cap-and-trade program were adapted from existing voluntary standards, including those developed for forest carbon projects.[548]

CASE STUDY:

CORSIA

Beginning in 2013, the International Civil Aviation Organization (ICAO) set a goal to achieve carbon neutral growth for the airline industry beginning in 2020. ICAO members identified several strategies with which to achieve this goal including improving aircraft fuel efficiency, transitioning to cleaner-burning fuels (e.g., biofuels), and implementing market-based mechanisms for emissions reductions (e.g., through the use of offsetting). Recognizing that international aviation had been expected to grow rapidly in the coming years, ICAO made the determination that improving fuel efficiency and using cleaner fuels will likely be insufficient to achieve the 2020 goal.[549]

As a result, in 2016 ICAO members adopted the first sector-wide carbon offsetting scheme, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). CORSIA will be launched and rolled out in three phases: a pilot phase (2021–2023), in which countries can participate on a voluntary basis; an official first phase (2024–2026), which will also be voluntary; and a second phase (2027–2035), in which all countries will be required to participate.[550]

Based on estimated growth in international aviation and the development of other emissions reductions activities (including fuel efficiency and cleaner-burning fuels), CORSIA could generate demand of 1.6–3.7GtCO_2e during its three phases of implementation (from 2021–2035).[551] This would dwarf any other operational or planned market, including the European Union's Emissions Trading Scheme and China's emerging cap-and-trade program, creating considerable new demand for forest and land use carbon offsets if such offsets are allowed.

However, these estimates could change, as the aviation sector has been particularly hard-hit by COVID-19 and ICAO has already moved to reduce the impact of CORSIA on airlines. For example, in June 2020, ICAO voted to change the 2019–2020 baseline (from which carbon neutral growth would be measured) to a 2019-only baseline for any carbon neutral growth during the pilot phase. This will likely reduce short-term demand for offsets under CORSIA from 2021–2023.[552, 553]

The growth of opportunities for forest and land use carbon projects in both compliance and voluntary markets has supported the corresponding growth of carbon project development companies and also carbon investment funds.

C. Why Is It Important to Biodiversity?

Climate Policies

There is a clear case for climate policies to address and provide tangible benefits to the protection of biodiversity. Deforestation, land degradation, coastal ecosystem degradation, and other land use changes contribute to both higher emissions and declining biodiversity.

The IPCC also found that temperature changes caused by climate change will shift or eliminate the habitable ranges of both marine and terrestrial species.[554]

While negotiations under the UNFCCC include a mandate for "no net harm" to biodiversity in any country with REDD+ programs, broader guidance has not been given to countries in the formation of their NDCs. As a result, country NDCs can range from a handful of pages to more than 100 pages, and references to biodiversity vary considerably.

A study encompassing 73 NDCs was analyzed for links to the Aichi Targets. It found that 84 % of countries mentioned forestry in their NDCs;

however, only 31 % mentioned the ocean, coasts, or marine habitats despite the fact that 86 % of the NDCs represented a coastal or island country.[555] Furthermore, few of these NDCs explicitly mentioned any biodiversity metrics or measures.[556]

There is some optimism that biodiversity might be better quantified and targeted in future NDCs. As with the lack of data on emissions targets in some of the first NDCs, the lack of biodiversity inclusion in NDC targets could be attributed to a lack of preparation as well as the absence of quantitative data.

Additionally, most proposed NCS activities have biodiversity benefits (15 of the 20 identified NCS pathways have demonstrated biodiversity benefits).[xxviii, 557] Of the NCS pathways that have demonstrated biodiversity benefits, the estimated use of these pathways in country NDCs equals an estimated 21.1 $GtCO_2e$ per year (89 % out of the total estimated potential of 23.7 $GtCO_2e$ per year reduction).[558, 559]

Carbon Pricing

Although carbon offsets are created and traded based on their climate benefits, many offset projects have positive collateral effects, or "co-benefits," that may include the protection of forests and biodiversity. The co-benefits associated with forest carbon projects can include protecting watershed areas that supply clean water, safeguarding critical habitat for biodiversity, and even providing important social benefits such as the health and welfare improvements associated with using clean cookstoves and biofuels for cooking. Mangroves and seagrass ecosystems, while sequestering carbon, also provide important havens for marine biodiversity as well as contribute to disaster risk reduction.[560]

The various voluntary and compliance market standards and methodologies for designing and verifying carbon projects, including those developed for forest carbon, are largely focused on the accounting for greenhouse gas reductions or carbon sequestration and do not consider measures for protecting biodiversity. Two standards allow projects to report on Sustainable Development Goals impacts, which could include biodiversity outcomes: the Gold Standard and Verra's Sustainable Development Verified Impact Standards (SD VISta).[561, 562] A third standard, Verra's Climate, Community and Biodiversity Standard (CCB), requires projects to benefit local communities and conserve biodiversity and is most often paired with projects developed under Verra's widely used Verified Carbon Standard (VCS).[563, 564]

The Gold Standard estimates that its afforestation/reforestation projects create $150/$tCO_2e$ worth of biodiversity benefits in the form of hectares restored, preserved, or otherwise dedicated to conservation.[565] Meanwhile, CCB estimates that its projects have conserved 11 million hectares and restored 10 million hectares of native forests (representing more than 70 $MtCO_2e$).[566] However, aside from these project-specific methodologies and site-specific quantification of biodiversity impacts, there are no comprehensive studies that assess the biodiversity benefits from forest and land use carbon.

As new compliance programs come online, and as these programs expand to allow forest and other land use-based offsets, it will become increasingly important to ensure that metrics for evaluating biodiversity impacts are included.

D. Financial Impact: Current and Future

A number of types of carbon policies, programs, and market and pricing mechanisms are involved in determining the financial value for carbon and GHG emission reductions and, by extension, for biodiversity. In determining approximate levels of current and future spending on carbon programs that have discernible benefits to

[xxviii] These activities include biochar, conservation agriculture, animal management, improved feed, and improved rice cultivation.

biodiversity, this report examined the following specific programs and mechanisms:

1. Voluntary markets that incorporate forest and other land use project for offsets
2. Cap-and-trade programs and other compliance markets that incorporate forest and other land use project for offsets or allowances
3. National carbon tax programs that put a price on carbon and, with offsets, additionally incorporate provisions for protection of forests or other ecosystems
4. Subnational and jurisdictional programs being rolled out for REDD+ and forest carbon but with future potential to support greater development of low- and zero-deforestation commodity producers
5. National climate plans and programs (NDCs) that incorporate NBS as part of their overall climate goals.

Current State

The current state of the nature-based solutions and carbon market expenditures is summarized in Table 5.22.

The total current capital flows to carbon markets consist of four categories, two of which are specific to the Californian and Australian carbon markets, which are included as standalone categories because they are the two largest carbon markets globally.

See Appendix A for detailed information on the calculations behind the current carbon market investments.

Future State

This report estimates that nature-based solutions and carbon markets in 2030 will fall in the ranges in Table 5.23.[xxix]

The 2030 projections for voluntary carbon markets, California's and Australia's compliance markets, and Payments for REDD+ are expected to grow annually between 2020 and 2030. The Compound Annual Growth Rates were calculated using historic growth rates of these markets, and more information can be found in the Methodology annex.

To calculate the future spending on natural climate solutions within NDCs, the price of NCS/NBS activities was set at $10/MgCO$_2$e, as estimated by Griscom et al. (2017).[575] Using this price, the total funding to meet all NDC commitments is estimated to be US$ 38.1 billion per year in 2030. However, recognizing that not 100 % of NCS/NBS in NDCs would be

TABLE 5.22 Current State (2020)

Category	Lower estimate *$bn/year (2019)*	Upper estimate $bn/year (2019)
Voluntary forest carbon market offset transactions	0.08	0.15
California carbon market	0.2	0.2
Australia carbon market	0.5	0.6
Payments for REDD+	0.04	0.5
Total	**0.8**	**1.4**

Note: The methodology behind these figures is presented in Appendix A.[567, 568, 569, 570]

[xxix] The Griscom et al. 2017 study identified two price points for reducing emissions through natural climate solutions. The first price point was at US$ 100/tCO$_2$e and the second was at US$ 10/tCO$_2$e. In the real world, however, activities would be accomplished with more variable pricing; some activities might cost $8/tCO$_2$e or $25/tCO$_2$e. Thus, the amounts listed here are initial estimates that could benefit from future studies.

TABLE 5.23 Future State (2030)

Category	Lower estimate $bn/year (2030)	Upper estimate $bn/year (2030)
Voluntary carbon markets	0.3	0.7
California	0.3	0.4
Australia	1.2	2.0
Payments for REDD+	0.2	2.7
Nature-based solutions / Natural climate solutions on Nationally Determined Contributions (NDCs)	22.9	34.3
Total	**24.9**	**39.9**

Note: The methodology behind these figures is presented in Appendix A.[571, 572, 573, 574]

implemented, it is then assumed reasonably that 60–90 % of the total set of activities are implemented resulting in the lower estimate of US$ 22.9–34.3 billion per year by 2030.

Carbon Policies

Since many NDCs have yet to be implemented, the true cost of NCS/NBS policies remains unknown and is expected to vary significantly by country. One recent study attempted to quantify the cost of NCS/NBS implementation, by assuming cost-effective NCS/NBS activities will average at an estimated $50/tCO$_2$e. The study found wide variation among countries, estimating that full implementation of cost-effective NCS/NBS might cost the Democratic Republic of Congo 46 % of GDP, compared to 1 % of GDP for India to meet the same criterion.[576]

However, payments for NCS/NBS today remain far less than $50/tCO$_2$e.[xxx] Countries and multilateral organizations have committed to pay billions to REDD+ programs, but in some cases at $5/tCO$_2$e. Much of the money to date has gone toward paying for REDD+ "readiness" that helps increase technical capacity and overcome implementation constraints within tropical forest countries. Additional funding has been promised to countries once the REDD+ programs generate emissions reductions. For example:

- The Forest Carbon Partnership Facility has pledged up to US$ 900 million.[577]
- The BioCarbon Fund Initiative for Sustainable Forest Landscapes has pledged up to $355 million.[578]
- The REDD Early Movers program has pledged up to US$ 306 million.[579]
- Norway has pledged US$ 2 million bi-laterally to countries.[580]
- Norway pledged 8,200 million NOK (US$ 900 million), Germany €54.9 million EUR (US$ 65 million), and Petrobras US$ 8 million to the Amazon Fund.[xxxi, 581]
- The Green Climate Fund has pledged US$ 500 million.[582]

Of the pledged funds, only US$ 1.5 billion has been disbursed to date as many REDD+ programs are still in the process of implementing emissions reductions policies and activities and not at this point producing verifiable emission reductions (ERs).

[xxx] This is beginning to change, as Norway recently pledged to pay US$ 10/tCO$_2$e for REDD+ programs developed under the new ART/TREES standard.
[xxxi] EUR to USD and NOK to USD conversion rate as of 08/04/2020, based on €1 = US $ 1.18, and 1 NOK = US$ 0.11 USD

Carbon Pricing

As relates to forest and land use carbon and the protection of biodiversity in the years since their inception, compliance markets have generated an aggregate US$ 1.6 billion in offset transactions, and the voluntary markets have generated an additional aggregate US$ 1 billion in offset transactions.[583] While the biodiversity gains of these protected forests have not been calculated, it can be assumed that a significant amount of forest-dependent biodiversity has been protected.

In recent comprehensive reports on the carbon markets, prices in the voluntary markets ranged from less than US$ 0.50/tCO_2e to more than US$ 50/tCO_2e, with offsets from forest carbon projects transacting at an average of US$ 5.1/tCO_2e, as compared to the average price of US$ 3.0/tCO_2e across all project types.[584]

An important, but currently small, component of these growing markets is the creation and growth of private equity funds and related investments that are set up to invest in forest and land use carbon (see section on Green Financial Products). Although private investment in forest and land use carbon is still a relatively small component of the total capital invested in conservation-oriented projects, it is growing annually and likely to play a larger and more important role in the future.

E. Obstacles and Enabling Conditions

Climate Policies

Translating NDC goals into domestic policy instruments could be a challenge for many countries. Most country NDCs recognize the role of the forestry or agricultural sectors in either the mitigation or adaptation plans. However, as few of these plans include specific goals or targets for NCS/NBS, there is a risk that NBS activities will be overlooked or not fully implemented.

Furthermore, while countries have included NCS/NBS in their climate commitments, they lack guidance on how to successfully implement such solutions to realize their associated climate and biodiversity benefits. To establish broader consensus on best practices for NBS, IUCN has introduced the Global Standard, which provides benchmarks for NBS to help governments, business, and civil society better implement them. [585]

While best practices are being formed, monitoring and understanding fluctuations in emissions from the forestry and agricultural sectors is complicated by the fact that most countries with the highest percentage of forestry and agricultural emissions represent a mix of developing and underdeveloped economies, some of which are among the poorest countries in the world. For these countries, lack of technical expertise, tools, and/or capacity can be a challenge.

There are also political challenges that are unique to forestry and agricultural sectors. Currently, only one country regulates emissions from the forestry sector (New Zealand) and no country regulates emissions from agriculture. Often the acutely poor rely on forestry or agriculture for their livelihoods, so regulating these sectors may require addressing the economic impacts and losses of reducing forest use and changing agricultural practices.

As a result, many countries have focused on providing payments for emissions reductions through NBS, rather than regulating those sources. The first REDD+ programs have often taken longer than anticipated to produce actual emissions reductions. After nearly a decade of action, only seven countries have reported results via the Lima REDD+ Information Hub and out of the 6.5GtCO_2e reported, only 306.3Mt of the results have been paid for.[586] That is expected to increase in the next few years, as more and more countries begin to move into the implementation phase of their respective programs.

Although forest and agriculture have dominated

discussions in many countries' NCS/NBS activities and NDCs, there is considerable and growing interest in other carbon-sequestering natural systems such as peat lands, coastal wetlands and mangroves, grasslands, and other ecosystems. In addition to providing carbon sequestration benefits, the protection of many of these systems, such as mangroves and coastal wetlands, provide considerable biodiversity co-benefits such as flood protection and fisheries habitat. While each of these natural systems includes the same challenges as previously noted for tracking and monitoring Emissions Reductions, it is likely that more and more of these systems will be included in expanding country NCS/NBS solutions over time.

Carbon Pricing

In addition to spurring country domestic action on climate change through the creation of NDCs, the 2016 Paris Climate Agreement also included a provision to allow countries to gain cost-efficiencies through trading emissions reductions across borders. Detailed rules for this text, called Article 6, are still being negotiated, but it lays out two main mechanisms for trading: Article 6.2 will establish rules for how countries can trade bilaterally or multilaterally with a new unit of GHG reduction called Internationally Transferable Mitigation Outcomes (ITMOs), while Article 6.4 will establish a centralized organization that issues credits (likely as a variation on the Clean Development Mechanism, a centralized carbon offset program established under the Kyoto Protocol). Given that the outcomes of Article 6 negotiations have yet to be resolved, countries have yet to take advantage of cross border trading efficiencies.

Outside of the international negotiations, the largest challenge to the expansion of compliance carbon markets and their biodiversity co-benefits is the need for individual country legislation to establish cap-and-trade or carbon tax programs and, additionally, to allow the use of forest and land use carbon offsets within these programs.

Finally, voluntary offsetting may be impacted by the upcoming international trading rules or by new compliance markets. Historically, voluntary markets have been unregulated but that may change, as now all countries have submitted NDCs and will likely be encouraging emissions

CASE STUDY:

International Carbon Trading under the Paris Agreement

Negotiators are still wrestling with key challenges of operationalizing Article 6 of the Paris Climate Agreement. However, once finalized, it could unlock a new source of demand for NCS/NBS credits.

A recent study that analyzed cost savings from Article 6 trading found that including NCS/NBS could increase savings by US$ 320 billion/year and mitigate an additional 9 $GtCO_2e$ by 2030—compared to only $5GtCO_2e$/year by 2030 of non-NCS/NBS mitigation.[587] This is based on economic modelling; true trading of credits will likely not be as efficient, due to political or other considerations when trading.

There are unanswered questions around what can be traded (e.g., whether the tradable unit is an offset or something different), how accounting between buyer and seller countries will work, and whether NBS emissions reductions will be excluded from trading.

Most importantly, any trading system needs to enhance and raise overall climate ambition, meaning trading should not reward countries with less stringent NDC targets that are able to sell excess emissions reductions.

reductions across a variety of sectors. Voluntary carbon offset standards and participants are currently debating whether voluntary offsetting will similarly need government approval before selling/exporting credits internationally (as compliance offsets will likely need to meet this requirement). Some project developers and standard setting bodies in the voluntary markets are looking at nesting their current and future projects within a larger government program.

F. Recommendations

National governments should include one or more nature-based solution (NBS) strategies, such as reforestation, within the next round of Nationally Determined Contributions (NDCs) commitments under the Paris Agreement.

- All countries should include national climate targets for the forestry and agricultural sectors in their NDCs and, more specifically, use science, economic, and policy screens to determine the best NBS strategies that can also provide biodiversity benefits.

Governments with existing carbon markets should allow the use of offsets from agriculture, forests, and other land uses. Governments without existing carbon markets should enact new carbon pricing programs that include carbon taxes, cap-and-trade programs, or other climate policies that price carbon emissions and allow for the use of carbon offsets from agriculture, forests, and other land use practices.

- Governments should develop an approved suite of NBS programs that can be included in their carbon offset programs. This list should be regularly revisited and updated as new evidence on the benefits of NBSs is established.
- Extension services are necessary, provided either by government, international, or national organizations, to disseminate the expertise needed for individuals, communities, and private entities to implement NBSs and take advantage of the subsequent carbon offsets that accrue with such actions.

Governments of forest-rich and biodiversity-rich countries should enact policies to increase implementation and scalability of national and jurisdictional REDD+ programs, including the opportunity to nest existing REDD+ projects to maximize scale.

- As national and jurisdictional REDD+ programs are developed and come online, bilateral and multilateral donors and funding facilities must commit to fund both program development and purchase qualifying Emission Reductions (ERs) at reasonable values.

The governments and standard-setting bodies that govern both compliance (cap-and-trade) and voluntary carbon markets should require the use of, and adherence to, standards that include biodiversity and social safeguards for all forestry and land use projects, and for NBS. These bodies should also improve the transparency and quantifiability of biodiversity within all existing and new standards that apply to forests and natural systems.

- In addition to these standards, these governance bodies should review other methodologies in the energy, agricultural, and transportation sectors that might currently negatively impact biodiversity, and should change these standards and methodologies so that they encourage the protection of biodiversity.

5.8 Official Development Assistance (ODA)

A. Introduction

Official development assistance (ODA) is broadly defined as aid disbursed by countries directly or through multilateral institutions designed to support and promote the economic development and welfare of developing countries.[588] ODA includes concessional finance, grants, and the provision of technical assistance. There has been a United Nations target since 1970 for developed countries to provide 0.7 % of Gross National Income (GNI) as ODA to developing countries.[589] This pledge was reconfirmed as part of developed countries' commitments to the United Nations 2030 Agenda for Sustainable Development in 2015; however, only five countries met the 0.7 % target in 2019.[xxxii, 590]

The Organisation for Economic Cooperation and Development's Development Assistance Committee (OECD DAC), which is the lead agency setting standards and collecting data on development assistance, established that for financial flows to be considered ODA they must meet three conditions:[xxxiii]

1. Have the main objective of promoting the economic development and welfare (this is now considered to include sustainable development, adaptation, and resilience to the impacts of climate change and the conservation and sustainable management of countries' natural environments and biodiversity);[xxxiv]
2. Be concessional in nature with a grant element of at least 25 %; and
3. Be provided by official agencies, including state and local governments, or their executive agencies.

The latest figures from the OECD indicate that total ODA flows reached US$ 152.8 billion in 2019, an increase of 1.4 % in real terms over 2018 levels. That amounted to 0.3 % of OECD DAC countries' combined GNI, with only five countries—Denmark, Luxembourg, Norway, Sweden, and the UK—achieving the UN target of 0.7 % of GNI for foreign assistance.[591] The UN Secretary General has called for a substantial increase in foreign aid flows to help the world cope with the COVID-19 global health crisis and associated global recession. The UN's most recent assessment of progress on the Sustainable Development Goals (SDGs) suggests that the pandemic is undermining progress on nearly all of the SDGs.[592] This significantly increases the demand for foreign aid flows across the entire spectrum of SDGs, from health care to education to gender equality to food security. In that context, it is noteworthy that the World Health Organization's Manifesto for a Healthy Recovery from COVID-19 lists as the first element of its prescription for a healthy, green recovery to "protect and preserve the sources of human health: nature."[593]

ODA for biodiversity can be understood as flows of development finance to developing countries with explicit goals related to the conservation and sustainable management of biodiversity. The level of foreign aid flows to support biodiversity has been a contentious issue in the Convention on Biological Diversity (CBD) negotiating process over the years, as it has been in all multilateral environmental agreements. Target 20 of the 2010 Aichi Targets addresses

[xxxii] They were Denmark, Luxembourg, Norway, Sweden, and the UK.

[xxxiii] Other forms of aid that are not considered to be ODA are official aid (OA) and other official flows (OOF). OA meets all of the ODA criteria except that is directed toward "more advanced" developing and eastern European countries on the Part II list of aid recipients rather than the traditional Part I list of aid recipients. OOF are financing flows by official agencies that do not meet the criteria for ODA or OA because they are either not primarily aimed at promoting development or do not meet the minimum of 25 % grant element criteria.

[xxxiv] The Part I and Part II Lists of DAC ODA recipients can be found here: http://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm.

resource mobilization and calls for a "substantial increase" in resources available from all sources to support the implementation of the convention. At the following CBD Conference of Parties (COP) in 2012, the parties adopted a further decision calling on donor countries to double foreign aid flows for biodiversity by 2015, relative to 2010 levels, and at least maintain them at that level through 2020. As the numbers below indicate, foreign aid for biodiversity has been on an upward trajectory for most of the last decade, and while the doubling did not quite happen by 2015, it is likely to have been surpassed in 2019 based on the trajectory. There are two key positive trends in the data: first, total public and private funding to biodiversity conservation has been increasing (see Chapter 3); second, the relative share of biodiversity funding within the overall ODA aid budget has also been increasing.

Since its adoption, the CBD has relied on the Global Environment Facility (GEF) as the financial mechanism of the convention, meaning it serves as the principal multilateral mechanism by which donors program their aid for biodiversity. The GEF runs on four-year replenishment cycles. It is now in its seventh cycle, with US$ 4.1 billion pledged for the 2018–2022 cycle. GEF's System for Transparent Allocation of Resources (STAR) allocates funds based on the potential of impact (Global Benefits Index), the track record of the receiving country's performance (Country Performance Index), and an inverse weighting based on GDP.[594] Of that US$ 4.1 billion, about US$ 1.3 billion is programmed for biodiversity over the four years.[xxxv] The CBD COP provides guidance to the GEF on its biodiversity funding strategy. For the seventh replenishment, the COP has mandated the GEF Biodiversity Strategy to follow three objectives: "Mainstream biodiversity across sectors as well as landscapes and seascapes; Address direct drivers to protect habitats and species; and Further develop biodiversity policy and institutional frameworks." [595]

B. Description of Mechanism

The OECD is the authoritative source for tracking ODA flows and has specifically tracked ODA for biodiversity—as well as for climate change mitigation, climate change adaptation, and desertification—since 1998 and made reporting on biodiversity activities financed through ODA mandatory since 2006. The data are publicly available in the OECD Creditor Reporting System (CRS) database. Through the CRS database, DAC members are required to monitor and statistically evaluate whether or not the ODA commitments target biodiversity outcomes using what are known as the "Rio-Markers."

The Rio-Markers provide a system to tag ODA activities as having conservation and sustainable management of biodiversity as a "principal" objective, a "significant" objective, or not having this as an objective. Activities that are considered to have biodiversity as a "principal objective" are defined as those that would not have been funded if not for that policy objective. Activities with biodiversity as a "significant objective" can be understood as having other primary objectives but because of their structure, still support biodiversity objectives. In the two-year period between 2015 and 2016 bilateral biodiversity-related ODA classified as having biodiversity as either a "principal" (conservation is outlined as a main objective of provided ODA) or "significant" (conservation is a co-benefit of the ODA's prime objectives) objective accounted for an average of 6 % of total bilateral biodiversity-related ODA, with 43 % of this having biodiversity as the "principal" objective.[596]

The majority of bilateral biodiversity-related ODA is distributed across five sectors: (1) Environmental protection (e.g., environment-related policy design and capacity-building); (2) Forestry; (3) Water supply and sanitation; (4) Agriculture and fishing; and (5) Multisector aid (e.g., rural development).[597] Investments in these sectors accounted for 73 %

[xxxv] The rest of the GEF money is programmed for climate change, international waters, land degradation, and chemicals and waste.

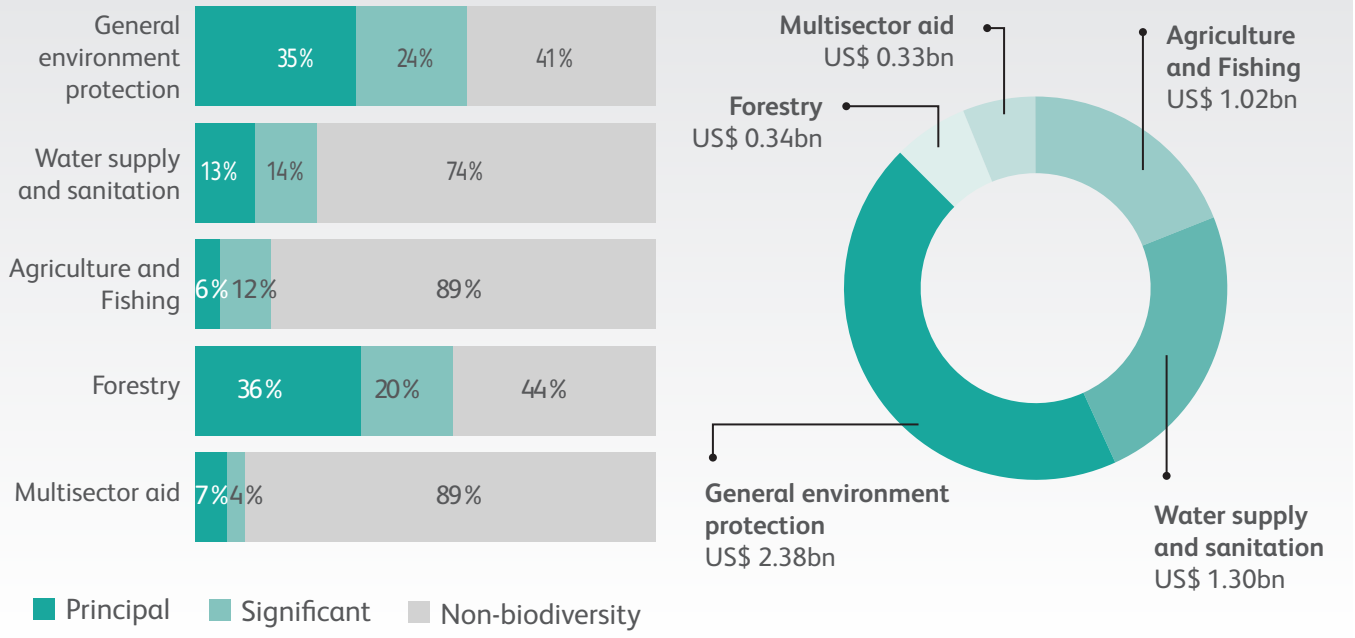
of total bilateral biodiversity-related ODA over the same time period and were often channeled into projects specifically focused on biodiversity conservation and sustainable management of natural resources. Figure 5.9 shows this distribution and representation of the Rio-Markers within ODA in each sector.

A large portion of the source of bilateral biodiversity ODA is concentrated among a few donors. Between 2012 and 2016 the United States, Germany, France, and Japan accounted for over half (56 %) of committed bilateral biodiversity-related ODA, and 10 donors accounted for 90 %. Many of these donors have marked biodiversity as an objective of their broader development activities and for some of these, such as Norway, Belgium, and Iceland, biodiversity ODA is a relatively large share (over 10 %) of their total ODA.[598] There is also an increasing overlap with the climate-related aid agenda. Norway has provided upwards of half a billion dollars a year for the last decade through its Norwegian International Forest and Climate Initiative, which largely targets greenhouse gas emissions from tropical deforestation and therefore has significant biodiversity co-benefits.

Regionally the largest share of ODA was received by African countries (34 %), followed by Asia (23 %), the Americas (10 %), Europe (13 %), and Oceania (1 %), with the remaining being unallocated by country or region.[599]

The multilateral donor community has attempted to mainstream biodiversity into development financing and projects that are primarily focused on socioeconomic development. Multilateral ODA can directly benefit biodiversity projects or it can be delivered to non-biodiversity projects in a way that implements environmental and social safeguard policies, which minimize projects' environmental impacts. The International Finance

FIGURE 5.9 Top five sectors receiving bilateral biodiversity-related ODA: Total commitments and biodiversity as a share of overall ODA to sector



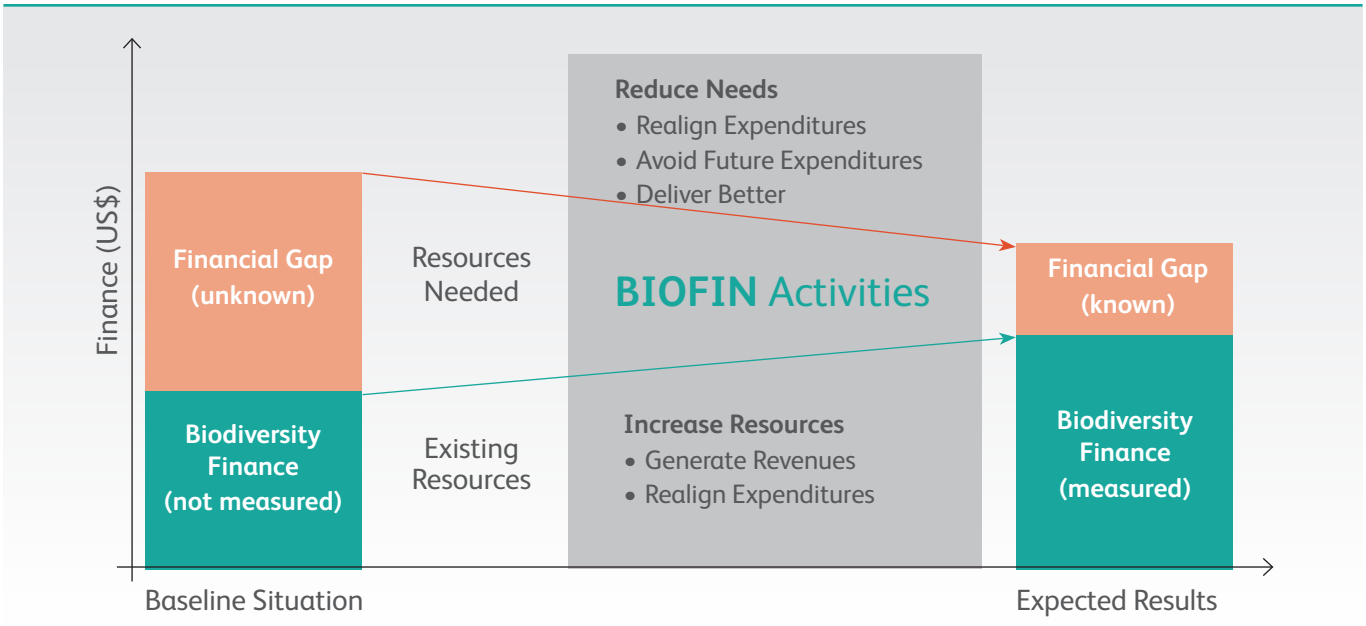
Source: OECD (2018). DAC Creditor Reporting System (database). Note: The data in this figure represents commitments. US$ billion, constant 2015 prices, three-year average, 2014–2016.

Corporation (IFC) of the World Bank Group, for example, has developed a set of environmental and social Performance Standards (PS), including PS3 Resource Efficiency and Pollution Prevention and PS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources,[600] that has been adopted by a number of other donors.[xxxvi] These policies are aimed at identifying, mitigating, and managing the risks and potential impacts on the environment that these projects and investments pose if not properly designed and managed. (See the section on the biodiversity offsets mechanism.) While that policy framework sets the global standard, there is little available evidence to know whether or not the banks are implementing it effectively or whether biodiversity offsets are effective, let alone even happening as required. While banks often do a good job of auditing social impacts and social requirements of their projects over the long term, they do not systematically collect information on the implementation of required biodiversity offsets.

C. Why Is It Important to Biodiversity?

ODA is necessary but not sufficient to finance global biodiversity conservation at the required levels, making it essential that ODA funding is used in the most effective way possible to build capacity to mobilize other sources of finance. Miller, Agrawal, and Roberts (2013)[601] conclude that historically, ODA for biodiversity has been relatively well-targeted, as the allocation of biodiversity aid is positively associated with the number of threatened species in recipient countries after controlling for country size, national population, and wealth. However, they also point out that flows are insufficient to meet conservation needs in developing countries. These findings are echoed by a 2015 OECD study[602] that concluded that there is much more data on the levels of ODA flow for biodiversity than on its effectiveness,[xxxvii, 603] and also pointed to the challenges with inconsistent metrics for biodiversity impact in recipient countries.[604]

FIGURE 5.10 UNDP BIOFIN approach



Source: UNDP, 2018.[605]

[xxxvi] Performance Standard 6 has also set a global norm for private sector banks though the Equator Principles on social and environmental risk management, which have now been endorsed by more than 100 financial institutions across 38 countries.

[xxxvii] Stepping and Meijer (2018) have identified a number of challenges for assessing the impact and effectiveness of biodiversity ODA. First, there are few indicators that measure biodiversity impact at a national level in a consistent and comparable way. Second, multi-thematic aid programs tend not to reveal the exact funding amount attributed to their respective biodiversity components. Third, changes in biodiversity status are empirically and conceptually difficult to attribute to aid activities.

The OECD paper also indicates that ODA for biodiversity has been an important mechanism to catalyze additional financial resources for biodiversity in developing countries. In particular, it highlights the effectiveness of ODA support for environmental fiscal reform, payment for ecosystem services, and the expansion of markets for green products.

UNDP's Biodiversity Finance Initiative (BIOFIN) has been a critical partner to help developing countries realize this potential. BIOFIN has used ODA resources to help more than 30 developing countries conduct national expenditure reviews to understand how much they are spending on biodiversity conservation and national needs assessments to help them understand what they should be spending. Putting those together, BIOFIN helps countries develop Biodiversity Finance Plans to define a national strategy to close their biodiversity financing gaps.

This general approach of the BIOFIN Initiative—accounting for national expenditures, estimating national financial needs to reach stated goals, and developing a national plan to close that gap—is the model for what this report is attempting to do for the world in aggregate. It is also a model that can be replicated for every country around the world at the national level. This will require the smarter use of foreign aid to build capacity for national biodiversity finance plans, their implementation, and the systems to monitor their financial and ecological impacts.

D. Financial Impact: Current and Future

The most recent figures for ODA flows for biodiversity are represented in OECD Table 5.24 for the period 2015–2017. They indicate that the average over this period was in the range of US$ 3.9 to 9.3 billion per year (US$ 4.0–9.7 billion in 2019, as summarized in Table 5.25).

The lower estimate in Table 5.24 accounts for aid that tags biodiversity as the principle objective

TABLE 5.24 International Public Biodiversity Finance: Bilateral and Multilateral Flows
(annual, 2015–2017 average, US$ millions)

	Lower estimate (Principal)	Mid-range estimate (Principal + 40 % Significant)	Upper estimate (Principal + Significant)
Bilateral			
Biodiversity-related allocable bilateral ODA (% of total allocable bilateral ODA)	US$ 3,535 million (3 %)	US$ 5,474 million (4 %)	US$ 8,383 million (7 %)
Biodiversity-related other official flows	US$ 6 million	US$ 13 million	US$ 24 million
Bilateral total	US$ 3,541 million	US$ 5,487 million	US$ 8,407 million
Multilateral			
Biodiversity-related multilateral ODA	US$ 321 million	US$ 482 million	US$ 724 million
Biodiversity-related multilateral non-concessional outflows	US$ 6 million	US$ 83 million	US$ 198 million
Multilateral total	US$ 327 million	US$ 565 million	US$ 922 million
Total bilateral and multilateral	US$ 3,867 million	US$ 6,052 million	US$ 9,329 million

Source: OECD, A Comprehensive Overview of Global Biodiversity Finance, Final Report, April, 2020. Note: Bilateral estimates cover Development Assistance Committee (DAC) members (including EU Institutions) and other official providers that reported biodiversity-related activities to the CRS. Multilateral estimates include reporting from the Global Environment Facility, Inter-American Development Bank, United Nations Development Programme and the World Bank Group. Reporting on biodiversity-related activities by multilateral agencies is not yet comprehensive or consistent across years.

while the upper range includes aid that also tags biodiversity objectives as significant. The mid-range estimate of US$6 billion includes all of the funding with biodiversity as the principal objectives and 40 % of the aid with biodiversity as a significant objective, discounting the rest on the assumption that not all of the project-level assistance with significant outcomes was impacting biodiversity outcomes.

TABLE 5.25 International Public Biodiversity Finance: Bilateral and Multilateral Flows in 2019 US$

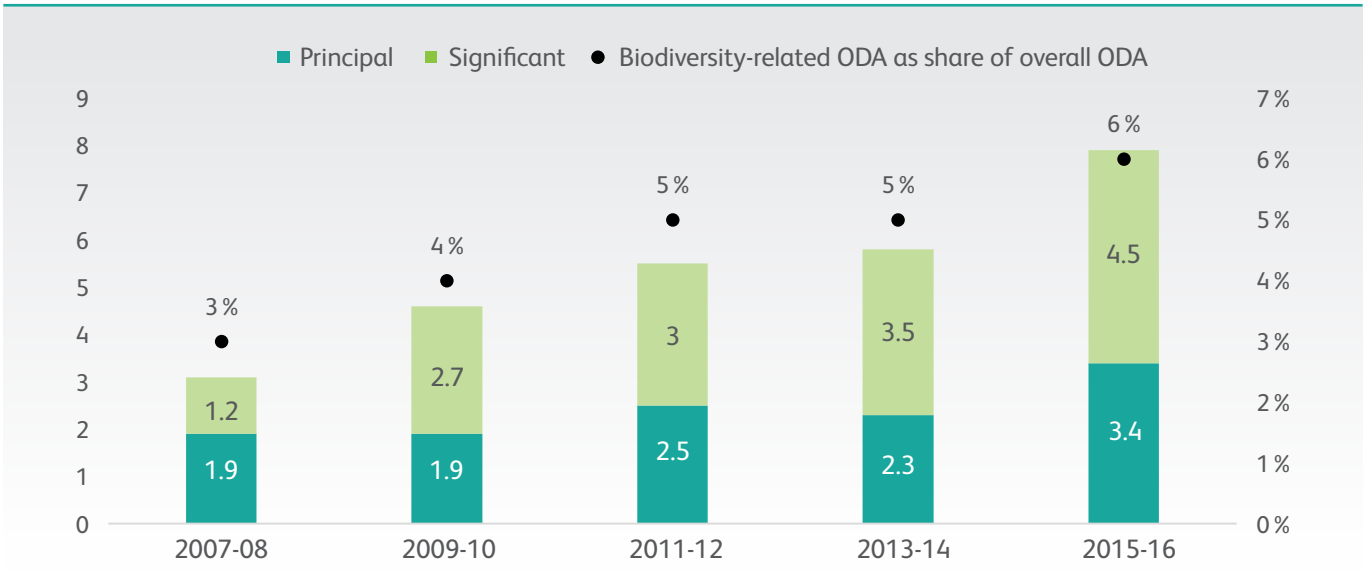
Category	Lower estimate *$bn/year (2019)*	Upper estimate $bn/year (2019)
ODA Bilateral	3.7	8.7
ODA Multilateral	0.3	0.8
Other Official Flows (OOF)	0.01	0.2
Total	4.0	9.7

Source: Based on OECD, 2020. A Comprehensive Overview of Global Biodiversity Finance. Note: Table 5.25 adjusted to US$ 2019 prices. Data reported to the Creditor Reporting System (CRS). The methodology behind these figures is presented in Appendix A.

Figure 5.11 accounts for aid that bilateral biodiversity-related ODA tags biodiversity as the "principal" objective as the lower estimate while the upper range also includes aid that tags biodiversity objectives as "significant." The mid-range figure of US$ 6 to 6.3 billion includes all of the funding with biodiversity as the "principal" objective and 40 % of the aid with biodiversity as a "significant" objective, discounting the rest on the assumption that not all of the project-level assistance with significant outcomes was impacting biodiversity outcomes. It should be noted that much of the project level ODA delivered with the biodiversity Rio-marker also contributes to one or more of the three other main Rio-marker goals, as aid to biodiversity often creates positive impacts for desertification and for climate change mitigation and adaptation.

The longer-term trend in biodiversity ODA is that it has been rising steadily both in terms of the share of total bilateral biodiversity-related ODA commitments and in absolute value between 2007 and 2016. Total commitments have doubled between 2007–2008 and 2015–2016. Total ODA flows toward climate change have grown even faster over the last decade. Climate-

FIGURE 5.11 Bilateral biodiversity-related ODA, 2007–2016



Source: OECD, 2018. Annual 2015–2017 average. Notes: Two-year averages in US$ billion (constant 2015 prices) and shares of total bilateral biodiversity-related ODA.

related ODA for the agriculture, forestry, and fisheries sectors have recently become the second largest category after the energy sector, growing from US$ 2.2 billion in 2013 to US$ 5.3 billion in 2017, showing that there is a potential for mainstreaming biodiversity conservation.[606] Nevertheless, climate-related ODA for biodiversity conservation efforts such as natural climate solutions remains significantly underfunded relative to the potential contribution that the land use sector can make to climate mitigation (see section on Nature-Based Solutions and Carbon Markets). Recent analyses indicate that up to 30 % of the world's cost-effective, near-team mitigation potential can be provided by the land-use sector by stopping deforestation, restoring forests, and improving agricultural practices.[607]

The CBD's biodiversity donors agreed to double biodiversity-related ODA in 2012 to support the implementation of the Aichi Targets and have largely achieved that level of biodiversity-related ODA over the decade. That is both laudatory and repeatable. This report calls for the donor community to "double the doubling" in biodiversity aid by 2030 to help finance the new Global Biodiversity Framework. This could be driven in large part by the potential ODA bilateral and multilateral aid agencies' efforts at mainstreaming biodiversity across their grant and lending portfolios in the agriculture, fishing, water, and forestry sectors. The future state of ODA toward biodiversity conservation is summarized in Table 5.26.

These nature-based solutions were recognized in the Paris Agreement and received a significant political boost at the UN Climate Action Summit in September 2019. As bilateral and multilateral donors are making commitments to increase their climate-related ODA, it makes sense for them to significantly increase their assistance for nature-based solutions, commensurate with the share of the contribution they can make to climate mitigation and adaptation. There is a high potential for climate-related aid for nature-based solutions to also achieve biodiversity co-benefits, and those opportunities should be prioritized in donor aid programming. By using both the Rio-markers "principal" and "significant" as trackers for types of ODA, there is a risk of double counting between markers on biodiversity, land degradation, and climate change adaptation and mitigation[608] (see Appendix B). However, this should not stand in the way of maximizing opportunities to achieve synergistic outcomes for climate change mitigation and adaptation and biodiversity with the same aid expenditures.

TABLE 5.26 Potential International Public Biodiversity Finance: Biodiversity-Related Bilateral and Multilateral Flows in 2030

Category	Lower estimate $bn/year (2030)	Upper estimate $bn/year (2030)
ODA Bilateral	7.4	17.4
ODA Multilateral	0.6	1.6
Other Official Flows (OOF)	0.02	0.4
Total	8.0	19.4

Note: ODA Multilateral is based on a non-comprehensive estimate of current multilateral flows. The methodology behind these figures is presented in Appendix A.

E. Obstacles and Enabling Conditions

The long-term effectiveness of biodiversity ODA is dependent on the mainstreaming of biodiversity considerations within the policy frameworks of recipient countries. Considerations around national and local ownership of activities funded by biodiversity ODA, as well as broader environmental and social safeguards to avoid negative impacts, are key in fostering effective and sustainable outcomes.[609] As with all of the other mechanisms described here, the effectiveness of ODA fundamentally rests on broader issues of good governance and institutional capacity. That has been a consistent refrain of the development discourse for decades.

Here, biodiversity aid can be a broader solution-provider: community-based natural resource management can be a critical opportunity to strengthen local governance capacity and local institutions, and thus make an outsized contribution to a wide range of SDGs.

Another challenge in scaling biodiversity-related ODA is the reliance of ODA on per capita income as its predominant eligibility criterion. Some middle-income countries and other countries disproportionately affected by ecological degradation or that are particularly biodiversity-rich are calling for the use of more nuanced criteria in donors' assessment of ODA recipient needs.[610] For example, vulnerability to ecological degradation or potential to preserve biodiversity as a public good may justify channeling ODA funding to countries otherwise categorized as "too developed." Most of the mega-diverse countries in the world, which can thus contribute the most to the global public good of biodiversity conservation, fall into the middle-income category. That means they are in a position to mobilize greater domestic resources for biodiversity than least developed countries but may need additional foreign assistance to help catalyze the underlying policy reforms to enable domestic and private sector resources.

Last, significant gaps remain in reporting on both bilateral and multilateral biodiversity ODA. This makes it difficult to understand the scale of the global funding gap for biodiversity.

F. Recommendations

Foreign aid donors should recommit to double ODA flows again by the year 2030 relative to 2019 levels to support the implementation of the post-2020 Global Biodiversity Framework. Provision of ODA should include biodiversity conservation as criteria, alongside other existing ones such as economic development, in prioritizing countries that receive ODA flows.

- The CBD's biodiversity donors should double biodiversity-related ODA to support the implementation of the forthcoming Global Biodiversity Framework.
- All biodiversity donors should meet the 0.7 % of Gross National Income target for ODA, thereby ensuring more diversified and sustainable streams of funding in the future.

Donor governments should better deploy the increased aid to focus on the in-country enabling conditions to unlock other mechanisms discussed in this report, including the development of National Biodiversity Strategies and Action Plans (NBSAPs) and National Biodiversity Finance Plans.

- Governments should ensure that a significant portion of the increased ODA flows be made available to help recipient countries develop and implement national resource mobilization strategies to meet their enhanced commitments under the post-2020 Global Biodiversity Framework.
- Donor governments should also ensure that any increases in biodiversity ODA target biodiversity-rich countries, which can make the biggest contribution to global biodiversity conservation efforts, and least-developed countries, where

opportunities for domestic resource mobilization are limited.

Bilateral and multilateral aid agencies should strengthen their efforts at mainstreaming biodiversity across their grant and lending portfolios.

- Donor agencies and Multilateral Development Banks (MDBs) should proactively seek to maximize co-benefits for biodiversity in their climate funding, by rigorously and consistently screening their operations for opportunities to invest in nature-based solutions for mitigation and ecosystem-based adaptation projects. Programming for agriculture, land-use sector climate mitigation, and biodiversity conservation should be mutually reinforcing.

Bilateral donors and multilateral development banks should require reporting of results from biodiversity projects, as well as be more accountable for their application of IFC Performance Standard 6, especially with respect to the application of the mitigation hierarchy and biodiversity offsets.

- The bilateral and multilateral banks should adopt and further develop the necessary, long-term auditing capacity to both collect and disclose information on the implementation of offsets required under their performance standards so that offsets and compliance can be tracked and evaluated (see Biodiversity Offsets mechanism).

5.9 Sustainable Supply Chains

A. Background

This section identifies and quantifies the opportunities within supply chains for mitigating damage to biodiversity and transforming supply chains into channels that amplify positive outcomes for biodiversity.

Supply chains can be understood as the complex networks of organizations, people, activities, and resources that are involved in producing, moving, consuming, and disposing of products from suppliers and producers to end consumers. Supply chain sustainability relates to the management of environmental, social, and economic impacts, and the encouragement of good governance practices, throughout the life cycle of these networks.[611]

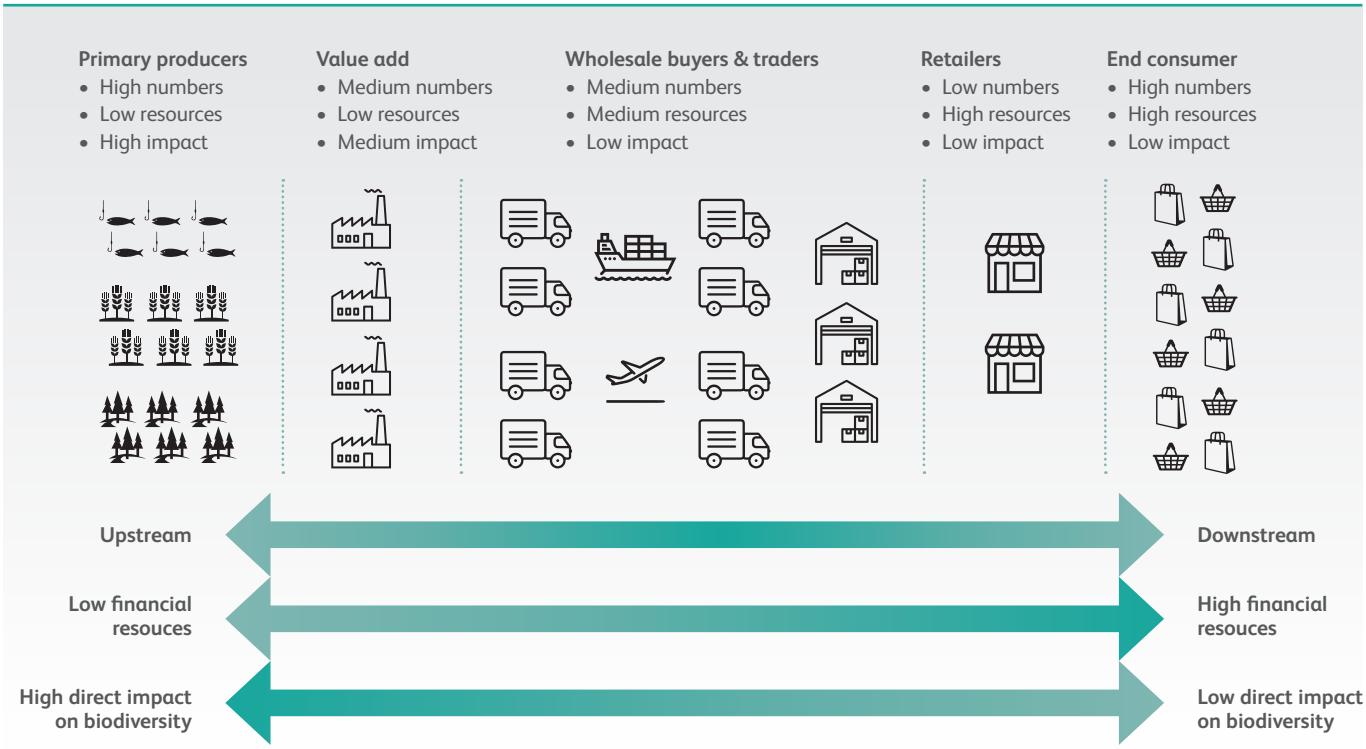
As shown in Figure 5.12, actors across the supply chain have different levels of influence and resources to invest in biodiversity-supportive practices and avoid causing harm. Producers have the greatest direct impact on biodiversity but often have the least amount of resources available to transition to different practices as most primary producers receive the smallest percentage of the consumer price through the value chain.[612] For example, out of a GBP 2.50 cup of coffee, only 10 pence is spent on the coffee bean, of which growers only receive 1p.[613] However, the resilience of these producers underpins the supply chain; without continual, sustainable production the supply chain would be driven to find other producers or shut down. Large-scale agricultural producers may have ready access to substantial capital and resources to change their production methods, but this is often not the case for smaller producers; indeed, the Food and Agricultural Organization of the UN estimates that at least 90 % of global farms are controlled by individual farmers or households. A 2017 study found that small farms (≤20 ha) produce more than 75 % of most food commodities in sub-Saharan Africa, southeast Asia, south Asia, and China; and very small farms (≤2 ha) contribute to about 30 % of most food commodities in sub-Saharan Africa, southeast Asia, and south Asia.[614]

Further down the supply chain are intermediate buyers, traders, manufacturers, logistical enterprises, retailers, and the final consumer. The profit margins for intermediary buyers and traders are typically much smaller than for manufacturers and retailers. Even so, intermediaries still play an important role due to their influence on producer behavior via purchase agreements and contracts. In cases where these actors have a direct relationship with producers, and their off-takers require biodiversity-supportive practices, intermediaries can integrate these practices into any agricultural extension support programs and related technical assistance (e.g., providing *in situ* training to producers). Success in implementing these commitments is more likely where intermediaries are involved at the early stages of developing these goals.

Supply chain practices may have an impact on biodiversity to different extents at different points, but the largest financial resources available to support producers in adopting biodiversity-supportive practices tend to be at the opposite end of the supply chain from producers and therefore constitute the focus of this section. While actors close to the end of supply chains may have access to substantial financial resources, they may not have the same level of direct influence on production practices as producers do.

Nowadays, supply chains are largely cross-border frameworks where multinational corporations are involved in over 80 % of global trade.[615] These companies have significant influence over the suppliers and producers in their supply chains through their spending power, which can be

FIGURE 5.12 Indicative supply chain network



Source: OECD, 2018. Annual 2015–2017 average. Notes: Two-year averages in US$ billion (constant 2015 prices) and shares of total bilateral biodiversity-related ODA.

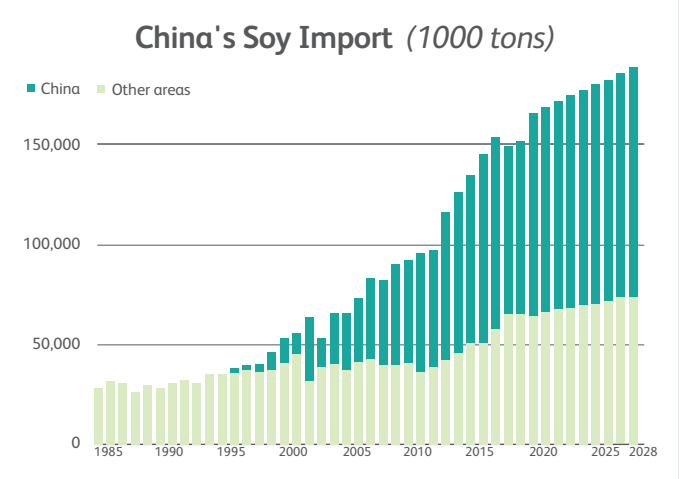
(and sometimes is) leveraged to drive changes in production practices. With the value of global trade in exports and imports for merchandise estimated to be $19.7 trillion in 2019 (over 20 % of global GDP),[616] increasing the proportion of supply chains that are sustainably managed can direct enormous amounts of capital away from harmful activities and toward those that support biodiversity. For example, the supply chain program managed by CDP (formerly the Carbon Disclosure Project) is working with 125 supply chain members that represent US$3.6 trillion in purchasing power to strengthen sustainability through requesting disclosures from suppliers on environmental impacts to allow them to assess these risks and address them.[617]

The historic impact of global supply chains on biodiversity has been largely negative, driven by extractive activities, land use change, and unsustainable fisheries and land management practices linked to the production of traded commodities. As an illustration, Lenzen et al. (2012) found that 30 % of global species threats are due to international trade, based on an analysis of 15,000 commodities linked with 5 billion supply chains across 187 countries.[618] An additional point highlighted in this study was that supply chains largely originated in developing countries of high biodiversity value who were net exporters to developed countries. This resulted in some developed countries being exposed to greater biodiversity risk from their imports compared to their domestic production. In particular, supply chain commodities with the greatest impacts on biodiversity (beef, soy, timber/pulp, and palm oil) accounted for 113 million hectares of tropical forest loss between 2000 and 2012 and 40 % of overall global deforestation,[619] with 31 % of deforestation resulting from these commodities linked to exports to the EU and China.[620] China in particular has a unique position to dramatically decrease

CASE STUDY:

Potential Growth of Certified Soy in China

As shown in the figure below, China accounts for the majority of the growth in global soybean consumption.



For many years, the international community has made great efforts to protect the forests and other native vegetation in the soybean production countries in South America. Soybean production is especially damaging to biodiversity through land conversion, which also contributes to a rise in carbon emissions and soil erosion. However, such efforts are often focused at a local scale, and their impact has been limited so far.

At present in the Chinese market, the implementation of international soybean sustainability standards and certification schemes is confronted with two major challenges. On the one hand, the variety of these standards does not provide consistent guidelines to companies and therefore weakens their appeal. On the other hand, China's needs and potential role in reshaping the global soybean supply chain are yet to be fully factored into these existing standards, which results in a lack of buy-in and support from the Chinese actors. In addition, these companies are also concerned that the additional costs associated with certification may further eat into their bottom line.

To address the biodiversity impact arising from China's commodity sourcing, the China Council for International Cooperation on Environment and Development (CCICED) has launched a special policy study report on greening China's global value chains. In addition, the Paulson Institute, in cooperation with The Nature Conservancy, Solidaridad, and WWF-US, has led an effort to create the Sustainable Soybean Trade Platform designed to engage the key actors in the China–South America soy trade and promote sustainable sourcing.

One of the key proposals is to create a streamlined Chinese sustainable soybean standard and certification system that is based on key existing standards and certification schemes. In this envisioned system, a newly established China Soybean Industry Federation (CSIF) will vet the existing international sustainability standards for soybeans. CSIF, through industrywide self-regulation, will also implement a soybean processing quota system designed to curb the excessive soybean import, reduce overcapacity in the domestic soybean crushing sector, and promote sourcing soybeans that meet sustainability standards.

In the meantime, COFCO, China's leading agribusiness company and a major player in global soybean trade, is also taking concrete steps to improve the sustainability of its soybean sourcing. In a keynote address to the 2019 Brazilian Agribusiness Congress, Johnny Chi, chair of COFCO International, announced that the company would link its main bank credit facility of US$ 2.3 billion to sustainability targets and channel long-term financing to support the expansion of soy production on degraded land. In addition, the company was exploring opportunities to directly connect farmers into global carbon markets.

Source: The China Council for International Cooperation on Environment and Development and Paulson Institute. (2018). A China Solution for a Global Sustainable Soybean Supply Chain.

deforestation from palm oil use as the nation is one of the largest importers of palm oil for domestic use. Risks for Chinese companies that use palm oil include increased production costs for palm oil derivatives and subsequently losing customers to buyers with zero deforestation commitments; to help acknowledge these risks, the Chinese government uses a regulatory approach that requires companies to measure and mitigate risks that contribute to climate change, including deforestation from palm oil.[621]

Few companies account for the magnitude of the environmental cost within their supply chains or how their supply chains are dependent on biodiversity and ecosystem services.[622] Of those who do, the results can often reveal the substantial level of impact supply chains have on the environment. For example, Kering, the French luxury group, concluded in 2019 that 92 % of its environmental impacts originated within its supply chains, with the overwhelming majority (76 %) derived from raw materials alone.[623]

On the demand side, the market for ethically and sustainably produced goods has grown over the past decade, particularly for goods that are organic, deforestation-free, and have sustainability certifications or ecolabels. Prior to economic upheavals triggered by the COVID-19 pandemic, the global organic food and beverage market was expected to grow 16 % per year to reach US$ 327 billion by 2022, driven by increased consumer demand, governmental policies to support organic agriculture in the Asia-Pacific, European, and North American regions, and investments from key private players such as General Mills, Starbucks Corporation, The Kroger Co., and numerous others.[624]

Most sustainable supply chain commitments concern deforestation-free production. In addition, between 2001 and 2016, at least 66 companies made some kind of biodiversity commitment as shown in Table 5.27, which summarizes some of the leading initiatives to unite companies on sustainability commitments

TABLE 5.27 Initiatives by Companies to Prevent Biodiversity Loss within Supply Chains

Initiative	Year	Membership	Summary of Initiative
Consumer Goods Forum	2010	>400 members with combined revenues of more than US$ 2.8 tn per year	Resolution that committed the members to mobilize resources to achieve net zero deforestation within supply chains by 2020 through the responsible sourcing of the four key forest risk commodities (soy, timber/pulp, beef, and palm oil).[627]
New York Declaration on Forests (NYDF)	2014	200 endorsements as of September 2019	Voluntary and nonbinding initiative that brings together governments, companies, civil society, and other stakeholders to work collaboratively toward halving the loss of natural forests by 2020 and ending it by 2030. Goal 2 (of 10) is linked to commodity-driven deforestation and aims to eliminate deforestation from the production of agricultural commodities such as soy, timber/pulp, beef, and palm oil by no later than 2020.[628]
G7 Fashion Pact	2019	50 companies and 250 brands	Commitment by the fashion industry aimed at stopping global warming, restoring biodiversity, and protecting oceans.[629]
Business for Nature Coalition	2020	-	Bringing together a unified business voice to the CBD, UNGA, SDG, UNFCCC, and UNCLOS processes, calling for a global reversal of nature loss by 2030.[630]
UN Global Compact	2020	11 corporations and environmental NGOs	Commitment to deliver “net-positive” impact on freshwater resources by 2050 worldwide.[631]
International Council of Mining and Metals (ICMM)	-	>50 % of members	Members have made some form of commitment or have an aspiration to achieve no net loss or a net gain of biodiversity.[632]

within their supply chains that either target biodiversity directly or concern environmental issues that are closely linked to biodiversity loss.[625] However, as noted by the International Council on Mining and Metals (ICMM), the implementation of these commitments is subject to significant challenges due to the lack of implementation guidance, lack of reporting or monitoring frameworks, and factors undermining the credibility of these commitments.[626]

Given that the COVID-19 pandemic has highlighted some of the vulnerabilities of the world's existing supply chains, following the pandemic governments have the opportunity to reshape their economic recovery policies to benefit biodiversity conservation.[633] In addition, financial institutions and the corporations must collectively increase their commitment to minimize their impacts on nature. Doing so would further the goals of post COVID-19 recovery stimulus packages, which emphasize that transitions to clean, circular economies, which restore biodiversity and cut pollution, are necessary to economic recovery.[634]

B. Description of the Mechanism

Table 5.28 presents the main opportunities for the private sector to avoid and reduce harm to biodiversity, through supply chain actions, and achieve positive impact through acknowledging both their impact and dependency on biodiversity and ecosystem services. Supply chain actors also participate in biodiversity and carbon offsetting as well as contribute to natural infrastructure conservation and protection (see sections on Nature-Based Solutions and Carbon Markets and on Natural Infrastructure). Additionally, philanthropic payments made by corporates are not covered due to the relatively small size of these financial flows.

TABLE 5.28 Opportunities to Improve Supply Chain Impacts on Biodiversity

Avoiding/reducing harm	Achieving positive impact
i) Improved corporate policies, standards, and implementation to safeguard against negative biodiversity impacts ii) Third-party sustainability standards	iii) Sustainable jurisdiction/landscape level sourcing initiatives iv) Conservation-focused management of naturally sourced ingredients

These opportunities should not be seen as mutually exclusive. Taking advantage of more than one of them could exploit synergies and accelerate the transition of supply chains to support biodiversity. A description of each of these opportunities is provided below:

i) Avoiding/reducing harm: Improved corporate policies, standards, and implementation to safeguard against negative biodiversity impacts

This opportunity describes corporate and investor-level policies seeking to avoid harm to biodiversity and the incorporation of these policies to guide sourcing. These requirements may then be incorporated into purchase agreements and contracts with producers to transform producer practices. In some cases, corporate buyers will provide finance for adopting these higher standards. Starbucks US$ 50 million Global Farmer Fund supports farmers to adopt their Coffee and Farmer Equity (C.A.F.E.) standard developed together with Conservation International, which includes criteria to support biodiversity conservation.[635]

Beyond internal corporate standard systems, one of the most significant developments over the past decade has been corporate zero-deforestation commitments and policies for their implementation. These initiatives have come under criticism in 2020 as it became evident that some of these targets, such as the 2010 Consumer Goods Forum (CGF) commitment referred to in Table 5.27, have not been met. Deforestation and natural ecosystem conversion are especially present at the production stage of supply chains and are highly place-dependent—timber/pulp and palm oil come primarily from Southeast Asia and West Africa, while cattle and soy originate mostly in areas subject to high deforestation in Latin America.[636]

According to the Forests 500 assessment, of the 210 companies that do have deforestation commitments in place, 100 (48 %) have reported no progress on achieving their commitments.[637] The latest New York Declaration on Forests (NYDF) assessment indicates that deforestation rates have gone up 44 % since the CGF resolution was signed.[638] The CGF has since revised its strategy and will no longer focus on tools for improving individual supply chains (e.g., certification and traceability).[639] Instead it will focus on systemic change to create a coalition of positive action in forests through supply chain management and integrated land use approaches. Prior to the NYDF there have been some commodity and geography specific successes in combating deforestation, with the voluntary Amazon Soy Moratorium signed in 2006 widely credited with reducing deforestation in the Amazon biome as a result from soy production from 30 % a year to only 1.5 % a year.[640] However, there are concerns that the moratorium incentivized an increase in soy-related deforestation within the cerrado biome instead, where no such preventive measures exist to fight deforestation.[641]

Increased visibility within supply chains can allow companies to adjust and build sustainable supply chain models that focus not only on quality products and supporting biodiversity but also on providing producers with equitable development options through implementing desired changes to processes that are aligned with company standards. These standards, in turn, need to be well defined. However, to reach this stage and have the desired biodiversity positive impact, rigorous monitoring and enforcement of implementation of supply chain policies and standards are necessary. Companies may benefit from investments into traceability systems and technology to maintain this level of surveillance; in the case of Marfrig, the second largest beef producer in Brazil, the beef supplier is establishing a tracking system for cattle raised in the Amazon.[642] The challenge of consumer visibility on these standards is underlined by Wilting et al. (2017), who state that more than 45 % of supply chain-related biodiversity loss caused by the food and chemical sectors occurred due to the limited visibility buyers had on the practices upstream of the suppliers.[643]

ii) Avoiding/reducing harm: Third-party sustainability standards

Third-party sustainability standards include criteria requiring the producer to avoid and safeguard against harm to biodiversity. There is a broad range of third-party "ecolabels," sustainability certifications, and certifications with varying standards and qualification requirements, all of which have different implications for biodiversity. The Ecolabel Index lists 457 ecolabels in 199 countries across 25 sectors.[644] Examples of certification standards with direct relevance to supply chain impacts on biodiversity include organic certifications, the Roundtable on Sustainable Palm Oil (RSPO), Global Roundtable for Sustainable Beef (GRSB), the Round Table on Responsible Soy (RTRS), the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification (PEFC), the Sustainable Forestry Initiative (SFI), the Marine Stewardship Council (MSC), the Aquaculture Stewardship Council (ASC), and the ICMM Mining Principles. These certification schemes cover a range of requirements that range from banning products whose sourcing is associated with harmful biodiversity practices, such as palm oil from deforested land, to the use of sustainable/ethical methods, such as providing adequate feed and space to farm animals.

iii) Achieving positive impact: Sustainable jurisdiction/landscape level sourcing initiatives

Governments, companies, finance institutions, and NGOs are increasingly looking to "jurisdictional approaches" to scale efforts that decouple harmful activities, such as deforestation and land degradation, from commodity production. Current models range from jurisdiction-wide certification of one or

more commodities (e.g., Malaysia's 10-year plan to achieve full jurisdictional Roundtable on Sustainable Palm Oil [RSPO] certification in the state of Sabah) to directing corporate buyers to high performing jurisdictions (e.g., Unilever's and Marks & Spencer's "produce and protect" commitments) and securing alignment with national climate targets.[645] Landscape level initiatives often exceed certification requirements and provide further resources for natural ecosystem protection and restoration beyond the direct impact of the supply chain itself. For example, the Dutch government funded an initiative of the Sustainable Trade Initiative (IDH) for sustainable landscapes that carries out landscape-level activities to ensure that 60,000 hectares of the South West Mau forest, Kenya's largest closed-canopy montane forest providing critical ecosystem services for the country, is restored and conserved by 2030. To achieve this initiative, IDH has collaborated with the private sector, government, and NGO actors such as Unilever Tea Kenya, Finlays, and the Kenya Tea Development Agency, who have mobilized over EUR 25 million of private investment into a tree enrichment planting program and supporting forest surveillance activities to demonstrate biodiversity-positive impact and support long-term landscape health.[646] These jurisdictional approaches benefit from addressing all producers in a given area rather than just the largest or most prominent, guaranteeing that all actors are subject to the same standards. They target positive change at the level where most consequential land use decisions are made, instead of just at the individual farmer level where farmers could simply look for alternative buyers or crops to avoid sustainability standards.

iv) Achieving positive impact: Conservation-focused management of naturally-sourced ingredients

In connection with this opportunity, supply chain actors support the conservation of natural ecosystems to secure a sustainable supply of naturally occurring products that are extracted in or derived from these ecosystems.[647] *In situ* biodiversity holds genetic resources that society may also come to rely on for resilient strains of crops or products needed to maintain supply chains in the future, particularly in the face of climate change.

Many businesses generate revenue from the production and sale of goods derived from naturally sourced ingredients such as the global cosmetics market. This market is valued at US$ 200 billion and is heavily reliant on the availability and continued access to valuable commodities that are threatened by deforestation. For example, the supply of both shea butter and argon oil used in cosmetics are derived from the shea and argon tree, respectively, which are at risk from deforestation and forest degradation.[648]

C. Why Is It Important for Biodiversity?

Businesses depend on nature for supply chain performance and physical security, but their supply chain maintenance also has an equal impact on the degradation of nature, biodiversity, and the delivery of ecosystem services. Resource extraction or production from supply chains can drive exploitative land management practices and exacerbate environmental degradation. These practices may in turn cause material losses to businesses. This section addresses how applying the four main opportunities described in the previous section can reduce supply chains' negative impact on biodiversity or align supply chains with biodiversity-positive impact.

i) Avoiding/reducing harm: Improved corporate policies, standards, and implementation to safeguard against negative biodiversity impacts

Multinational companies account for more than US$ 15.74 trillion of global trade, and mainstreaming sustainable management practices presents an enormous opportunity to reduce their negative impacts on biodiversity.[649] However, it is difficult to assess and quantify the potential value of improved corporate policies

and practices on biodiversity.

In light of these challenges, examples can be used to illustrate the scale of the financing flows that could be diverted away from harming biodiversity. A report by Forest Trends and the UK government estimates that, in terms of trade, the value of agro-commodities (beef, leather, soy, palm oil, tropical timber, pulp and paper, and plantation wood products) produced on land and illegally converted from tropical forests has a value of US$ 61 billion per year.[650] They note that the EU, China, India, Russia, and the United States were among the largest buyers of these commodities and, given the right mix of policy, trade, and investment incentives, their consumer demand could also be leveraged as a force for positive change. In the fishing industry, the World Resources Institute estimates that, in the Pacific region alone, illegal, unreported, and unregulated (IUU) fishing is valued at US$ 4.3–8.3 billion a year.[651] Agnew et al. (2009) estimate that IUU fishing costs the global economy as much as US$ 23.5 billion annually, illustrating the scale of the financing flows that could be diverted away from harming biodiversity.[652]

Improved corporate policies, standards, and implementation of safeguards for biodiversity in supply chains can help to eliminate the illegal trade of commodities mentioned above. By doing so, the funds that currently flow to actors in these illegal trades can be redirected to actors whose practices support biodiversity and the long-term sustainability of the resource stocks. A first step to addressing this issue is to understand the impacts of business operations.

A limited but growing number of corporations have developed methods to monetize the value of the impacts of their business operations and therefore avoid biodiversity harm within supply chains through improved corporate policies. One such method is environmental profit and loss (EP&L) accounting, a methodology used for valuing and providing companies with an insight into the main areas of environmental impact in a company's supply chain, including those on land use and biodiversity. To date, only a limited number of corporations have used this method to monetize, and therefore visualize, the value of their operational impacts on the environment and natural capital therein.[653]

CASE STUDY:

Kering EP&L[654]

Kering is a French luxury group that owns a number of global brands including Gucci, Yves Saint Laurent, and Alexander McQueen, as well as German sportswear brand Puma. Kering has been calculating and reporting the EP&L accounting of its brands since 2015. With EP&L, Kering reported that it had an environmental impact of US$ 568 million in 2018, with US$ 179.8 million of that related to land use. To estimate its land use impact, Kering calculates the loss of ecosystem services that results from activities in its supply chain using three indicators: above ground biomass, species richness, and soil organic carbon, which is a strong indicator of soil health. The impacts are also disaggregated along five different tiers in the supply chain: stores, warehouses, and offices; assembly; manufacturing; raw material processing; and raw material production. While Kering's environmental impact has increased in absolute terms since it started reporting its EP&L, its EP&L intensity—the EP&L impact per unit of revenue—has decreased by 14 % since 2015, a figure in line with Kering's target to reduce its EP&L footprint by 40 % relative to its growth across the supply chain by 2025. In 2020, Kering published it first corporate Biodiversity Strategy, committing to a net positive impact to biodiversity by 2025. In addition, Kering launched a regenerative agriculture fund for one million hectares of land in partnership with Conservation International.

ii) Avoiding/reducing harm: Third-party sustainability standards

A report by GIZ analyzing standards and labels for the promotion of biodiversity-supportive production and commercialization found that standards generally "include requirements for habitat protection, prohibited clearance of certain land-cover types, specified criteria for priority habitat areas, impacts on threatened species and measures to address invasive species" and a number of safeguards to address key pressures on biodiversity and ecosystems services.[655] However, inconsistency in terminology and approaches between different standards, and inadequate or costly monitoring of biodiversity impacts, make it difficult to clearly identify the contribution of standards to the conservation of biodiversity.

Given the variety of different standards, there is a challenge to understanding how, and to what extent, different certification standards integrate biodiversity and the degree to which they deliver biodiversity benefits. In addition, the lack of a broadly applicable metric such as there is in the climate change area (metric tons of CO_2 equivalent) makes it difficult to compare the relative impact of different initiatives. In the area of biodiversity, one project may be looking at hectares of forest restored while another is looking at population growth rates of endangered species, while yet another is looking at indicators of water quality or pollution reduction. In such a situation it becomes difficult to assess the relative merits of each initiative and make decisions about which should receive continued funding, and which should be terminated.

Despite these complexities, it is broadly agreed that such standards can compel producers to improve the sustainability of supply chains and subsequently reduce negative impacts to biodiversity caused by supply chain activities.[656] For example, since the implementation of the Better Cotton Initiative (BCI), a program that licenses and trains farmers on sustainably farmed cotton, BCI farmers across four major countries reported less water use, less pesticide use, higher yields, and higher profits compared to non-BCI farmers; in the case of Pakistan, BCI farmers used 17 % less synthetic fertilizer, 17 % less water, and 17 % pesticide compared to non-BCI farmers but gained 40 % more profit and 15 % more yield.[657] Other benefits include the use of a price premium on sustainable products—consumers can pay a premium between 10 % to 50 % for organic produce and 22 % to 25 % for fair trade coffee.[658] Premiums can be used to cover the higher costs often needed for biodiversity-supportive procedures, and thus enable investment for organizations to switch to sustainable methods.

iii) Achieving positive impact: Sustainable jurisdiction/landscape level sourcing initiatives

Sustainable landscape- and jurisdiction-level approaches to sourcing materials aim to foster sustainable development through new frameworks that ensure sustainable production beyond the site, producer, or farmer level. Landscape approaches focus on collaborating with multiple stakeholders to achieve a sustainable landscape, while jurisdiction approaches are achieved within clearly demarcated political boundaries.[659] This approach may also involve jurisdictional certification, a form of sustainability certification that addresses sustainability issues that may be difficult to solve at the producer level without the support of other actors within a given jurisdiction. Both approaches, through the design of broad frameworks, aim to deliver productivity gains, net positive environmental impacts, and desirable social outcomes for stakeholder communities and may enable businesses to deliver their commitments on emissions reductions, deforestation, and biodiversity. Through scaling up positive biodiversity impacts and engaging all stakeholders in shared responsibilities, jurisdictional approaches can lower the costs of achieving sustainability

impacts through economies of scale, capturing a wide range of stakeholders in an area, and overcoming bureaucratic barriers that have often stalled other sustainability commitments.[660] These approaches, by involving a wider group of stakeholders than other approaches, can create economic co-benefits beyond the preservation of biodiversity.

IDH has applied its Production, Protection and Inclusion (PPI) approach to 13 landscapes in 9 countries across multiple sectors including tea, coffee, cacao, cotton, aquaculture, apparel, palm oil, tropical timber, soy, and pulp and paper.[661] As of 2018, IDH had invested in more than 50 landscape supply chain projects reaching over 2.7 million farmers with services to improve sustainable production and reducing their environmental footprint. This has resulted in 5.5 million metric tons of sustainably produced commodities and 6.5 million hectares under sustainable production practices.[662] In one such project in Uganda, the Dutch bank ABN AMRO provided US$ 9 million of funding with IDH providing a first loss guarantee up to year 5 of the project as part of a sustainable sourcing strategy from Neumann Kaffee Gruppe (NKG), the world's largest coffee trader.[663]

The Tropical Forest Alliance (TFA), a platform designed to help private companies meet their anti-deforestation commitments within supply chains, identified 61 jurisdictional programs across Africa, Latin America, and Asia focused on commodities such as soy, palm oil, cacao, pulp and paper, coffee, and cattle.[664] These programs involve collaboration with public- and private-sector stakeholders at different capacities (e.g., subnational and national governments, SMEs, and large corporations) to ensure a supply of sustainable commodities that allow businesses to meet their commitments on sustainable sourcing. Further, these programs aim to reduce commodity-driven deforestation and achieve both biodiversity and carbon benefits. An example of one program is the jurisdiction-wide voluntary Green Municipalities Program (PMV) in the state of Pará in Brazil, which has a forest area of 88 million hectares (covering 25 % of Brazil's Amazon region) and has 8 % of its GDP derived from agriculture. The PMV supports Brazil's ABC (Low-Carbon Agriculture) Program and the Amazon Fund, the first-risk capital fund in the region (worth BRL 20 million, or approximately US$ 6 million) that supports the transition to reforestation, sustainable production, and a green economy.[665] Overall, the jurisdictional collaborations with TFA and IDH prove that greening supply chains can be achieved through management at the regional level, especially when producers and other important stakeholders are concentrated in specific geographical areas.

iv) Achieving positive impact: Conservation-focused management of naturally-sourced ingredients

In 2017, PwC calculated that the value of the global genetic resource-dependent economy in 2016 was US$ 690.8 billion, where genetic resources refer to plant, animal, and microbial materials whose intrinsic value comes from their hereditary genetics.[666] It is unclear what share of these resources are currently under conservation-focused management. Supply chain actors wishing to use these naturally occurring resources may fund their protection and restoration, or must share financial benefits from their use with local communities and indigenous groups living in the areas they are extracted from under the Nagoya Protocol on Access and Benefit Sharing (2014).[667] Access Benefit Sharing contributions are not included here in the sustainable supply chains estimates.

Some companies have taken the matter of ensuring the ongoing supply of key ingredients into their own hands by investing directly in the landscapes and habitats where these ingredients are sourced. Natura, a Brazilian cosmetics firm, has invested around US$ 347.2 million (1.5

CASE STUDY:

Natura

Natura is a cosmetics company based in São Paulo, Brazil, with operations in more than 70 countries and approximately 40,000 employees, making it one of the largest beauty companies in the world. Key to Natura's brand and marketing strategy is its commitment to sustainability, including having all products be carbon-neutral, using 100 % recycled plastic in packaging, and partnering with local Brazilian producers to protect 18,000 km^2 of Amazonian rainforest. As part of its EKOS product line, Natura is dedicated to an "ethical sourcing system" that emphasizes biodiversity as the center of all of Natura's products and investments. Natura sources many ingredients exclusively from local communities and has replaced palm oil as an ingredient with more biodiversity-supportive inputs native to Brazil, such as *andiroba* and murumuru. In return for natural ingredients, Natura provides direct payments via purchase agreements and investments into community development. The combination of the two protects incomes for local families and encourages proper environmental management to ensure the availability of these inputs. In the case of *murumuru*, the tree was at risk of extinction due its limited use and encroachment by *açaí* plantations. However, with the use of *murumuru* oil in Natura products, 157 families in the State of Pará work to harvest murumuru in a sustainable manner and save it from extinction.

Natura utilizes various methods to ensure the value and sustainability of its supply chain, including access benefit sharing and lifecycle thinking. In accordance to recommendations from the Convention of Biological Diversity, Natura's access benefit sharing model offers advanced payments and a percentage of the income attributable to an ingredient if the community identifies and develops a new raw material. These payments also come with prior consent from communities along with mutually agreed-on terms. Natura uses an Organizational Life Cycle Assessment methodology to map its impacts from material extraction to product disposal. With this, the company found that most of its biodiversity impacts are concentrated in resource extraction, packaging, and water use associated with the use of its products. Therefore, Natura focused on securing natural ingredients and going through the data-intensive processes of tracking and verifying biodiversity-supportive sourced materials. In 2019, Natura has been able to deliver on both their sustainability and growth goals, doubling its revenues to US$ 3.2 billion since 2012.

billion Reais) since 2011 in preserving 1.8 million hectares of Brazilian Amazonian forest where many of its raw materials are sourced.[668]

Table 5.29 summarizes how the opportunities identified in this section can either avoid harming or have a positive impact on biodiversity.

D. Financial Impact: Current and Future

Current State

Based on the data available, we have estimated that sustainable supply chains globally are allocating US$ 5.5–8.2 billion annually toward biodiversity conservation. (See Appendix A for more information about methods and data used to obtain these estimates.) These figures are based on estimated financial flows allocated to biodiversity associated with certified products in 2019. There are additional resources invested directly by supply chain actors to implement internal policies and standards related to biodiversity in sourcing areas, but data on this spending category are not widely available on a global or sector level.

By contrast, the value of major illegally sourced commodities, which cause significant damage

TABLE 5.29 Examples of the Opportunities Impacting Biodiversity

Opportunity	Example
Avoiding/reducing harm	
i) Improved corporate policies, standards, and implementation to safeguard against negative biodiversity impacts	Unilever's Sustainable Agriculture Code (2017) includes a section titled "Biodiversity and Ecosystem Services." This contains mandatory requirements for producers to avoid conversion of high conservation value areas, or areas used for hunting, fishing, or gathering of rare, threatened, or endangered species and to coordinate farmer's Biodiversity Action Plans.[669]
ii) Third-party sustainability standards	The Global Round Table on Sustainable Beef (GRSB) maintains sustainability standards and 12 roundtables around the world including the United States, Brazil, Europe, and South Africa. In the United States alone, US GRSB members represent 30 % of all cattle herds, 80 % of all processed beef, and 34 % of US consumers with members committed to social responsibility and environmentally sound procedures in beef production.[670]
Achieving positive impact	
iii) Sustainable jurisdiction/ landscape level sourcing initiatives	Aceh Tamiang in Indonesia aims to improve sustainable palm oil yields by 30 % through a PPI (Production, Protection and Inclusion) Compact between the district government, PepsiCo, Musim Mas Group, and Unilever along with local stakeholders. These three companies are exploring investment opportunities in the district to increase sustainable palm oil production while protecting the Leuser Ecosystem.[671]
iv) Conservation-focused management of naturally sourced ingredients	The cosmetics company Natura, with a market valuation of US$ 7.5 billion, is paying for the protection of 1.8 million hectares of Amazonian rainforest, where many of its raw materials are sourced from.[672]

TABLE 5.30 Estimated Market Value of Certified Sustainable Forest Products, Palm Oil, Agricultural Goods, and Seafood in 2019

Sustainable product	Total market value
Certified forest products	US$ 228 bn
Certified palm oil	US$ 16 bn
Certified agricultural goods	US$ 190 bn
Certified seafood	US$ 102 bn

to biodiversity through the conversion of natural forest ecosystems and unregulated depletion of fisheries, are estimated to be approximately US$ 85 billion per year.[673] Comparably, expanding and maintaining protected areas (PAs) for conservation to 30 % of the earth's surface would generate an extra global economic output of an extra $64–$454 billion by 2020 compared to a scenario of non-expansion.[674]

This section does not cover the role of the finance sector in sustainable supply chains, as

TABLE 5.31 Estimated Annual Financial Flows Associated with Certified Products Allocated to Biodiversity in 2020

Good/Service Sector	Value allocated to biodiversity: lower limit (2019 US$ bn/ year)	Value allocated to biodiversity: upper limit (2019 US$ bn / year)
Certified forest products	2.0	3.5
Certified palm oil	0.2	0.2
Certified agricultural goods	1.9	2.9
Certified seafood	1.1	1.6
Total	**5.5**	**8.2**

Source: Breukink, G. et al., 2015 and FSC & PEFC, 2020; Marketsizeforecasters, 2020; UNDP BIOFIN, 2020; FAO-SOFIA, 2020 and Seafood Certification & Ratings, 2019, Seafoodsource, 2019. Note: The methodology behind these figures is presented in Appendix A. For all of these commodities there is an assumption that 1–1.5 % of the sustainable market valuation is reinvested into biodiversity initiatives in that sector. The 1 % is based on the forestry sector, which has more data and is further explained in Appendix A.

this is covered in the Green financial products section of this report.

Table 5.31 provides conservative upper and lower limit estimates of how much capital from these certified sustainable products is allocated to biodiversity-related conservation. The lower estimate is that 1 % of the sustainable product total market value is allocated to biodiversity conservation and the upper estimate is that 1.5 % is allocated to biodiversity conservation. The 1 % value is taken from the more robust data available in the forestry sector and, given the lack of data in other sectors, assumed to apply to the other markets. The use of 1.5 % as an upper limit is taken as a reasonably conservative upper estimate.

Future State

The growth in sustainable supply chains has been considerable over the last decade. It is expected that this growth will continue based on the commitments companies have made toward reducing negative environmental impacts in their supply chains, and increasing demand from consumers for environmentally and socially responsible products.[675] Business for Social Responsibility (BSR) estimated in 2018 that, based on a US$ 2 trillion supply chain finance market, sustainable supply chain finance will eventually represent one third of the market, or US$ 660 billion.[676]

The 2030 market value for certified sustainable forest products, agricultural goods, and seafood sectors has been calculated using data available on the growth potential of these markets. Further details on sources and methods are contained in Appendix A. Similar to the current flows, it has also been assumed that 1.0–1.5 % of these markets is allocated to biodiversity. This results in capital flows that could be allocated to biodiversity by 2030 to be US$ 12.3–18.7 billion.

In the event that policy actions lead to more stringent regulation of supply chain sustainability and shareholder, stakeholder, and consumer pressure continues to intensify, an increase in the amount of resources directed by supply chain actors into biodiversity conservation should be expected. However, as it is not possible to quantify this impact yet, this scenario has not been incorporated into the estimates above.

TABLE 5.32 Estimated Financial Flows Associated with Sustainable Supply Chain Management Allocated to Biodiversity in 2019 and Projected for 2030

Good/Service Sector	Lower limit value allocated to biodiversity (2030 est.) in 2019 US$ bn/yr	Upper limit value allocated to biodiversity PV (2030 est.) in 2019 US$ bn/yr
Certified Forest Products	3.7	5.5
Certified Palm Oil	0.4	0.6
Certified Agricultural Goods	6.7	10.0
Certified Seafood	1.6	2.6
Total	**12.3**	**18.7**

Source: Breukink, G. et al., 2015, and Business & Sustainable Development Commission, 2017; Marketsizeforecasters, 2020; Business & Sustainable Development Commission, 2017; Coherent Market Insights 2018 and Seafood Certification & Ratings, 2019. Note: *The methodology behind these figures is presented in Appendix A.*

E. Obstacles and Enabling Conditions

National regulation on biodiversity protection is one of the strongest incentives for supply chain actors to avoid and reduce harm to biodiversity. Because regulation applies broadly to supply chain actors (as opposed to voluntary initiatives, which may be implemented by only a subset of market actors), national regulation can have a much larger influence on supply chain biodiversity impacts. Regulation also addresses the problem of free riders putting more sustainable actors at a competitive disadvantage, at least when sustainability comes at a cost to producers and intermediaries.[677]

There are several international policy

frameworks, such as the UN Convention on Biological Diversity (CBD), that can influence corporate decision-making and target-setting. Multinational companies taking a progressive stance on sustainability may engage actively in the CBD process and align their corporate target-setting to support CBD objectives. However, for most supply chain actors, the CBD influences them only indirectly, through the national policies, laws, and regulations that nation-states may implement as a result of their ratification of the CBD. Other international policy frameworks include the Natural Capital Protocol initiated by the International Union for Conservation of Nature (IUCN) and the World Business Council for Sustainable Development (WBCSD), which provides a framework for accounting for biodiversity in business decisions making.[678]

Even so, the most ambitious policies to safeguard against negative biodiversity impact by supply chain actors are still predominantly voluntary. These include industrywide commitments such as those of the Consumer Goods Forum members and the signatories to the New York Declaration on Forests,[679] and participation in the voluntary sustainability certifications standards discussed earlier in this section. However, according to the latest WEF Global Risks report, biodiversity is mentioned in less than half of Fortune 500 company ESG reports, of which only a handful set measurable and time-bound targets.[680] Further, while voluntary measures can be useful, they may develop slowly and are often adopted unevenly.

There are still serious deficiencies in the effectiveness of regulation and enforcement on biodiversity protection globally due to weak governance, lack of resources, ineffective judicial systems, and insignificant penalties that fail to create the right incentives in the market. Regulatory frameworks that effectively manage supply chain impacts on biodiversity will only make a difference if they are stringent and are enforced vigorously. The importance of government to effect this change cannot be overstated along with coordination of international trade agreements and organizations to solidify sustainability across multinational supply chains.

The existence of perverse incentives poses a major obstacle to redirecting supply chains toward more positive biodiversity impacts, including government subsidies and incentive programs, as they may encourage the conversion of natural habitat and other activities deleterious to species and ecosystems. Annual farmer subsidies under the EU's 140 billion Euro Common Agricultural Policy (CAP), for example, have required landowners to maintain fallow land in a "cultivatable" state free from shrubs and trees, directly affecting the ecological integrity of these lands, and has contributed to a significant decline in farmland biodiversity reported across the region.[681] The Harmful Subsidies section of this report includes further information on this topic.

There are several limitations associated with the use of these third-party standards. In terms of effectiveness, the impact on biodiversity is not always clear. For example, while RSPO certification has been shown to reduce deforestation, it has mostly been adopted in older plantations with little primary forest cover.[682] Farmers and growers can also lack the technical and financial resources to implement some of the lengthy and technical principles and meet the criteria set out by certification bodies. The transaction costs of paying for assessments and verifications can make the process cost-prohibitive for producers with a low resource base or narrow profit margins, although some group certification programs are in place to help overcome this obstacle. Even so, consumers and mid-supply chain operators may not be willing to pay a premium for certified products. These additional costs can reduce the competitiveness of certified commodities. Concerning scalability, growth in certification for certain commodities has recently stagnated. Analysis from the International Trade Centre shows that the area

certified for sustainable commodities such as palm oil, coffee, and cocoa is only increasing slowly or, in some cases, declining.[683] As of 2019, 19 % of global palm oil production was RSPO-certified,[684] 2 % of soy was RTRS-certified, 28 % of industrial roundwood was FSC- or PEFC-certified, and less than 1 % of beef was GRSB certified.[685] Although organic food accounted for only 5.5 % of the US market as of the time of this writing,[687] as mentioned earlier the global organic market is expected to grow by 16 % a year to 2022.[688]

There is strong evidence that shareholders are becoming more assertive in urging investee companies to mitigate the negative biodiversity impacts in their supply chains. Pressure associated with "stakeholder capitalism," the need to maintain brand reputation, and concern over companies' social license to operate can also compel corporations to address biodiversity loss in their supply chains. Peter Brabeck-Letmathe, chair emeritus of Nestlé and former chair and CEO of Nestlé SA, has stated that stakeholder capitalism means "business policy needs to create value for the many people, resources and communities it impacts."[688] Positive action on biodiversity can enhance a company's brand and reputation, which are important factors in a company's market capitalization and its ability to hold its social license to operate.[689]

However, while consumer demand for more sustainable products may be increasing in various parts of the world, there is less evidence that consumers are prioritizing biodiversity conservation globally. Rather, a range of other factors such as cost, quality, and branding continue to be the dominant drivers of most purchasing decisions.[690] In a competitive marketplace, this makes it more difficult for actors further up the supply chain to remain competitive while absorbing the additional costs of safeguarding biodiversity.[691]

Even though consumers now are not directly targeting biodiversity conservation in products, they are increasing the demand for markets that are tied to biodiversity-positive actions, like the organic sector. As mentioned earlier in this section, the market for organic produce is expected to grow by 16 % per year and reach US$ 327 billion by 2022.[692] Meta-analysis of organic farming methods indicates that organic farming results in around 30 % higher biodiversity compared to conventional farming,[693] and in the UK organic products are associated with a consumer price premium of roughly 30 %.[694] However, beyond the organic sector, the realization of price premiums for other certified products is less evident. In the palm oil sector, it is reported that consumers may be willing to pay a 15–56 % premium for palm oil produced without the conversion of natural ecosystems, although the extent to which this translates into actual price premiums is unclear.[695]

A range of targets, metrics, and accounting approaches are available to help businesses understand and assess their biodiversity impacts and dependencies. Even with this assistance, progress on integrating biodiversity in business and investment decisions (e.g., strategy, governance, impact assessment and risk management, due diligence, and disclosure) remains limited.[696] This is often due to short-term commercial priorities, as well as other pressing sustainability issues that are more readily measured and managed, such as greenhouse gas emissions.

Furthermore, there is currently limited traceability (or transparency of traceability data) in most commodity supply chains. To make things more difficult, commodities may be traded through numerous intermediaries along the supply chain, increasing the likelihood that products from multiple sources are mixed and information about the original sources is lost. Traceability allows buyers to distinguish between producers that are compliant with their standards and those that are noncompliant, and potentially to discontinue purchasing from the latter. There is still a risk that noncompliant producers simply sell products to other buyers with lower

expectations about sustainability, but if enough customers require higher standards it may result in a supply chain reaching a tipping point beyond which most or all production becomes sustainable. This also requires producers to commit to transparency with their consumers to ensure consumer standards are being met in all stages of the production process.

A possible solution for improving traceability is the development of new supply chain and traceability technology. One example is Trase, which was developed to enable governments, companies, investors, and other users to understand and address the social and environmental impacts linked to their supply chains more comprehensively.[697]

Recently the use of blockchain to ensure deforestation-free supply chains is being tested and will no doubt face challenges due to the complexity of some of these supply chains. While blockchain may legitimize claims about the origin of a particular product, there continue to be issues obtaining data from the production (or extraction) end of the supply chain. And although blockchain can guarantee that data has not been tampered with, it still relies on rigorous data entry along the supply chain.[698] But the technology holds significant promise to ensure better biodiversity impact management along commodity supply chains. Nestlé, for example, has indicated that they are exploring the use of blockchain technology to help improve the traceability of products along their supply chains.

F. Recommendations

All actors engaged in supply chains should collaborate to foster the green transformation of supply chains, with an immediate focus on soy, palm oil, cattle, and forest products, including developing and implementing production standards and improving the means of tracking products and impacts from producer to consumer.

Governments in supplier (exporting) countries should improve the land use planning and enforce legislation and measures to reduce deforestation and conversion of other natural ecosystems. Governments should also provide both financial and technical support, including agricultural extension services, and facilitate market access for compliant producers to incentivize the sustainable production of commodities.

- Governments should, where regulation exists, strengthen enforcement of, or implement improved land use planning, regulation, and monitoring to increase transparency around which companies are complying with regulations and which are not.
- Governments should actively promote and provide both technical and financial support for local practices that result in more sustainable and efficient resource use, limit waste production, mitigate pollution, and avoid land-use change of biodiversity-dense areas such as rainforests.
- Government regulations and central coordination can provide large purchasing companies, local suppliers, and primary producers guidance on where they should direct supply chain investment and capital.

Governments in buyer (importing) countries should leverage their market and diplomatic power to encourage exporting country governments to enforce sustainable practices.

- Governments of the emerging market countries with large consumption of soy, timber/pulp, cattle, and palm oil must assume greater responsibility in greening their supply chains to mitigate these commodities' effects on natural ecosystems.

- Governments should analyze their bilateral and multilateral trade agreements to identify how they incentivize commodities and supply chain practices harmful to biodiversity and examine how these agreements can be reformed to strengthen trade relations without degrading nature.
- Importing country governments should set the example by using their public procurement budget to incentivize reforms in supplier countries by purchasing more sustainable commodities.

Consumers should, with support from governments and companies, educate themselves about the environmental impact of their consumption behavior and subsequently use their spending power to demand greater transparency and improved practices, such as deforestation-free products, via increased use of ecolabels and certification systems by companies and brands to support biodiversity-positive practices in supply chains.

Large buyers with significant influence in supply chains should develop and implement green procurement policies and standards; work within the supply chain to monitor, track, and verify biodiversity impacts to assure that primary producers are adhering to the required sustainability standards; and work with governments to incentivize, support, and require local producers and intermediaries in the supply chain, who operate at a more local or jurisdictional scale, to transition away from unsustainable practices toward those that support biodiversity.

- Companies should incentivize, enforce, and support policies, standards, and guidelines on supply chain reform with adequate levels of investment and through assurances of continued purchasing.
- Companies should develop and implement monitoring and evaluation processes that allow for traceability and robust assurance in changes being made through the supply chain. This could be either through solely company action or in collaboration with government and local suppliers on such initiatives.
- Companies should establish clear metrics on their intended impact on biodiversity to track and benchmark progress, in particular by employing third-party certification and sustainability standards. Companies should publicize data on their supply chain impacts and efforts to improve supply chain sustainability. This information sharing can assist in consumer education.
- Enforcing and assuring the reform of supply chains will require collaborative action from actors in the supply chains who have the legal and financial power to do so. They, in turn, will need to be supported by government policy and regulation that incentivizes local actors to align practices with those required as part of sustainable supply chains, including but not limited to upholding sustainability certifications and standards.

Countries should increase efforts through the international architecture, specifically the WTO, to develop green trade agreements that facilitate and incentivize increased trade in commodities produced without conversion of natural habitats.

- International trade organizations such as the WTO should assume a leadership role in convening and facilitating discussion on greening multinational supply chains, producing sustainable production standards, and incorporating trade in sustainably produced goods in trade agreements.

CHAPTER 6

Report Level Recommendations

This report has presented a series of biodiversity finance mechanisms that collectively have the potential to close the world's aggregate biodiversity finance gap. As the recommendations in each section demonstrate, the effective scaling up of those mechanisms relies largely on government action to create the right regulatory structures and incentives and markets to attract and direct private sector financing in the right directions. Governments therefore have the biggest opportunity to act to enable, implement, and incentivize the growth of mechanisms as suits their national and local circumstances.

A key implication of this report is that while governments can fulfil this responsibility, their funds alone are insufficient to meet the needs of biodiversity financing. The private sector and financial institutions must acknowledge and address their role in financing actions that impact on biodiversity and step up their levels of ambition, financing, and action to support biodiversity through their operations. For least developed countries, official development assistance (ODA) flows will remain critical sources of biodiversity finance, but for most countries, the real work begins with domestic policy reforms to unlock both public and private financial flows. Foreign aid can certainly help with that process and the needed capacity building, but in addition to covering essential domestic contributions to biodiversity as global public goods, it should be viewed principally as catalytic. It is also important to bear in mind that biodiversity is not distributed evenly across the world. Foreign aid and capacity building efforts need to take this into account in terms of geographic distribution to balance recipient country funding needs with global conservation opportunity.

The key insights of this report are that governments should undertake catalytic policy reforms to unleash new types and levels of biodiversity funding and also redirect subsidies away from harmful activities and toward those that benefit biodiversity; and that the private sector should be ready to align their operations to support government efforts, adhere to regulations, and take advantage of market opportunities. To do this, governments should figure out what their biodiversity funding needs are, assess each of the mechanisms reviewed in this report, and then begin the hard work of implementing the policy reforms and enabling conditions for the financing mechanisms that are most relevant and impactful in their own countries to unlock the full range of public and private finance available for biodiversity. There is no time to lose if the world is to close the gap collectively by 2030.

Beyond these fundamental recommendations, this report also presents the following recommended actions that, if implemented, would support the goal of reducing biodiversity loss, independent of which the nine mechanisms are used.

Recommended Action 1: Countries must take *immediate policy actions* to protect their natural capital and expand biodiversity conservation financing. This report identifies nine mechanisms with the highest promise for resource generation and harm-prevention including prioritizing rural economic support that subsidizes farmers to provide ecosystem services, avoiding major infrastructure development impacts on critical habitats, and investing in nature-based climate solutions.

Countries should not wait for the conclusion of the CBD negotiations on the post-2020 framework and the development updated National Biodiversity Plans and Strategies before implementing biodiversity finance mechanisms. This report has identified multiple mechanisms with the highest resource generation and harm-prevention potential, most of which make sense on their own and are likely to emerge in any fully developed future National Biodiversity Finance Plan. Many of these are immediate, no-regrets actions governments can take while they develop new NBSAPs and financing plans for them. These immediate actions make sense as part of any economic stimulus or post-disaster recovery strategies for governments. For example, governments can provide the following:

- *Agricultural Support:* Prioritize rural economic support programs that incentivize farmers to use location appropriate production practices, such as regenerative or conservation agriculture, that also provide ecosystem services that yield public goods, such as improving water quality, soil health, and flood control.
- *Infrastructure Development:* Avoid major infrastructure impacts on critical habitats (the first step in the mitigation hierarchy), which would significantly reduce the need for future biodiversity spending, even if it takes time to put in place a robust biodiversity offsets regulatory system. Additionally, the 42 countries that have biodiversity offset regulations in place can immediately strengthen enforcement and generate additional revenue from offsets.
- *Ecosystem Restoration:* Invest in nature-based climate solutions, especially forest restoration. Ecosystem restoration is labor intensive and has a high level of job creation per dollar of investment relative to other rural economic investments, and nature-based solutions can often be cheaper than climate mitigation efforts in other sectors, and can contribute significant benefits in terms of disaster risk reduction and ecosystem-based adaptation. Similarly, donors should prioritize well-designed nature-based solutions in climate aid programs to simultaneously support climate mitigation and biodiversity outcomes.
- *Economic Stimulus:* Where appropriate and undertaken as part of a government's emergency economic response to crisis situations, economic stimulus funds should be focused toward supporting a green recovery and the protection and development of natural assets that provide both livelihood and economic benefits to local communities and support national economic growth.

Recommended Action 2: Government and philanthropic donors should use their funds strategically to support countries to implement the financing mechanisms identified in this report, and to catalyze subsequent public and private sector investment. This report calls for a doubling of foreign aid for biodiversity with the incremental resources being devoted to biodiversity-rich countries and toward implementation of these mechanisms.

While the total amount of funding that the philanthropic community provides for biodiversity is relatively small compared to other sources identified in this report, it can be incredibly catalytic. Their support to advocacy organizations, policy think tanks, capacity development, and government innovation have tremendous leverage in both financial and on-the-ground impacts. Both government and private donors should increase support for:

- Policy design, advocacy, and implementation;
- Capacity building for policy implementation, participation in investment mechanisms, and the measurement of impacts; and
- Establishment of new bilateral and multilateral funding channels to support the development of National Biodiversity Finance Plans and their effective implementation.

Recommended Action 3: National and subnational governments should strengthen their regulatory and financial enabling conditions to significantly accelerate private sector actions and finance for biodiversity conservation. Governments should set policies and take actions to de-risk and incentivize private sector investment, build in-country support for sustainable commodity production, and ensure needed legal conditions including land tenure.

A baseline condition for effective biodiversity financing is that governments, at the national and subnational levels, need to strengthen the enabling conditions to encourage the growth of private sector capital in biodiversity positive initiatives. This is a long-term endeavor. Enabling conditions at the subnational level also need to be addressed alongside national ones as the subnational level is where the biodiversity and finance interact. While the time to implement these enabling conditions may vary, governments can and should commit to taking initial steps to incentivize and crowd in catalytic investment from donors and private capital, thereby building momentum and accelerating the progress across other recommended actions in this report. In the short to medium term, the key enabling conditions that governments can act on are the following:

- Governments need to enhance domestic security and stability. Investments of private capital are more likely to flow to regions and countries that demonstrate a stable domestic environment and international relations. This is especially important when investing in biodiversity and natural ecosystems where there are often competing claims to land stemming from ill-defined land tenure rights.
- Concurrently, secure and recognized land tenure as well as robust enforcement of associated rights is crucial. Capital flowing to biodiversity projects is less likely when there is a perception of capital at risk or uncertain returns. Clear articulation of land tenure rights, such as via a land register, and enforcement of these rights, through legislation and regulation, provide more certainty to investors. Additionally, guidelines such as the Free Prior Informed Consent and Voluntary Guidelines on Responsible Governance and Tenure should be embedded into laws and regulations to protect both investors as well as local communities.
- Understanding that tensions may arise between local community groups, as well as between communities and investors, governments should ensure objective and easily accessed dispute resolution mechanisms.
- Governments should align policies both vertically (between levels of government) and horizontally (between departments). This can be accelerated by placing the responsibility for biodiversity finance across both environment and finance ministries or through a supra-ministerial coordination body. This ensures that technical, financial, and policy expertise are aligned across government ministries and agencies to ensure policy coherence across them.

Recommended Action 4: Private sector actors should implement the recommendations from the sections on sustainable supply chains, harmful subsidy reform, natural infrastructure, biodiversity offsets, nature-based solutions and carbon markets, green investment, and investment risk management to both increase their opportunities to invest in biodiversity and minimize their biodiversity-related financial risks. In addition, major companies should adopt science-based targets for biodiversity within their operations and investments consistent with the 2050 vision of the UN Convention on Biodiversity.

The impacts of the corporate sector on biodiversity, and vice versa, are large, complex, and highly specific based on industry, operation, and location. Nevertheless, there are a number of general actions that companies can take to shift their operations and industries to become more supportive of biodiversity. Several of these measures have already been described in the recommendation sections on sustainable supply chains, harmful subsidy reform, natural infrastructure, biodiversity offsets, nature-based solutions and carbon markets, green investment, and investment risk management.

In addition, this report recommends that companies undertake the following key actions:

- *Adopt science-based targets for biodiversity actions across their operations and investments.* The approach, originally conceived as a way to set corporate targets on emissions consistent with the Paris Agreement, is now expanding with a goal to enable companies to set science-based targets for biodiversity as well as for freshwater, land, and ocean ecosystems. This report encourages companies to engage in those standard setting processes while they are under development and to set enterprise-wide targets for themselves that will be consistent with the 2050 vision of the UN Convention on Biological Diversity of living in harmony with nature.
- Begin to proactively measure and report on their operational and financial dependence and impact on biodiversity as well as take steps to invest in operations that actively support biodiversity. Companies should take proactive steps to measure and disclose how they interact with biodiversity, and subsequently invest in their operations so that they are positioned to take advantage of policy reforms that reward companies whose practices are supportive of biodiversity and penalize those that do not. This will have a co-benefit of increasing a company's appeal to the growing pool of value driven investors.
- *Proactively engage with governments in setting regulations pertaining to biodiversity.* Companies should engage with and support government efforts to develop policies, legislation, and regulation that protects nature. In this way companies can be better positioned to manage regulatory and reputational risks.

Recommended Action 5: Governments and international agencies should improve the tracking and reporting on biodiversity finance. Some of the best data collection and analysis that is available is spread across the OECD, UNDP's BIOFIN initiative, and the CBD Secretariat. Additional public funding should be secured to support these institutions to enhance global finance data collection and build capacity of governments to collect and share data.

There is no systematic, global tracking of biodiversity finance, nor a universally accepted definition of what constitutes biodiversity finance. The research for this report relied on a combination of literature review, original research and modeling, and expert opinion. Nevertheless, if the UN Convention on Biological Diversity is going to set global targets for resource mobilization to support the Global Biodiversity Framework, it will need a clearer and less ad hoc way to track progress at the national and global levels. This report endorses the recommendations of the recent OECD report that addressed this issue well.[699,700]

The OECD calls for governments and international organizations to:

- Develop and agree on an internationally harmonized approach for assessing and tracking public biodiversity finance, building on existing frameworks and classification systems.
- Establish a common framework to assess and track private finance for biodiversity, drawing lessons from OECD's Research Collaborative on Tracking Finance for Climate Action.

- Increase national-level efforts to identify, assess, and track public expenditure harmful to biodiversity, including biodiversity-harmful subsidies.
- Develop guidance and adopt measures to evaluate the effectiveness of biodiversity finance flows and related policy instruments.[xxxviii]

Some of the best data collection and analysis that is available is spread across the OECD, UNDP's Biofin initiative, and the CBD Secretariat; those three institutions could form the core of the data collection exercise and capacity building support for the public sector. The cost of this will largely fall on governments and may therefore require incremental financial support for developing countries. Data collection for private sector biodiversity finance flows, however, has proven more challenging. Again, these three institutions are perhaps best placed to undertake that assessment, starting with the elaboration of clearer methodologies and lessons based on ongoing efforts to track private sector climate funding, in particular those of the OECD and the EU Taxonomy Regulation.[xxxix]

Recommended Action 6: In the context of the UN Convention on Biological Diversity negotiations, Parties should agree to develop and implement National Biodiversity Finance Plans (NBFPs) to guide the implementation of their national efforts toward the CBD's new Global Biodiversity Framework. The NBFPs should address opportunities to mobilize resources at all levels—local, national, and global—as well as from all sources—public, private and philanthropic. To achieve this outcome, this report recommends four Resource Mobilization targets for the Global Biodiversity Framework by 2030.

The current negotiations under the UN Convention on Biological Diversity will develop a new Global Biodiversity Framework, with a new set of global goals and targets. Countries will then be expected to update their National Biodiversity Strategies and Action Plans (NBSAPs) in line with the new framework. They should go a step further and develop National Biodiversity Finance Plans to identify the policies and mechanisms, tailored to their national circumstances, that close their own national biodiversity financing gaps and allow them to effectively implement their updated NBSAPs. The biodiversity resource mobilization strategies should address opportunities to mobilize resources at all levels—local, national, and international—as well as from all sources—public, private, and philanthropic.

To achieve this outcome, this report recommends the following Resource Mobilization targets for the Global Biodiversity Framework by 2030:

- Global target: Financial flows to investments that generate measurable and auditable improvements in the status of biodiversity increase globally to fully close the biodiversity financing gap by 2030 (est. US$ 598–824 billion annually),
- Process Target: 100 % of Parties immediately develop National Biodiversity Finance Plans (NBFPs) and fully implement them by 2030; and
- National Targets: Each Party mobilizes 100 % of the necessary resources identified in their NBFPs to fully and effectively implement their NBSAPs.

The previous resource mobilization strategy for the Aichi Targets also encouraged countries to develop national biodiversity finance plans. Unfortunately, few of them did, mainly because of lack of financial support for the planning

[xxxviii] OECD, A Comprehensive Overview of Biodiversity Finance, Final Report, April, 2020, p. 16, https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf.

[xxxix] The Taxonomy Regulation will establish an EU-wide classification system or framework for identifying whether economic activities can be considered to be "environmentally sustainable." See https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf.

process.[xl] For that reason, this report also recommends a global support system for all countries to have the capacity to develop and implement national biodiversity finance plans.[xli] That will require an additional target for donor countries and institutions:

- Global Target: International public funding for biodiversity at least doubles by 2030 and at least covers the costs, where needed, for developing countries to develop NBSAPs and NBFPs.

National governments will need to do the hard work of implementing the plans once they are developed. There is a key role for the bilateral aid agencies and multilateral development banks to support those implementation efforts, beyond the support for the development of the plans. As this report has shown, many of the most important resource mobilization mechanisms come down to policy reforms to create the right regulatory and market conditions to generate and or redirect financial flows in biodiversity-positive directions. To the extent that countries have articulated these intentions in their national biodiversity finance plans, they provide a clear expression of country ownership and thus a clear roadmap for foreign assistance in the form of institutional capacity building and support for domestic policy reform.

[xl] Evaluation and Review of the Strategy for Resource Mobilization and Aichi Biodiversity Target 20, https://www.cbd.int/conferences/post2020/POST2020-WS-2020-03/documents.

[xli] The Global Environment Facility already provides funding for countries to develop their NBSAPs, based on guidance from the CBD COP. UNDP's BioFin program has developed a robust methodology for developing countries to develop national biodiversity finance plans.

APPENDICES

Appendix A: Methodologies and Analytical Framework

In this section, we present a detailed methodology for calculating the various estimates presented throughout the report. First, we describe in Appendix A.1 the methods involved in estimating the current global biodiversity conservation finance. This is separated into domestic and international public sources, domestic and international public-private sources, and private sources. Second, in Appendix A.2 we describe the methods and assumptions used to estimate the global biodiversity conservation funding needs. In Appendix A.3 we present the methodology and assumptions for the estimated global biodiversity conservation finance by 2030.

Note: All inflation rates are obtained from the US Bureau of Labour Statistics (https://www.bls.gov/data/inflation_calculator.htm).

Appendix A.1. Current Domestic and International Public and Private Capital Flows to Biodiversity Conservation (Chapter 3)

P1–P2: Domestic and International Public Sources

Public funding flows for biodiversity conservation have been identified below with the following upper and lower estimates.

TABLE A 1.1 Overview of Current Public (P) Funding to Biodiversity Conservation

Ref #	Mechanism	Lower estimate—amount [2019 US$ bn/yr]	Upper estimate—amount [2019 US$ bn/yr]
P1	Domestic budgets and tax policy	74.6	77.7
P2.1	ODA—bilateral	3.7	8.7
P2.2	ODA—multilateral	0.3	0.8
P2.3	Other Official Flows (OOF)	0.1	0.2
Total		**78.6**	**87.4**

P1: Domestic Budgets and Tax Policy (Domestic Public)

Lower estimate: US$ 74.6 billion/year
Upper estimate: US$ 77.7 billion/year

The Organisation for Economic Co-operation and Development (OECD) provides the most recent estimate of domestic budgets spending on biodiversity from 80 countries as US$67.8 billion per year.[701] Within this category of domestic budgets spending it is recognised that countries do not adhere to a single common reporting standard of biodiversity spending, and as such the figures from different countries may not be directly comparable.

In addition to the 80 countries examined by OECD, additional data points[702] for seven countries were identified where domestic budgets spending on biodiversity is publicly available:[703, 704] Brazil US$ 89.77 million;[705] Chile US$ 107.34 million;[706] Peru US$ 288.32 million;[707] Argentina US$ 37.29 million;[708] Saudi Arabia US$ 47.8 million; Sudan US$ 2.7 million; and Mozambique US$ 2.6 million.[709]

The OECD domestic public biodiversity expenditure data 2015–2017 for 80 countries is based on 2017 or most recent year with 2014 cut-

off data available.[710] Data has been drawn from the Secretariat of the Convention on Biological Diversity (SCBD) Clearing-House database, the Classification Of the Functions Of Government (COFOG)[711] Biodiversity database, and the United Nations Development Programme Biodiversity Finance Initiative (UNDP BIOFIN) biodiversity expenditures reports.[712] However, the US$ 67.8 billion is assumed to be an underestimate of the global domestic public spend on biodiversity conservation, given that more than 100 countries are unaccounted for. The economies of the 80 countries tracked by OECD represent 85 % of global GDP, and thus the underestimate is assumed to be relatively small; however, a regression analysis was used to interpolate spending for the missing 100 countries. Under an assumption that the amount of spending on biodiversity is correlated directly with the Gross Domestic Product (GDP) of a country, a correlation equation can be estimated using the biodiversity spending and GDP values for the seven additional countries not included in the OECD dataset. For proprietary reasons it is not possible for this report to break down the US$ 67.8 billion figure from the OECD into the specific 80 countries' expenditures.[713] Therefore, to incorporate the OECD figure into a regression of global biodiversity spending on GDP, it has been assumed that the US$ 67.8 billion per year spending represents a single unit of observation (country) with a GDP equivalent to the sum of all 80 countries in the list (~US$ 72.56 trillion). Gross domestic product values for 2018 by country were extracted from the World Bank Databank.[714] To create the estimated domestic spending for the additional 100 countries, a univariate regression was calculated using R Statistical Software, comparing domestic public spending on biodiversity conservation and GDP. Domestic public spending on biodiversity and GDP were set to US$ values. This produced the following regression equation:

$$\text{Domestic public biodiversity spending} = \text{GDP} * 9.221\text{e-}04 \quad [R^2=0.99]$$

Using this equation, spending was calculated for the remaining 100 countries. Summing the calculated and source-based values results in a total global domestic spend of US$ 76.15 billion. To estimate the upper and lower values of this range, it is assumed that by using 1.96 standard errors above and below the coefficient of 9.221e-04, a 95 % confidence interval can be generated for the global domestic spending on biodiversity. Using this approach results in US$ 74.602–77.691 billion per year of domestic budgets spending on biodiversity conservation.

In addition to domestic budgets spending, there are a number of other specific governmental tax policies spending flows contributing to biodiversity conservation. These include biodiversity-positive subsidies, biodiversity-positive subsidies to agriculture, and domestic fees and charges. However, these tax policy categories are assumed to already be included in existing data on countries' biodiversity public spending summaries.

P2.1, P2.2, P2.3: ODA Bilateral, ODA Multilateral, and Other Official Funds (OOF) (International Public)

Lower estimate: US$ 4.0 billion/year
Upper estimate: US$ 9.7 billion/year

This estimate uses the official development assistance (ODA) values tracked by the OECD Creditor Reporting System (CRS). CRS data is monitored and analysed by the OECD Development Assistance Committee (DAC). The OECD uses the International Monetary Fund (IMF) definition of ODA as:[715]

> Flows of official financing administered with the promotion of the economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 percent (using a fixed 10 percent rate of discount). By convention, ODA flows comprise contributions of donor government agencies, at all levels, to developing countries ("bilateral biodiversity-related ODA") and to multilateral institutions. ODA receipts

comprise disbursements by bilateral donors and multilateral institutions" (IMF, 2003). Other Official Flows (OOF) are defined as "transactions by the official sector with countries on the List of Aid Recipients which do not meet the conditions for eligibility as Official Development Assistance or Official Aid, either because they are not primarily aimed at development, or because they have a Grant Element of less than 25 per cent.

The OECD adopts an approach to their estimates that accounts for the potential double counting between ODA and OOF and figures reported by countries in their domestic public budgets.

The estimates of biodiversity-related ODA and OOF presented in OECD (2020) are the sum of flows marked as "principal" and "significant" for biodiversity and are therefore considered the upper estimates of biodiversity-related ODA and OOF.[716] This is because the Rio marker data reflects the full amount reported against the activity by the provider, rather than the biodiversity-specific share or component of the activity. This report references the OECD DAC analysis using the Rio marker methodology and screening the ODA commitments objectives, which presents a lower estimate of biodiversity-related ODA (equivalent to "principal" flows), an upper limit (the sum of "principal" and "significant" flows), and a mid-range estimate (the sum of 100 % of "principal" and 40 % of "significant"). Lower and upper ODA Bilateral, ODA Multilateral, and OOF estimates[717] are based on the average 2015–2017 OECD Creditor Reporting System data. Given that not all countries have reported international public expenditures for each year, OECD have obtained the average of available data between 2015 and 2017. A large portion of the source of bilateral biodiversity ODA is concentrated among a few donors. Between 2012 and 2016 the United States, Germany, France, and Japan accounted for over half (56 %) of committed bilateral biodiversity-related ODA, and 10 donors accounted for 90 %; therefore, the OECD numbers are assumed to cover almost all of global ODA flows, and extrapolation is not necessary to cover all countries.

P2.1: ODA Bilateral

The estimates of international public finance flows for biodiversity are based on data reported to the OECD's Creditor Reporting System (CRS). However, a handful of official providers do not report to the CRS, including Brazil, the People's Republic of China, Colombia, Costa Rica, India, Indonesia, Qatar, and South Africa. It has not been possible to find biodiversity specific bilateral biodiversity-related ODA flows for these countries; however, it is assumed the downward bias in unreported ODA Bilateral from this subset of countries is small given that 90 % of ODA flows to biodiversity come from 10 countries that are already covered by OECDfigures.[718] The estimated range in 2019 US$ is US$ 3.7–8.7 billion annually.

P2.2: ODA Multilateral

ODA Multilateral is defined by the OECD as flows channelled via multilateral agency active in economic development (e.g., Inter-American Development Bank, United Nations Development Programme, and the World Bank Group). Resource flows to countries and territories on the DAC List of ODA Recipients (developing countries) and to multilateral agencies that are (a) undertaken by the official sector; (b) with promotion of economic development and welfare as the main objective; (c) at concessional financial terms. In addition to financial flows, technical cooperation is included in aid. The estimated range in 2019 US$ is US$ 0.3–0.8 billion annually.

P2.3: Other Official Flows (OOF)

Other Official Flows (OOF) are defined by the OECD (2020) as transactions by the official sector with countries on the OECD DAC List of ODA Recipients that do not meet the conditions for eligibility as Official Development Assistance, either because they are not primarily aimed at development, or because they have a grant element of less than 25 %. The estimated range in 2019 US$ is US$ 0.01–0.2 billion annually.

Domestic and International Public-Private Sources

Several funding flows can be either public or private or a combination of both. The estimates for funding flows from these sources are given below.

TABLE A 1.2 Overview of Current Public-Private (PP) Financial Flows to Biodiversity Conservation

Ref #	Mechanism	Lower estimate—amount [2019 US$ bn/yr]	Upper estimate—amount [2019 US$ bn/yr]
PP1	Natural infrastructure	26.9	26.9
PP2	Nature-based solutions and carbon markets	0.8	1.4
PP3	Green financial products—Green debt	1.6	3.3
PP4	Biodiversity offsets	6.3	9.2
PP5	Philanthropy/ foundation and conservation NGOs	1.7	3.5
Total		**37.3**	**44.4**

As described in Appendix B, it is recognized that there is potential for double counting between public and public-private funding sources. For example, a significant portion of natural infrastructure spending may derive directly from government sources, presenting potential for double counting between natural infrastructure spending with domestic budgets and tax policy (P1). The amount of potential double counting across spending categories is difficult to quantify given the coarse resolution of available data on public and public-private spending on biodiversity conservation, and thus caution is recommended as estimates provided herein may represent an upper limit to current global biodiversity conservation financial flows.

PP1: Natural Infrastructure

Lower estimate: US$ 26.9 billion/year
Upper estimate: US$ 26.9 billion/year

Current natural infrastructure funding is based on Bennett and Ruef's (2016) estimate of US$ 24.7 billion allocated to watershed investing, based on 387 programs, largely driven by investments in public subsidies for watershed protection.[719] Other categories include user-driven watershed investments, water quality trading and offsets, and environmental water markets.

The 387 natural infrastructure watersheds programmes are 153 user-financed, 203 government-financed, and 31 compliance. Bennett and Ruef estimate that only about US$ 15 million in natural infrastructure watersheds investments were specifically private sector payments for watershed services.

Bennett and Ruef's estimate uses 2015 data and as such it has been converted to 2019 values, using an inflation factor of 1.09. This results in 2019 US$ 26.9 billion.

PP2: Nature-Based Solutions and Carbon Markets

Lower estimate: US$ 0.8 billion/year
Upper estimate: US$ 1.4 billion/year

The current state of the carbon markets is summarized in the table below.

TABLE A 1.3 Overview of Current Flows for a Range of Carbon Markets

Mechanism	Lower estimate—amount [2019 US$ bn/yr]	Upper estimate—amount [2019 US$ bn/yr]
Voluntary forest carbon market	0.08	0.15
California forest carbon market	0.2	0.2
Australia forest carbon market	0.5	0.6
Payments for REDD+	0.04	0.5
Philanthropy/foundation and conservation NGOs	1.7	3.5
Total	**0.8**	**1.4**

The total current financial flows to carbon markets consist of four categories, two of which are specific to the California and Australia carbon markets, which together make up the two largest carbon markets globally.

1. Voluntary forest carbon markets. The lower estimate for this category was obtained from Hamrick and Gallant, which reported US$ 74.2 million in Voluntary Forest Carbon Market Offset transactions in 2017.[720] This was then converted to 2019 US$. The upper estimate was obtained from Donofrio et al., which reported financing for all project types amounted to US$ 295.7 million in 2018.[721] However, this report also highlighted that only 51.5 % of offsets from a total of 98.4Mt were tied to natural climate solutions/nature-based solutions giving a proportion of 51.5 %. This same proportion was then applied to the total financing amount of US$ 295.7 million to give an upper estimate for the capital flows through this category. The resulting value was then converted to 2019 US$.
2. California. In the three years from 2015–2017, 73 % of the total offsets, 62.7Mt, had been purchased in California amounting to 45.77 Mt. A conservative offset price of US$9.48/Mt has been assumed. This is based on applying a discount offset price of 21 %[722] to a minimum offset price of US$12/Mt,which in turn is based on the Auction Reserve Price (or floor price) that was set at $12.10 in 2015.[723] Using US$9.48/Mt as a cost for all 45.77Mt gives a total of US$ 433.2 million over the three years, or a constant annual spend of US$ 144 million in 2015. This has then been converted to 2019 US$.
3. Australia. The lower US$ 0.5 billion and upper US$ 0.6 billion estimates for the Australian Emissions Reduction Fund (ERF) were obtained from the Clean Energy Regulator Australia in 2019.[724] In July 2019, Australia has extended the ERF with an additional AUD$ 2.5 billion for 2020–2021. Historically the bulk of this has gone to natural climate solutions/nature-based solutions.
4. Payments for REDD+. The lower U$0.037 estimate was obtained from Hamrick and Gallant and then converted to 2019 US$.[725] The upper estimate includes this lower estimate of US$ 0.037 billion but in addition includes REDD+ initiatives from 15 countries, as reported by the Global Climate Fund in 2019. Cumulatively these countries expect to reduce emissions by 490 $MtCO_2e$ between 2013 and 2018, resulting in total payments of US$ 2.45 billion.[726] This value has been divided by five to obtain the annual spend on REDD+ programs resulting in US$ 0.490 billion. This results in US$ 0.497 billion converted to 2019 US$.

PP3: Green Financial Products—Green Debt

Lower estimate: US$ 1.6 billion/year
Upper estimate: US$ 3.3 billion/year

The estimates for green financial products—green debt aggregates financial flows estimates of green bonds, green loans, sustainability linked loans, landscape loan facilities, and environmental impact bonds.

For green bonds, the total market size was obtained from Bloomberg NEF; Climate Bonds Initiative (CBI); and Linklaters.[727, 728] Based on experts' opinions from Bloomberg NEF and the Climate Bonds Initiative, we estimated that between 0.5 % (US$ 1.4 billion lower estimate) and 1 % (US$ 2.7 billion upper estimate) of the US$ 271 billion green bonds markets were used to finance biodiversity-related conservation measures. In addition, Climate Bonds Initiative experts screened the CBI labelled green bonds data to identify green bonds transactions in 2019, which included biodiversity conservation as a primary or secondary investment objective.

For green loans, the total market size was obtained from Bloomberg NEF; Climate Bonds Initiative; and Linklaters. Based on experts'

opinions from Bloomberg and the Climate Bonds Initiative, we estimated that between 0.3 % (US$ 0.3 billion lower estimate) and 0.5 % (US$ 0.4 billion upper estimate) of the US$ 89.6 billion labelled green loans were used to finance biodiversity-related conservation measures.

For sustainability linked loans, the total market size was obtained from Bloomberg NEF; Climate Bonds Initiative; and Linklaters. Based on expert opinions from Bloomberg and the Climate Bonds Initiative, we estimated that between 0.03 % (US$ 0.04 billion lower limit) and 0.05 % (US$ 0.06 billion upper limit) of the US$ 121.5 billion of sustainability linked loans were used to finance biodiversity-related conservation measures.

Landscape loan facilities make up a separate category within green debt. US$ 0.12 billion in 2019 was issued by the Tropical Landscapes Finance Facility (TLFF). However, it is acknowledged that not all of this will have been used directly to support biodiversity and as such the UNDP BIOFIN standard attribution of indirect investments toward biodiversity has been used. For the lower estimate, a Medium attribution (50 %) has been assumed; this is used for initiatives such as organic agriculture support and watershed management. The upper estimate uses the high attribution (75 %) rate, which corresponds to initiatives such as biodiversity-related education, private conservation measures, and PES schemes. This gives a range of US$ 0.06–0.09 billion per year.

Finally, environmental impact bonds are included in the category of green debt. In 2019 there was US$ 0.6 billion of issuances using this mechanism. These were US$ 0.014 billion for the City of Atlanta Department of Watershed Management (DWM), US$ 0.0062 billion for the Baltimore Environmental Impact Bond, two Blue Forest Conservation Bonds of US$ 0.006 and US$ 0.008 billion, US$ 0.0547 billion for the NIB Environmental Bond, and US$ 0.030 billion for the Buffalo Environmental Impact Bond. Data for the latter has been obtained from Quantified Ventures who are market leaders in environmental impact bonds market. However, it is acknowledged that not all of this will have been used directly to support biodiversity, and as such the UNDP BIOFIN standard attribution of indirect investments toward biodiversity has been used. For the lower estimate, a Low attribution (5 %) has been assumed; this is used for initiatives such as improved irrigation systems, reduction of fertilizer use, and sustainable forestry. The upper estimate uses the Medium low attribution (25 %), which corresponds to initiatives such as sustainable wetland use, sustainable fisheries, and ecosystem-based adaptation. This gives a range of US$ 0.03–0.015 billion per year from this category

Note of caution: According to the Convention on Biological Diversity (CBD) website, biodiversity conservation received 4 % of green bond proceeds and sustainable land use 2 % . However, it is believed that this is an overestimate of the use of proceeds to finance biodiversity-related conservation measures. The CBI estimates that about 4 % of the labelled green bonds in 2018 (US$ 167.3 billion) have been issued to finance projects related to sustainable land use. From 2012–2018 only US$ 4–5 billion of labelled green bonds have been issued to finance projects related to sustainable land use, with biodiversity conservation measures representing potentially an even smaller amount. Without detailed analysis of each bond issuance and use of proceeds it is not possible to come up with a robust estimate for the capital flowing to biodiversity outcomes from these instruments; however, this is acknowledged and a rough estimate in the face of such uncertainty is presented.

PP4: Biodiversity Offsets

Lower estimate: US$ 6.3 billion/year
Upper estimate: US$ 9.2 billion/year

We conducted an in-depth literature review and found limited expenditure data for biodiversity

offsets implemented to meet national policy requirements, and little to no data for offsets implemented to meet financial performance standards or voluntary corporate targets. Indeed biodiversity offset implementations were only documented for 22 offsets carried out to meet financial performance standards, and 20 voluntary corporate offsets, over the past 10 years, which suggests financial performance standards and voluntary efforts are resulting in few offsets each year. We were, however, unable to identify sufficient empirical data to include even these projects in our annual estimate of offset expenditures.

There are currently 42 countries with established biodiversity offsets national policy requirements. However, 33 countries with offset policy requirements had little to no implementation activity.[729] We then focused on biodiversity offset expenditure data for five countries: Australia, Brazil, Germany, Mexico, and the United States (Table A.1.4). Germany and the United States account for the overwhelming majority of the annual biodiversity offset expenditures. Estimates were not readily available for the offset programs in Canada, France, the Netherlands, or Spain. As a result, our estimate only reflects biodiversity offsets implemented to meet national policy requirements, does not attempt to extrapolate to cover all offset spending, and therefore likely represents an underestimate.

The table below provides expanded information on offsets implemented to meet policy requirements. It includes offset expenditure data identified for five countries: Australia, Brazil, Germany, Mexico, and the United States.

Australia: Australia has a national-level offset policy, the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999, and several subnational offset programs (IUCN, 2019). Data were only readily available, however, for the BioBanking program of New South Wales. The program reported A$ 19.2 million (US$ 13 million) deposited into its biobanking fund over a 2-year period from 2015–2017, for an average deposit of A$ 9.6 million/year (US$ 6.5 million/year). Total funds held in the BioBanking Trust Fund were A$ 61 million in 2017.[730]

Brazil: Brazil has three environmental compensation programs that were authorized by three corresponding statutes: The National Protected Areas System law (Federal Law 9985/2000, SNUC Law); the Forest Code (Law 12651 of 2012); and the Atlantic Rainforest Law 11.428/2006 (IUCN, 2019). While anecdotal information suggests that the SNUC program had generated more than US$ 200 million by 2014, no additional information was readily available.[731] Information on offsets related to the Forest Code Law were also not readily available. Funbio, which manages several biodiversity conservation programs including the

TABLE A 1.4 Overview of Current Public (P) Funding to Biodiversity Conservation

Country and year of estimate	Estimated annual offset expenditures (US$/year million, unadjusted for inflation)	Estimated annual offset expenditures (US$/year billion, converted to 2019$)
Australia (2017)	$6.5 million	0.007 billion
Brazil (2016)	$4.0 million	0.004 billion
Germany (2010)	EUR 1,100–3,400 million ($1,228–$3,794 million)	1.4 billion–4.4 billion
Mexico (2011)	$61 million	0.08 billion
United States (2007)	$3,822 million	4.8 billion
Total	**US$ 5.2–7.8 billion**	**US$ 6.3–9.2 billion**

Atlantic Forest Fund, reported that over a 7-year period (2009–2016), the program had led to the collection of R$ 114 million (equivalent to US$ 28.2 million) for an average of US$ 4.0 million/year.[732] Not all of Brazil's offset programs have been successful at disbursing funds. Funbio reports that approximately R$ 260 million in federal compensation funds earmarked for the Amazon remain unused.

Germany: Offset expenditures in Germany are not well known, but a European Commission study estimated that the total cost of offsets per year is approximately US$ 2.5 billion, based on an extrapolation from data from 1992–2010 for the state of Hesse.[733]

Mexico: Article 118 of the General Law on Sustainable Forestry mandates offsets for land-use change of forest areas (IUCN, 2019). The National Forestry Commission (CONAFOR) administers the national offset program. CONAFOR reported that over an 8-year period (2003–2011), it allocated US$ 489 million (average of US$ 61 million/year) under its payment for ecosystem services program, conserving 3.2 million hectares and benefiting 5,967 ejidos, communities, and smallholders in the country.[734]

United States: A 2007 study by the Environmental Law Institute (ELI) estimated that the annualized cost of compensatory mitigation conducted under five federal programs is approximately US$ 3.8 billion.[735] This figure included an estimated US$ 2.9 billion a year for the entire wetland and stream compensation program through all compensation mechanisms (banks, in-lieu fee mitigation, and permittee-responsible mitigation). A 2017 study by Forest Trends estimated that the average value of credit transactions through the wetland and stream market, excluding permittee-responsible mitigation, was US$ 3.55 billion a year.[736] Note that a 2017 study found that approximately 23 % of all wetland and stream permits issued in that year met their offset requirements through permittee responsible mitigation, which was not captured in the estimate.[737] Forest Trends also estimated that the value of credit transactions in the species program through conservation banks only was US$ 354 million.[738] Forest Trends' estimate, therefore, for the average annual credit transactions in 2016 under these two programs was US$ 3.9 billion. If permittee-responsible mitigation costs are assumed to be similar to other wetland and stream mitigation, this would add US$ 816 million (23 % * US$ 3.55 billion) to the estimate for a total of about US$ 4.7 billion. This is consistent with the inflation-adjusted ELI estimate of US$ 4.7 billion.

PP5: Philanthropy/Foundations and Conservation NGOs

Lower estimate: US$ 1.7 billion/year
Upper estimate: US$ 3.5 billion/year

The estimates for this category are built using four sources:

Philanthropy. Based on the average 2017 OECD Creditor Reporting System (CRS)[739] data of 26 philanthropic foundations. Of these, 14 foundations were found to support biodiversity-related activities. It is important to note that figures on philanthropic funding may change significantly from one year to the next. However, as far fewer foundations reported data to the CRS in previous years, taking the average across years would lead to an underestimation of philanthropic funding. Therefore, this analysis presents data for 2017 only. CRS data were analyzed by the OECD Development Assistance Committee (DAC) using the Rio marker methodology and screening the ODA commitments objectives. Adjusted for US$ 2019 prices the estimated range is US$ 1.20–2.30 billion per year. The lower estimate consists of commitments tagged as "principal" to biodiversity within the dataset whereas the upper estimate uses commitments tagged with both "principal" and "significant."

Conservation NGOs. The estimates for this source cover five of the world's largest

biodiversity conservation NGOs, which each receive significant corporate and individual (e.g., members and donors) contributions: Conservation International, Royal Society for the Protection of Birds, The Nature Conservancy, the Wildlife Conservation Society, and the World Wide Fund for Nature. Revenues from the public sector and philanthropic foundations were subtracted from the lower limit estimate to avoid double counting (Conservation International and Affiliates, 2017; RSPB, 2017; The Nature Conservancy, 2017; WCS, 2017; WWF International, 2017). Adjusted for US$ 2019 prices the estimated range is US$ 0.222–0.380 billion per year.

Private finance mobilized by Development Assistance Committee (DAC) countries' official development finance interventions. This source covers private finance mobilized by activities of DAC countries' development finance institutions, development banks, and other agencies working on development (i.e., bilateral flows). The lower limit only counts projects where biodiversity is the principal objective. Although existing coverage of the dataset is small, it is improving. Adjusted for US$ 2019 prices the range estimated for this source is US$ 0.200–0.510 billion per year.[740]

Private finance leveraged by the Global Environment Facility (GEF). This source covers co-finance leveraged by GEF from for-profits and beneficiaries (communities and individuals). Co-financing from civil society organizations and philanthropies is not included due to the potential overlap with other datasets. The lower limit only captures biodiversity-focal area projects. The upper limit also includes multi-focal area projects with a biodiversity component. Adjusted for US$ 2019 prices the range estimated for this source is US$ 0.041–0.155 billion per year.

Private Funding

At the other end of the spectrum from wholly public sector–driven funding are private sector–driven investments. Those of relevance for biodiversity conservation are listed below.

TABLE A 1.5 Overview of Current Private (PR) Funding to Biodiversity Conservation

Ref #	Mechanism	Lower estimate [2019 US$ bn/yr]	Upper estimate [2019 US$ bn/yr]
PR1	Sustainable supply chains	5.5	8.2
PR2	Green financial products—Private equity impact investing	2.3	3.0
Total		**7.7**	**11.2**

PR1: Sustainable Supply Chains

Lower estimate: US$ 5.5 billion/year
Upper estimate: US$ 8.2 billion/year

Global sustainable supply chains have been disaggregated into four subsectors of sustainable commodities markets: (1) sustainable forestry products, (2) sustainable agricultural products, (3) sustainable fisheries and seafood products, and (4) sustainable palm oil. For all of these commodities there is an assumption that 1–1.5 % of the sustainable market is reinvested into biodiversity conservation initiatives in that sector. The lower estimate assumption of 1 % is based on the forestry sector reinvestment in biodiversity conservation initiatives, which has more data and is further explained below, whereby it is assumed sustainable supply chain investments in this commodity sector are representative of other sectors. The upper estimate assumption 1.5 % is used as a reasonable assumption above the lower estimate to account for heterogeneity in biodiversity investment across the sectors.

For the sustainable forestry products, the OECD provides a figure for sustainable investments that covers FSC and PEFC markets as US$ 2.3–2.8 billion per year in 2016.[741] The range of the market size for this commodity was calculated by focusing on the two largest forest certifications schemes that have explicit objectives on biodiversity, namely the Programme for the Endorsement of Forest Certification (PEFC)

and the Forest Stewardship Council (FSC). The Breukink et al. survey of FSC-certified operators puts annual post-certification costs for FSC at US$ 3.33–4.07 per cubic meter of roundwood.[742] Specific data on the costs of PEFC certification were not found; however, for the purpose of this analysis it has been assumed that they are similar to FSC. The volume of FSC and PEFC certified wood in 2016 was 689 million cubic meters.[743] In 2019 US$, the market size is US$ 248.4–305.6 billion per year. Using this market size and the investment gives an allocation of roughly 1 % of market size to biodiversity.

For the sustainable agricultural products, it is assumed that 1 % (US$ 1.9 billion lower estimate) and 1.5 % (US$ 2.9 billion upper estimate) of the US$ 190 billion sustainable commodities were used to finance biodiversity-related conservation measures. The US$ 190 billion market value is obtained from UNDP BIOFIN.[744]

For sustainable palm oil it is assumed that 1 % (US$ 0.163 billion lower estimate) and 1.5 % (US$ 0.245 billion upper estimate) of the US$ 163 billion sustainable palm oil market were used to finance biodiversity-related conservation measures. The US$ 16.3 billion market value is obtained from a summary of the 2019 Market Study Report on the Global Sustainable Palm oil market.[745]

For the sustainable fisheries products, it is assumed that 1 % (US$ 1.1 billion lower estimate) and 1.5 % (US$ 1.6 billion upper estimate) of the US$ 102.25 billion value of the sustainable certified seafood market was used to finance biodiversity-related conservation measures.[746] To generate these values, we estimated the size of the total global sustainable seafood market. The first sale value of fisheries and aquaculture in 2018 has been estimated by FAO at US$ 401 billion/annually; this is a conservative value as it does not include value added along the supply chain nor any mark-ups involved in the sale of an end-product. Of this market we assume that 25 % is estimated to qualify as "sustainable seafood" production.[747]

PR2: Green Financial Products—Private Equity Impact Investing

Lower estimate: US$ 2.3 billion/year
Upper estimate: US$ 3.0 billion/year

For the lower limit estimate, an annual average growth rate in investment from 2004–2015 has been calculated as 16.60 % per year based on the 2016 State of Private Investment in Conservation (SOPIC) report (see table A.1.6). This growth rate is then used to calculate the 2019 investments by applying it to the US$ 2.0 billion conservation investment figure in 2015 and adjusting it to 2019 US$ inflation rates, resulting in US$ 4.03 billion.

TABLE A 1.6 State for Private Investment in Conservation, 2004–2016 [748]

Year	Annual investment		% Growth
2004	$	0.2	
2005	$	0.3	33.33 %
2006	$	0.3	0.00 %
2007	$	0.4	25.00 %
2008	$	0.4	0.00 %
2009	$	0.8	50.00 %
2010	$	0.8	0.00 %
2011	$	0.9	11.11 %
2012	$	0.9	0.00 %
2013	$	0.9	0.00 %
2014	$	1.1	18.18 %
2015	$	2.0	45.00 %
Average annual growth			16.60%

Acknowledging that the SOPIC survey respondents include funding flows from philanthropic donors, to limit the analysis to private equity investors, the ratio of respondents who were private investors (56 %) was used to calculate the effective financial flows from private equity, resulting in US$ 2.3 billion in 2019.

TABLE A 1.7 Private Equity Impact Investing: Assets Under Management (AUM) and Capital Invested[750]

Capital Invested / AUM	Survey Year	AUM	Capital invested	% AUM Growth	Annually Invested % Growth
19.68 %	2015	$ 77,400,000	$ 15,231,000	32 %	31 %
19.42 %	2016	$ 114,000,000	$ 22,142,000	50 %	38 %
15.57 %	2017	$ 228,100,000	$ 35,526,000	5 %	-2 %
14.64 %	2018	$ 239,000,000	$ 35,000,000	41 %	25 %
11.60 %	2019	$ 404,000,000	$ 46,875,000		
Average of Capital Invested / AUM: 16.18%					Annual Average of Capital Invested / AUM : 23%

For the upper estimate the GIIN impact investing 2020[749] survey gives total Assets Under Management (AUM) as well as information on the allocation of those assets across sectors. The total Impact Investing AUM in 2019 was US$ 404 billion.

The AUM for sectors related to biodiversity conservation were added together. These sectors are Food & Agriculture and Water Sanitation & Hygiene and Forestry. The total AUM for these sectors was US$ 76.76 billion. From the same GIIN report, the amount of capital invested in each year is provided from 2015–2019 as well as the total AUM for that year. Therefore, it is possible to calculate a percentage of AUM that is invested per year. The average capital invested in relation to the AUM from 2015–2019 was 16.18 % (see table A.1.7). This percentage was then applied to the US$ 76.76 billion across the sectors of interest resulting in an annual capital investment of US$ 12.42 billion. Finally, the GIIN report provides a breakdown of capital invested by mechanism. To avoid double counting with public and private debt, which is covered in the green debt calculation, only investments via equity and other mechanisms have been counted. For the lower estimate the allocation of capital through private equity (11 %), public equity (2 %), real assets (2 %), and equity like debt (2 %), and other (4 %) were used. The sum of assets allocated through these mechanisms (21 %) was then applied to the annual capital investment of US$ 12.42 billion, calculated in the previous step, resulting in a lower estimate of US$ 2.60 billion per year.

Acknowledging that the GIIN survey is not exhaustive, it was necessary to add in impact asset funds that were not included in the GIIN survey but are relevant for biodiversity conservation. Based on 2019 Impact Assets data with focus on Natural Resources & Conservation from the Impact Assets portal[751] it is assumed that all of the annual capital is invested in biodiversity-related conservation measures, equivalent to the 16.18 % of the AUM for the subsequent funds: Althelia Funds of Mirova Natural Capital Limited invested (US$ 0.499 billion), Lyme Timber Company invested (US$ 1.0 billion), Encourage Capital (US$ 0.499 billion), EcoEnterprises Fund (US$ 0.499 billion), and Ecosystems Integrity Fund (US$ 0.499 billion), all adding up to US$ 0.04 billion. However, for some funds only a portion of their annual spend is invested in biodiversity conservation. In line with the GIIN data on forestry sector assets under management it is assumed that the 5 % of the annual spend is allocated to forestry across the following funds: Altante Capital, Aqua-Spark, DBL Partners, EFM, Finance in Motion, Fledge, Full Cycle, Iroquois Valley Farmland REIT, and Kairos Investment Management Company, all adding up to US$0.002 billion. Summing the Impact Assets values with GIIN survey results in US$ 3.01 billion per year.

Appendix A.2. Methodology Appendix for Biodiversity Conservation Funding Needs (Chapter 4)

TABLE A 2.1 Overview of Biodiversity Conservation Funding Needs

Ref #	Biodiversity Conservation Funding Needs	Lower estimate—Amount [2019 US$ bn/yr]	Upper estimate—Amount [2019 US$ bn/yr]
	Protected Areas		
FN1	Global Protected Areas (30 % of all terrestrial and marine ecosystems)	149.0	192.2
	Managing the Middle		
FN2	Agriculture—Croplands	314.9	419.8
FN3	Agriculture—Rangelands	81.1	81.1
FN4	Forests	18.9	31.5
FN5	Fisheries	23.0	47.4
FN6	Coastal ecosystems	26.6	37.3
FN7	Invasive species management	36.0	84.3
	Urban Environments		
FN8	Urban environments biodiversity and water quality protection	72.6	73.2
Total		**722.1**	**966.9**

FN1: 30% of Protected Areas by 2030

Lower estimate: US$ 149.0 billion/year
Upper estimate: US$ 192.2 billion/year

The proposed global target for increasing both terrestrial and marine protected areas is to reach 30 % by 2030, consistent with proposals by the Campaign for Nature, The Nature Conservancy, and other organizations, and in anticipation the new set of biodiversity targets to be negotiated at the CBD COP15. Expanding on the cost estimates to manage existing protected areas (US$ 67.6 billion per year in 2015 US$), Waldron et al. have estimated the additional annual costs to expand protected areas under six scenarios, all of which achieve the 30 % protected areas target.[752] The additional costs incorporate acquisition, management, and establishment costs. Two of the scenarios are production focused, three are biodiversity focused, and one is a biodiversity/production compromise. Given that this report is focused on achieving global biodiversity protection and conservation, the two production focused scenarios are discounted. One of the biodiversity focused scenarios (Global Deal for Nature) aims to reach 50 % protected areas, making its associated cost estimate beyond the scope of this report, and it is therefore discounted. This leaves three scenarios, Biodiversity/Production Compromise (BPC), Save Species from Extinction (SSE), and Biodiversity/Wilderness Consensus (BIWI). The lower estimate is obtained from BPC as it allows for a compromise between productive landscapes and biodiversity conservation, which aligns with the concept of a "managed middle" used in this

report. BIWI is obtained as the upper estimate in preference to SSE because it focuses on delivering biodiversity conservation in areas that ensure the integrity and viability of ecosystems, whereas SSE has a narrower focus on protecting areas that primarily save species from extinction. Inflating the costs for BPC and BIWI into 2019 US$ leads to an estimated range of US$ 149–192 billion per year.

FN2: Agriculture—Croplands

Lower estimate: US$ 314.9 billion/year
Upper estimate: US$ 420.8 billion/year

Agriculture production is the largest direct habitat impact globally. To balance food production systems with biodiversity conservation, a large-scale shift to sustainable agriculture practices is envisaged. To generate a global cost to transition to sustainable agriculture practices globally, agricultural lands are divided into two overarching categories: croplands and rangelands. Transition costs for these are estimated separately.[753]

Sustainable agriculture is characterized as following "conservation agriculture" (CA) practices.[754] These practices involve three principles of minimum soil disturbance, cover crops, and diversity of crops. The time horizon for the transition to sustainable agricultural practices is defined such that CA practices will have been implemented on 100 % of global cropland by 2050.[755] To estimate the global financial needs to meet this transition to CA practices globally on croplands, the following set of assumptions is used:

1. Transitioning to conservation agricultural practices represents the best balance between productive landscapes providing food for the future as well as protecting and incorporating biodiversity conservation into sustainable agricultural practices. In this regard, the transition to CA practices for firms is viewed as all or none. Thus, it is assumed that all costs attributed to transitioning to CA practices are attributable to maintaining a balance between biodiversity conservation and continued food production, notwithstanding that funding to support agriculture includes activities that may both impact and benefit biodiversity.
2. Capital is malleable and therefore land and agricultural equipment such as machinery can be repurposed under CA practices within the income support provided. Furthermore, farms are assumed as still profitable after a transition to CA practices. Therefore, we hold that the costs associated with converting to CA are dominated by income support during the transition period.
3. The transition period to CA practices is to range between 3 and 4 years, and that income support is required throughout this period.
4. The total global area under agricultural production is held constant out to the time horizon of 2050.
5. Costs for institutional changes, increasing awareness and capacity via extension, and research and development are not directly included in our estimate, although it is acknowledged that these activities are important for supporting a transition to CA practices.[756]

Our approach to estimating a global CA transition cost is to first estimate the current agricultural area in need of transition. Subsequently, regional gross agricultural production value per ha is calculated as a proxy for farmer income per area.[757] Finally, transition costs are calculated as allocated equally over a time horizon to achieve CA practices on 100 % of agricultural lands by 2050. Estimates of global area of agricultural croplands and percentages of croplands under sustainable agriculture practices were obtained from Kassam et al. (2018).[758] For each reporting region, the total area in need of transition to CA practices is amortized equally across years to reach complete conversion by

2050, providing an annual area increment of cropland for which transition costs are estimated. It is then assumed that the cost of transitioning to CA is to provide income support that equals the production value of the annual incrementally transitioned cropland in one year, which is costed for a transition period of either three or four years (to provide a range in estimates).[760] Cropland production value per ha per year was generated using FAOSTAT information on gross agricultural production, using the most recent values available at the time of this writing (2016 values).[761] Production values were summarized at the FAO region level, with the exception of Russian and Ukraine for which country-level data were utilized. Regional (or country) specific annual production value per ha was calculated. Applying regional (or country) specific annual production values to the annual incremental, the total gross production for 2016 was divided by the total hectares under cropland in each region leading to US$/ha valuations that are region specific, and are subsequently converted to 2019 USD equivalents (using 1 US$ 2016 = 1.07 US$ 2019).

TABLE A 2.2. Annual Land Valuation by Region

Country / region	US$/Ha/yr
Africa	$ 1,690.40
Asia	$ 6,644.53
Australia & NZ	$ 910.44
Europe	$ 6,734.02
North America	$ 1,632.00
South America	$ 2,516.41
Russia & Ukraine	$ 616.22

Author's creation based on data from FAOSTAT, 2019

This was then multiplied by the annual amount of land to be converted to CA and summed across all regions to give US$ 104.9 billion for one year of price support. Transition costs for each global annual increment of area to be converted to CA practices were applied over a moving window to calculate transition costs, using either a three- or four-year transition period to CA practices in generating a low–high range in estimated costs. This leads to the figures of US$ 314.9 billion for three-year transition and US$ 419.8 billion for four-year transition.

FN3: Agriculture—Rangelands

Estimate: US$ 81.1 billion/year

Of the estimated 25 % of Earth's terrestrial surface currently in rangeland,[762] 10–20 % is classified as degraded.[763] Sustainable rangeland practices include preventative measures to mitigate habitat degradation such as strategic grazing siting and rotation practices, as well as restorative measures, such as terraforming to capture runoff or revegetation efforts.[764] Estimates of costs to implement sustainable rangeland management practices that mitigate ecosystem degradation while still supporting livestock production range between US$ 73 and US$ 554 /Ha annually (estimates adjusted to US$ 2019),[765] with an average cost of US$ 329/year/Ha. It is assumed that costs to transition to sustainable rangeland practices are incurred as upfront restorative investments over the initial two years, whereby longer-term sustainable grazing siting and rotation practices are maintained but without significant net increase in costs,[766] using a 2050 time horizon to transition all rangeland, degraded and otherwise, to sustainable grazing practices, amortizing equally across years to generate an annual incremental area of degraded area to be transitioned.[767] It is assumed that the transition to sustainable rangeland practices requires two years, over which per ha transition costs are incurred.[768] As with croplands, a moving window of transition costs is applied to the annual incremental area of degraded lands to be transitioned to sustainable practices.[769] It is assumed that all rangeland should be put under sustainable rangeland management practices[770] by 2050 and use the average reported cost per

ha for sustainable rangeland[771] management to generate an estimate in plausible financial needs to support a transition to sustainable practices on degraded rangeland globally, resulting in an estimate of US$ 81.1 billion per year.

FN4: Forests

Lower estimate: US$ 18.9 billion/year
Upper estimate: US$ 31.5 billion/year

Forests provide valuable ecosystem services ranging from fiber production, habitat supporting species biodiversity, soil stabilization, and carbon capture, among other benefits. We assume that sustainable forestry practices maintain these ecosystem services in perpetuity, and thereby must implement forest management practices that balance harvest and planting practices with soil health, water management, and biodiversity protection to maintain ecosystem integrity.[772] Thus, we view sustainable forest management practices as providing the best balance between maintaining forest products production with ecosystem integrity supporting biodiversity conservation. To generate the annual cost of sustainable forest management, we first calculated the global forest area using World Bank data at the country level. Subsequently, we discounted this global forest area estimate by 30 % to reflect that under the 30 x 30 global protected area goal (FN protected areas, above), approximately 30 % of forest areas would be captured under conservation protection. Under our conceptual model of the "working middle," we used the recent 2020 estimate from the FAO Forest Resource Assessment[773] that gives 1,150m Ha of forests classed as primary production forests and an additional 749m Ha as productive for multiple uses. Of this working landscape forested area, the UNECE and FAO estimate 11 % (438.54m Ha) is currently managed under sustainable forestry practices.[774]

The 2015 forest resource assessment from FAO shows that there has been a negligible (-0.06 %) drop in production forest area from 2000–2015,[775] and the 2020 forest resources assessment states that "Worldwide, the area of forest designated primarily for production has been relatively stable since 1990." Therefore, it is assumed that global forest production area is held constant to 2030. Recurring annual costs of sustainable forest management have been estimated at US$ 13/Ha and US$ 21.6/Ha of recurrent annual costs (as reported in Köthke and adjusted to 2019 US$). Using this range in values applied to the estimate of forested working landscapes not currently under sustainable management practices, we generated a low-high-low estimate of annual global sustainable forestry management costs of US$ 18.9–31.5 billion as a future biodiversity conservation financial need.

FN5: Fisheries

Lower estimate: US$ 23.0 billion/year
Upper estimate: US$ 47.4 billion/year

Sustainable fisheries management utilizes science-based fishery resource management to achieve long-term harvest production that preserves the integrity of marine ecosystems and leads to economically efficient fisheries. Sustainable fisheries management is characterized by precautionary harvest that recognizes ecosystem-level impacts of fishing and protects long-term natural capital, enforcement of fisheries management practices, and secure fishing rights (i.e., dedicated access privileges) for fishers that align economic and ecosystem conservation incentives. To estimate a global annual need for sustainable fisheries management, thereby balancing food production with biodiversity conservation, we utilized estimates for global sustainable fisheries management costs from Mangin et al.[776]

These authors present annual sustainable management costs from a database encompassing 72.4 % of global fishery catches. We report numbers from Mangin et al. as expanded to represent 100 % of global catches

(i.e., expanded cost = estimated cost/0.724), and utilize their costs estimated for catch control-based management (i.e., a potentially lower-cost sustainable management approach, which lacks explicit inclusion of dedicated access privileges) as a lower limit and their "extreme cost" scenario (which includes dedicated access privilege-based management, generally agreed on as a "gold standard" for fisheries management) as an upper limit on global annual sustainable fisheries management resource needs. Mangin et al. report management costs in US$ 2012, which we inflate to US$ 2019 equivalents in reporting global fisheries biodiversity conservation financial needs (1 US$ 2012 = 1.11 US$ 2019), producing a global annual cost for sustainable fisheries management ranging from US$ 23.0–47.4 billion per year.

FN6: Coastal Resilience

Lower estimate: US$ 26.6 billion/year
Upper estimate: US$ 37.3 billion/year

Critical coastal ecosystems including plant-dominated systems of mangroves, seagrasses, and marshlands provide substantial habitat for biodiversity and provide flows of a number of key ecosystem services including disaster risk reduction, protection from coastal erosion, greenhouse gas sequestration, pollution removal, and livelihood security to coastal cities. Below, we assess the financial needs to restore mangrove, saltmarsh, and seagrass coastal ecosystems globally. Our approach is to estimate a baseline restoration area target, estimate a per unit area restoration cost, and then estimate total annual costs amortized to achieve restoration to target baseline by a time horizon of 2050.

Animal-dominated oyster and coral reef systems also provide vital ecosystem services supporting high biodiversity and coastal resilience. For example, oyster reefs filter pollutants from massive volumes of water, and coral reefs harbor global marine biodiversity hotspots. Both systems also produce hard structure that dissipates storm and wave energy. Estimates of global oyster reef loss are up to 85 % (Beck et al. 2011), and recent die offs of corals globally, including the Great Barrier Reef, belie a worrying trend of rapid degradation of these systems. As with plant-dominated coastal ecosystems, reductions in coastal runoff and city-borne pollution, and long-term climate warming mitigation, will be important for conserving and restoring these systems. However, whereas for the plant-based critical coastal ecosystems, restoration activities can be effective with direct and large-scale plantings, animal-based reef systems are more complex and direct restoration efforts have proved difficult. Presently, coral reef restoration methods that can scale have not yet been proven and can be of high cost (e.g., genetic manipulation of out plantings). Thus, lacking viable restoration options, we did not include an estimate of direct coral reef restoration costs; however, we stress the importance of continued research and development to advance coral reef restoration tools. Similarly, oyster reef restoration has had mixed success, particularly when runoff and pollution stressors persist. For example, 50 years of oyster reef restoration efforts, most of which focus on out planting hard structure, along the US east coastline have resulted in a modest estimated 4.5 % recoup of lost reef area.[777] Thus, as with coral reefs, we emphasize both the importance of addressing wide-scale environmental stressors as well as continued research and development efforts to improve restoration tools for oyster reef systems globally; however, we do not attempt a direct financial needs estimate for direct reef restoration.

Mangroves

Global records for mangrove distribution are not available prior to 1980. While there is debate about the level of mangrove degradation prior to 1980, evidence suggests consistent loss of mangroves over the past 40 years.[778] Recent analyses estimate annual proportional loss in global mangrove cover of 0.26 % to 0.66 %

per year. Using values for current mangrove distribution generated from remote sensing data (73,624 km^2 to 152,607 km^2; year 2000 values reported in Casey and Hamilton and Casey, 2016, and decayed to 2019 values using 0.26 % or 0.66 % annual loss rate) and the range in annual loss rates (0.26 % /yr. to 0.66 % /yr.) we reconstructed a range of potential mangrove global distribution areas for 1980 as a restoration target baseline. Subsequently, we coupled the restoration area targets with per unit area estimates of mangrove restoration. Bayraktarov et al. (2016)[779] provide estimates of mangrove restoration costs per unit area.[780] Utilizing their median reported value of restoration costs per ha (as adjusted to US$ 2019 = US$ 10,484/ha) combined with the range in global restoration targets, we estimate a range in the total global financial cost for mangrove restoration to the 1980 baseline amortized equally on an annual basis to 2050 at US$ 0.3–1.6 billion per year.

Seagrasses

Global contemporary and historical estimates of seagrass distribution are available, with the most recent values generated in 2009 at 177,000 km^2 and representing an estimated 51,000 km^2 of seagrass beds lost since a historical baseline value of 1879.[781] Since 2009 there has been estimated continued loss of 110 km^2 per year resulting in an additional 1,1001100 km^2 lost between 2009 and 2019. Therefore, based on a historical baseline of 1879 we estimate the total area of seagrass to be restored is 52,100 km^2 or 173,667 ha per year to achieve global restoration by 2050. The per unit area cost of seagrass bed restoration has been estimated at US$ 124,934 per ha (median restoration cost value as reported in Bayraktarov et al. and adjusted to 2019 US$).[782] Combining restoration costs with the target restoration area and amortizing total restoration costs over the 2050 time horizon, we estimate an annual cost of restoring seagrass beds of US$ 21.7 billion annually.

Saltmarshes

Global current coverage of saltmarshes has been estimated at 5,495,089 ha, which represents a 25–50 % loss of saltmarsh areas relative to the historical baseline coverage.[783] Taking a range in historical baseline distribution of saltmarshes globally of 7,326,785 ha to 10,990,178 ha as a baseline saltmarsh distribution we estimate the area to restore saltmarshes globally to historic distributions range between 1,831,696 ha to 5,495,089 ha. The per unit area costs of saltmarsh restoration have been estimated at US$ 78,540/ha (median restoration cost value as reported in Bayraktarov et al. and adjusted to US$ 2019).[784] Combining this cost with the range in restoration targets into a total financial need for saltmarsh restoration and amortizing equally annually over a 2050 horizon, we estimate saltmarsh restoration costs to range between US$ 4.8–14.4 billion annually.

FN7: Invasive Species Management

Lower estimate: US$ 36.0 billion/year
Upper estimate: US$ 84.3 billion/year

Invasive species represent a critical global threat to biodiversity. Effective invasive species management requires resources for proactive efforts to prevent introduction of species, monitoring to detect species introductions as well as assess the state of extant introductions, control efforts to contain or eradicate invasions, and mitigation efforts to restore damaged systems.[785] The report to the Convention on Biological Diversity high-level panel on global assessment of resources for implementing the strategic plan for biodiversity 2011–2020 provides an assessment of global costs for invasive species management.[786] The authors include both upfront costs of management (e.g., monitoring infrastructure) as well as recurring annual management costs. Empirical analyses have demonstrated that shipping for trade represents the dominant transport vector of invasive species globally.[787]

To project annual global invasive species management costs to protect biodiversity moving forward, we assume resource needs for invasive species management costs scale proportionately with projections for growth in international trade. The World Trade Organization estimated a stable 2.5 % annual growth in world trade.[788] Assuming this trend holds into the coming decades, we estimate annual invasive species management to include an incremental addition of 2.5 % of upfront management costs estimated by Turpie et al. and that recurrent annual management costs inflate by 2.5 % per annum (as converted to US$ 2019).[789] Under this model, we assume that previous upfront investment costs estimated by Turpie et al. had already been achieved, such that forward-looking costs include incremental increases in upfront expenditures in addition to converted annual recurrent costs. Trade growth-inflated annual costs are projected over the 2020–2050 period, and the average annual value plus an upper and lower limit based on ranges in management costs estimates presented in Turpie et al. are presented as global annual invasive species management costs, generating an estimated range for global invasive species management costs over a 2050 time horizon of US$ 36.0–84.3 billion per year.

FN8: Urban Environments—Biodiversity in Urban Areas

Lower estimate: US$ 72.6 billion/year
Upper estimate: US$ 72.7 billion/year

While the spatial footprint of urban areas may be small relative to other land uses such as timber or agriculture, the biodiversity impacts of cities extends to surrounding areas through pollution and draw of natural resources for food, water, energy, and materials. We assume the habitat footprint of cities can be accommodated through the biodiversity conservation target of preserving 30 % of the surface of the earth in protected areas. Furthermore, we assume that the biodiversity impacts from the natural resource draw of food and fiber into urban areas are addressed by future biodiversity funding needs related to sustainable agriculture, forestry, and fisheries. Thus as an estimate of the remaining biodiversity conservation funding needs related to urban areas, we assess the costs to protect drinking water through investments into watersheds, achieving dual benefits of biodiversity conservation and providing potable water, and the costs of reducing outgoing waterborne pollution of cities, with the benefits of reducing threats to human health as well as reducing negative impacts of pollution on downstream freshwater and marine ecosystems such as rivers and reefs.

It is recognized that urban areas themselves can be designed with “green principles” in mind to promote green spaces, parks, and natural water treatment features (e.g., bioswales), which combine to promote human well-being. However, we contend that the aggregate biodiversity conservation impact of greening urban spaces, while important, would not scale significantly to contribute to global biodiversity conservation. Finally, we acknowledge the important contribution of urban areas to climate change through significant energy consumption; however, a sustainable energy transition and climate change mitigation is outside the scope of this report.

Biodiversity Protection Near Cities

The expansion of cities into peri-urban areas threatens biodiversity. The Nature in the Urban Century Assessment found that global urban expansion will convert about 290,000 km^2 of natural habitats into urban areas by 2030, and this has the potential to degrade 40 % of strictly Protected Areas (PAs) globally that will be within proximity of urban areas if not managed properly.[790] Conservation measures on 41,000–80,000 km^2 can help to protect Key Biodiversity Areas (KBAs) at risk from urban growth in 30

priority ecoregions and potentially prevent the extinction of 78 % of the at-risk vertebrates.[791]

It is difficult to assess the cost of this protection of natural habitat in the peripheries of cities, especially since most PAs are protected by government purchase rather than direct purchase. In 2003 Balmford et al. reviewed conservation costs for hundreds of projects globally and gave a range of cost of effective conservation in "densely settled regions of Latin and Central America, Africa, and Asia" from US$ 130–5,000/km^2/yr. Converting this into 2019 US$ gives a range of US$ 176–6,794/km^2/yr for effectively conserving biodiversity in urban environments.[792] To protect the amount of land proposed in McDonald et al. using these per unit area costs gives a range of US$ 14.1–544 million/yr.

Urban Water Pollution

Urban areas impact water quality in various ways, with sewage-based pollution a significant threat to human health as well as to downstream freshwater and marine ecosystems. The primary cause of sewage pollution globally is insufficient sanitation services in urban areas. A study by the World Bank estimated the cost of achieving the water supply, sanitation, and hygiene Sustainable Development Goals globally, calculating the costs to achieve basic sanitation standards (i.e., each household having access to a toilet or pit latrine) at $73.3 billion per year, to ensure safe faecal waste management.[793]

Summing costs for habitat protection and costs to provide adequate sewage treatment to reduce a key source of pollution from urbanized areas, we estimate an annual cost of US$ 72.6–73.4 billion per year.

Appendix A.3. Estimated Global Biodiversity Finance by 2030

The methods to estimate the scale of future financing for the biodiversity conservation mechanisms outlined in this report are provided in this appendix. The annual biodiversity finance values shown below are for the year 2030 and are assumed to follow one of two trajectories, low policy ambition growth or high policy ambition growth. The growth in the capital flowing through each mechanism is dependent on the levels of public and private commitment to enacting the specific recommendations described in this report.

Where Compound Annual Growth Rates (CAGR) estimates are available and evidenced by market research, they have been used to estimate the future financing via that mechanism from 2019 to 2030, using the estimates of current on global biodiversity conservation finance as the baseline. The equation used was

$$\text{Lower 2030 Estimate} = \text{Lower 2019 Estimate} * (1+\text{Lower CAGR})^{11}$$

$$\text{Upper 2030 Estimate} = \text{Upper 2019 Estimate} * (1+\text{Lower CAGR})^{11}$$

However, the CAGR method has not been employed for all financing mechanisms. Some mechanisms have 2030 projections that are based on global policy targets set for the relevant funding sources, such as doubling ODA flows or domestic budgets and tax policy by 2030. Subsequently, CAGRs have been calculated to provide a target growth rate assuming a linear trajectory between 2019 and 2030. For estimating the CAGR, the aggregate compounded value over 2019–2030 was computed and then an annual average growth was calculated. Table A.3.1 provides a summary of the 2030 projections, the CAGR, and whether that CAGR has been calculated from a policy target or is based on evidence from market research.

TABLE A 3.1 Overview of Global Biodiversity Conservation Finance in 2030

Ref #	Mechanism	Low ambition—Amount [2030 US$ bn/yr]	High ambition [2030 US$ bn/yr]	Potential growth 2019–2030
FS1	Domestic budgets and tax policy	103.0	155.4	Calculated. 2.97 % to 6.5 %
FS2	Official Development Assistance (ODA)	8.0	19.4	Evidenced. CAGR of 6.5 %
FS3	Natural infrastructure	104.7	138.6	Evidenced. CAGR of 12.2 % to 14.1 %
FS4	Nature-based solutions and carbon markets	24.9	39.9	Mix of evidenced and calculated. CAGR of 37.04 % to 32.6 %
FS5	Green financial products—green debt	18.7	75.6	Calculated. CAGR of 23.53 % to 26.10 %
FS6	Biodiversity offsets	162.0	168.0	See FS6
FS7	Sustainable supply chains	12.3	18.7	Calculated. CAGR of 10.16 % to 11.36 %
FS8	Green financial products—private equity impact investing	12.3	16.9	Evidenced. CAGR of 16.6 % to 17.0 %
Total		**445.8**	**632.4**	

FS1: Domestic Budgets and Tax Policy

Lower estimate: US$ 103.0 billion/year
Upper estimate: US$ 155.4 billion/year

To calculate the lower estimate, we assumed that the existing 2019 proportion of GDP allocated to domestic budgets and tax policy (~0.07 %) remains constant until 2030. The 2030 GDP has been obtained from the OECD long-term forecast portal,[794] resulting in an estimated lower limit of spending of US$ 103.0 billion per year in 2030. This results in an equivalent lower CAGR of 2.97 % that would need to be met each year between 2019 and 2030 to reach this estimate.[795]

To calculate an upper estimate, this report evaluates the global policy target that governments should commit to doubling the domestic budgets and tax policy flows resulting in an equivalent upper CAGR of 6.5 % .

To avoid double counting we assume that biodiversity related positive subsidies and biodiversity related fees and charges are included within this domestic budgets and tax policy estimate. Thus, forward projections for 2030 spending are not carried out as separate exercises for those categories.[795]

FS2: Official Development Assistance (ODA)

Lower estimate: US$ 8.0 billion/year
Upper estimate: US$ 19.4 billion/year

To calculate an upper estimate, this report evaluates the global policy target that governments should commit to doubling ODA by 2030.

To calculate a lower and upper estimate, this report evaluated the global policy target that the Parties to the Convention on Biological Diversity (CBD) agreed to double their biodiversity-related official development assistance (ODA) commitments by 2030.[797, 798]

In 2010, the Parties to the CBD that are biodiversity donors agreed to double their biodiversity-related ODA commitments in 2012 to support the implementation of the Aichi Targets by 2020, and have largely achieved that level of biodiversity-related ODA funding over

the past decade. This report calls for the Parties to "double the doubling" in biodiversity aid by 2030, to help finance the new Global Biodiversity Targets from 2020 to 2030.

For ODA 2030 projections, we utilized a lower and upper estimate of Compound Annual Growth Rates of 6.5 % (US$ 8.0 billion lower limit) and 6.5 % (US$ 19.4 billion upper limit) that would apply for each year for the 10 years from 2019–2030.

FS3: Natural Infrastructure

Lower estimate: US$ 104.7 billion/year
Upper estimate: US$ 138.6 billion/year

We evaluated the CAGR of 14.6 % in natural infrastructure watershed investments, reported by Bennett and Ruef, 2016[799] for the period 2012–2015, considering watersheds investments as a proxy for the broader natural infrastructure sector.[800] For the natural infrastructure projections, we utilized a +/- 10 % margin, on that 14.6 % CAGR to represent possible uncertainty in the natural infrastructure investment annual growth resulting, in lower and upper CAGR estimates of 13.1 % to 16.1 % over the 2019–2030 period. Current watershed investment flows have been driven by continued commitments in China. It has been assumed that any potential decrease in public natural infrastructure investments from China over the coming decade will be made up for by acceleration of natural infrastructure investment in other regions, thereby maintaining the annual growth rate. These estimates are consistent with previous market potential valuations from Abell et al.[800]

FS4: Nature-Based Solutions and Carbon Markets

Lower estimate: US$ 24.9 billion/year
Upper estimate: US$ 39.9 billion/year

The values for carbon markets are a summation of the following subsectors.

TABLE A 3.2. Annual Land Valuation by Region

Category	Lower estimate $bn/year (2030)	Upper estimate $bn/year (2030)
Voluntary carbon markets	0.3	0.7
California	0.3	0.4
Australia	1.2	2.0
Payments for REDD+	0.2	2.7
Natural climate solutions on Nationally Determined Contributions (NDCs)	22.9	34.3
Total	**24.9**	**40**

Voluntary carbon markets:[802] We utilized a lower CAGR for the 2019–2030 period equivalent to the global carbon pricing average growth rate reported in World Bank[803] carbon pricing data over the 1990–2018 period.[804] Using this data, we calculated that the global carbon pricing average growth rate between 2008 and 2018 was 12.7 %. We utilized an upper growth rate based on a Carbon Capture and Sequestration sector growth forecast for 2017–2026 reported by Statistics Market Research Consulting, equal to a CAGR of 14.7 %.[805, 806]

California carbon market: The California emissions program annual carbon offsets growth has varied from 6–8 % per year in recent years. Therefore, we utilize this range in growth for upper and lower CAGR rates to forward project this market size over 2019–2030.

Australia carbon market: Based on Australia carbon market auctions data reported by the Australian Clean Energy Regulator portal over the past nine years, the Australian Emissions Reduction Fund program has an anticipated annual growth rate of 8 % in the lower estimate and 12.6 % in the upper estimate.

Payments for REDD+: Payments for REDD+ Programs resources pledged and disbursed for

the Forest Carbon Partnership Facility Carbon Fund (FCPF), BioCarbon Fund (BioCF) Initiative for Sustainable Forest Landscapes (ISFL), and REED Early Movers. These account for US$ 2,949 million in results-based payments pledged. Of these, US$ 218 million has been disbursed for already-achieved emissions reductions. Therefore, there is at least US$2.73 billion that would need to be disbursed by 2030, which is equivalent to a 16.34 % annual growth in REDD+ payments disbursed from 2019–2030. We have then assumed that the same CAGR (16.34 %) is applied to scale up the lower limit of current spending to reach a lower limit estimate by 2030.

Nature-Based Solutions (NBS) / Natural Climate Solutions (NCS) in Nationally Determined Contributions (NDCs): To calculate the future spending on NBS/NCS within NDCs, we utilized carbon pricing presented by Griscom et al., who calculated that carbon reductions from 14 biodiversity-supportive activities would amount to 3.808 $GtCO_2$ equivalents priced at \$10/$MgCO_2$ equivalent (which is close to current prices at the time of this report).[807] The Griscom et al. study identified two price points for reducing emissions through NCS. The first price point was at US$ 100/tCO_2e and the second was at US$ 10/tCO_2e. In the real world, however, activities would be accomplished with more variable pricing; some activities might cost \$8/tCO_2e or \$25/tCO_2e. Thus, the amounts listed here are initial estimates that could benefit from future studies.

Griscom et al. defined a <2˚C "cost-effective" level of mitigation to meeting the Paris Climate Agreement goal as a marginal abatement cost not greater than ~US$ 100 $MgCO_2$-1 as of 2030. They found that about half (11.3 $PgCO_2e$ y^{-1}) of the maximum NBS potential meets this cost-effective threshold. To estimate the portion of NBS that are cost-effective for holding warming to below 2˚C, they estimated the fraction of the maximum potential of each natural pathway/scenario (high = 90 %, medium = 60 %, or low = 30 %) that could be achieved without exceeding costs of ~US$ 100 $MgCO_2$-1. Using parallel methods, Griscom et al. find that more than one third of the "<2˚C cost-effective" levels for natural pathways are low cost (<US$ 10 $MgCO_2$-1). We considered the two price thresholds of cost-effective and low-cost NBS and estimated the total value of NBS activities on NDCs at a price of ~US$ 10/ $MgCO_2$-1 totalling US$ 38.1B in 2030, and at a price of <US$ 100/ $MgCO_2$-1, totalling US$ 676.8B in 2030.

We assume this price would remain fixed over the 2019–2030 period, although it is possible that carbon pricing will likely start lower and increase over time, and thus our estimate may provide a conservative forecast over the next decade. Using this price, the total funding to meet all NDC commitments is estimated to be US$ 38.1 billion in 2030. However, recognizing that not 100 % of NCS in NDCs would be implemented, we assume that 60–90 % of the total set of activities would be implemented over the 2019–2030 period. To calculate the future spending on NCS within NDCs, the price of NCS activities was set at \$10/$MgCO_2$-1, as estimated by Griscom et al. Using this price, the total funding to meet all NDC commitments is estimated to be US$ 38.1 billion in 2030 (3.808 Gt for 14 biodiversity-supportive activities). However, recognizing that not 100 % of NCS in NDCs would be implemented, it is then assumed reasonably that 60–90 % of the total set of activities are implemented resulting in the lower estimate of US$ 22.9–34.3 billion by 2030. The lower estimate for spending on NCS by 2030 is 60 % of this US$ 38.1 billion and the upper estimate for spending on NCS by 2030 is 90 % of the US$ 38.1 billion annual spend to meet NDC commitments. In this instance, no CAGR has been used as we are unable to ascertain the current spending on natural climate solutions that are part of NDCs and instead a target for spending by 2030 is used.

In addition, the potential contributions from the Chinese Certified Emissions Reductions (CCERs)

for the energy sector and the Carbon Offsetting and Reduction Scheme for the International Aviation sector (CORSIA) might provide large demand for NCS in the future; however, given the large uncertainty associated with estimating the future values, they have not been included.

FS5: Green Financial Products—Green Debt

Lower estimate: US$ 18.7 billion/year
Upper estimate: US$ 75.6 billion/year

The estimates for green financial products aggregate funding flows through green bonds, green loans, sustainability linked loans, landscape loan facilities, and environmental impact bonds. For this category, no constant CAGR is used from 2019–2030; instead, we have estimated annual growth rates in the market size for each green debt instrument from conversations with experts. The growth rates reported in Table A.3.1 are calculated using the current spend via green debt and the sum of the future 2030 spending via green debt as presented below.

For green bonds we utilized total market size estimates available from three sources: Bloomberg, the Climate Bonds Initiative, and Linklaters.[808] We assume that 1 % (US$ 11.8 billion lower limit) and 4 % (US$ 44.8 billion upper limit) of the US$ 1,120.1 billion labelled green bonds in 2030 are estimated to finance biodiversity-related conservation measures. The annual growth rate in the green bond market is starting from a 2019 value of US$271 billion as shown in the table below. A medium growth scenario has been assumed, according to Bloomberg NEF, that implies the most recent average growth rate of 27 % (2018–2019) remains in place over the next two years. In addition, Moody's have estimated a 24–27 % increase in green bonds by 2020.[809] Moody's projected growth in combined issuance would represent a moderation compared with the 50 % growth achieved between 2018 and 2019. The annual change in growth rates was calculated by using Blackrock's estimate of the underlying markets of sustainability-themed investment funds between 2019 and 2028 as proxy for % annual growth of green debt markets. Its forecast that sustainability-focused funds will grow to $1.5 trillion between 2019 and 2028 is based on the assumption that there will be 5 % growth in annual growth rate in the underlying markets between 2020 and 2021. It also assumes growth starting at 5 % in 2021, with the change in rate of growth slowing by 0.5 % in 2022, with a pace in the range of zero to -3 % thereafter. We have assumed a -3 % pace between 2023 and 2027 and a 0 % pace thereafter.

TABLE A 3.3.1 Green Bonds 2020–2030

Year	Growth Rate	Change in Growth Rate	Change in Change in Growth Rate	Market Size (US$ bn/yr)
2020	27 %	0 %	-	$344.24
2021	27 %	5 %	5 %	$437.28
2022	32 %	4.5 %	-0.5 %	$575.15
2023	33 %	1.5 %	-3 %	$765.10
2024	32 %	-1.5 %	-3 %	$1,006.32
2025	27 %	-4.5 %	-3 %	$1,278.30
2026	20 %	-7.5 %	-3 %	$1,527.92
2027	9 %	-10.5 %	-3 %	$1,665.85
2028	-1 %	-10.5 %	0 %	$1,641.31
2029	-12 %	-10.5 %	0 %	$1,444.80
2030	-22 %	-10.5 %	0 %	$1,120.12

For sustainability linked loans, the total market size was obtained from Bloomberg and Linklaters. We assume that 0.1 % (US$ 0.5 billion lower limit) and 0.5 % (US$ 2.4 billion upper limit) of the US$ 502 billion labelled sustainability linked loans were used to finance biodiversity-related conservation measures. The annual growth rate in the sustainability linked loans market is starting from a 2019 value of US$ 121.5 billion and shown in the table below. We have used the green bond markets

medium growth scenario as a proxy, according to Bloomberg NEF, that implies the most recent average growth rate of 27 % (2018–2019) remains in place over the next two years. In addition, Moody's have estimated a 24–27 % increase in green bonds by 2020. Moody's projected growth in combined issuance would represent a moderation compared with the 50 % growth achieved between 2018 and 2019. The annual change in growth rates was calculated by using Blackrock's estimate of the underlying markets of sustainability-themed investment funds between 2019 and 2028 as proxy of % annual growth of green debt markets. Similar to the green bonds projections, it is assumed that there will be a 5 % annual growth rate in the underlying markets between 2020 and 2021. It also assumes growth starting at 5 % in 2021, with the change in rate of growth slowing by 0.5 % in 2022, with a pace in the range of zero to -3 % thereafter. We have assumed a -3 % pace between 2023 and 2027 and a 0 % pace thereafter.

TABLE A 3.3.2 Sustainability Linked Loans 2020–2030

Year	Growth Rate	Change in Growth Rate	Change in Change in Growth Rate	Market Size (US$ bn/yr)
2020	27 %	0 %	-	$154.34
2021	27 %	5 %	5 %	$196.05
2022	32 %	4.5 %	-0.5 %	$257.86
2023	33 %	1.5 %	-3 %	$343.03
2024	32 %	-1.5 %	-3 %	$451.17
2025	27 %	-4.5 %	-3 %	$573.11
2026	20 %	-7.5 %	-3 %	$685.03
2027	9 %	-10.5 %	-3 %	$746.86
2028	-1 %	-10.5 %	0 %	$735.87
2029	-12 %	-10.5 %	0 %	$647.76
2030	-22 %	-10.5 %	0 %	$502.19

For green loans, the total market size was obtained from Bloomberg, Climate Bonds Initiative, and Linklaters. We assume that 0.2 % (US$ 0.1 billion lower limit) and 0.6 % (US$ 0.3 billion upper limit) of the US$ 48.9 billion labelled green loans were used to finance biodiversity-related conservation measures. The annual growth rate in the green loan market is, starting from a 2019 value of US$ 89.6 billion, shown in the table below. Annual growth rates obtained from Bloomberg NEF anticipate the volume of offerings for all debt types to grow between 2020 and 2030, except green loans, which will decrease and give space to green bonds and sustainability linked loans offerings.

TABLE A 3.3.3 Green Loans 2020–2030

Year	Growth Rate	Market Size (US$ bn/yr)
2020	33 %	$119.08
2021	28 %	$152.31
2022	23 %	$187.95
2023	22 %	$229.12
2024	17 %	$268.99
2025	10 %	$295.63
2026	-1 %	$293.86
2027	-14 %	$252.44
2028	-28 %	$182.77
2029	-41 %	$107.66
2030	-55 %	$48.88

The growth rate of landscape loan facilities has been assumed to grow from the 26.3 % growth rate calculated from 2019 to 2020, at a rate of 0.5 % per year. This leads to a 2030 growth rate of 31.8 % and a market value of US$ 2 billion per year. However, it is acknowledged that not all of this will have been used directly to support biodiversity, and as such the UNDP BIOFIN standard attribution of indirect investments toward biodiversity has been used. For the lower

estimate, a medium attribution level (50 %) has been assumed; this is used for initiatives such as organic agriculture support and watershed management. The upper estimate uses the high attribution (75 %) rate, which corresponds to initiatives such as biodiversity-related education, private conservation measures, and PES schemes. This gives a range of US$ 1–1.5 billion per year.

The growth rate of environmental impact bonds has been assumed to grow from the 3 % growth rate calculated from 2019 to 2020, at a rate that is 5 % above the previous year until 2025 when the rate of growth rate increase drops to 3 % per year, and is 0 % for 2029 and 2030. This follows the same growth trajectory as the projection for green bonds with a two-year time lag reaching peak annual change in growth rate by 2024. This is summarized in the table below. Annual growth rates have been estimated from Quantified Ventures, Blue Forest Conservation, and NIB transactions data between 2017 and 2019. Using these growth rates gives a 2030 growth rate of 9 % and a market value of US$ 106.2 billion per year. However, it is acknowledged that not all of this will have been used directly to support biodiversity and as such the UNDP BIOFIN standard attribution of indirect investments toward biodiversity has been used. For the lower estimate, a low attribution level (5 %) has been assumed; this is used for initiatives such as improved irrigation systems, reduction of fertilizer use, and sustainable forestry. The upper estimate uses the medium low attribution level (25 %), which corresponds to initiatives such as sustainable wetland use, sustainable fisheries, and ecosystem-based adaptation. This gives a range of US$ 5.3–26.55 billion per year from this category.

TABLE A 3.3.4 Sustainability Linked Loans 2020–2030

Year	Market Size (US$ bn/yr)	Growth Rate	Change in Growth Rate
2019	$0.60	3 %	
2020	$0.62	3 %	1 %
2021	$0.67	9 %	6 %
2022	$0.80	19 %	11 %
2023	$1.07	35 %	16 %
2024	$1.66	55 %	21 %
2025	$2.86	73 %	18 %
2026	$5.35	87 %	15 %
2027	$10.63	99 %	12 %
2028	$22.00	107 %	9 %
2029	$47.40	116 %	9 %
2030	$106.18	124 %	9 %

FS6: Biodiversity Offsets

Lower estimate: US$ 162.0 billion/year
Upper estimate: US$ 168.0 billion/year

We estimated the potential conservation funding from future biodiversity offsets through the following steps: (1) based on projections of future development, estimated the spatial area of natural habitat impacts (a common proxy for biodiversity impacts) that should require offsets; (2) applied an impact-to-offset ratio to this area of habitat impact; (3) applied average offset costs per hectare for higher income countries and middle-to-lower income countries; and (4) estimated a range of potential conservation funding from biodiversity offsets based on policy adoption and the full potential.

We modeled terrestrial land impacts from infrastructure, energy industry, resource extraction, commercial agriculture, and urbanization worldwide using a spatially explicit global model that projects land expansion from a business-as-usual development trajectory to 2050.[810] This model calculates development expansion for 13 economic sectors—renewable energy development (concentrated solar power, utility-scale photovoltaics, wind, and hydropower); fossil fuel development (coal, conventional and unconventional oil and gas);

metallic mining and non-metallic mining; urban development; and cropland expansion.[811]

To estimate the spatial area that could be subject to future biodiversity offsets, we applied an approach consistent with the mitigation hierarchy. As established in policies and financial performance standards, the mitigation hierarchy requires that impacts to critical and natural habitat are first avoided, impacts are then minimized, and finally measures are carried out to offset the residual impacts of development. Thus, we assumed that development impacts would be avoided in areas of high biodiversity value. Identification of areas for impact avoidance should occur at landscape or jurisdictional scales that are relevant to inform land-use change decisions.[812] However, given the global nature of our assessment, we identified areas for impact avoidance as natural areas with low human modification[813] within IUCN Endangered and Critically Endangered ecoregions as well as all protected areas identified by IUCN (IUCN Ia-IV).[814] We assumed that the development footprint outside of these "avoid areas" would proceed, causing residual development impacts for which biodiversity offsets would be required.

At a global scale, we estimated a total future development footprint that would require offsets of about 3.60 million km^2 from 2019 to 2050. This is driven by agricultural expansion (~40 % or 1.52 million km^2), energy and mining (~33 % or 1.20 million km^2), and urban expansion (~27 % or 0.95 million km^2). Assuming a linear average over the 31-year time period from 2019 to 2050, we estimated an average annual area requiring offsets of 116,000 km^2 or 11.6 million hectares (i.e., 3.60 million km^2 converted to hectares and divided by 31 years).

1. Impact-to-Offset Ratio

Offset requirements differ across countries and programs. For simplicity, we assumed that offset programs would require a 1-to-1 ratio of impacts-to-offsets for the estimated development impacts of 11.6 million ha/year. This ratio is considered conservative. Offsets programs that seek to achieve a no net loss goal would likely need to apply ratios that require greater investments in offsets (e.g., impact-to-offset ratios of 1-to-2, 1-to-5, 1-to-10, or more).[815] These ratios may be necessary to address a range of concerns, uncertainties, and risks,[816] such as the lag time between the impact and when the offset will yield conservation results,[817] or the risks associated with successfully delivering offsets through restoration, management, and protection actions.[818]

2. Offset Cost Estimates

Data on per hectare offset costs are limited. Available data indicate that costs vary significantly—by orders of magnitude—for different countries and offset types. To develop global offset cost estimates, we first grouped countries by higher income and middle-to-lower income countries. We defined higher income countries as those included in the Equator Principles' list of Designated Countries. This list consists of 34 countries that are both OECD countries and World Bank higher income countries.[819] The remaining 161 countries of the world were grouped as middle-to-lower income countries.

To develop per hectare offset costs for higher income and middle-to-lower income countries, we applied data on offset cost information from 37 offset projects in different regions of the world[820] and from an offset cost study in the United States.[821] We estimated that the average offset cost for higher income countries is about US$ 100,000/ha and for middle-to-lower income countries it is approximately US$ 1,500/ha.[822] We recognize that there is a large differential in per-hectare offset costs. This reflects differences between higher income and middle-to-lower income countries for common offset cost elements, such as land acquisition and protection, labor, legal fees, and long-

term stewardship. In addition, offsets in higher income countries where past biodiversity losses have been significant may require more restoration activities, and these offset actions can increase costs.

TABLE A 3.4 List of Higher Income Countries

1. Australia	18. Japan
2. Austria	19. Korea, Rep.
3. Belgium	20. Latvia
4. Canada	21. Lithuania
5. Chile	22. Luxembourg
6. Czech Republic	23. Netherlands
7. Denmark	24. New Zealand
8. Estonia	25. Norway
9. Finland	26. Poland
10. France	27. Portugal
11. Germany	28. Slovak Republic
12. Greece	29. Slovenia
13. Hungary	30. Spain
14. Iceland	31. Sweden
15. Ireland	32. Switzerland
16. Israel	33. United Kingdom
17. Italy	34. United States

Source: Source: Higher income countries are defined by countries included on the list of Equator Principles Designated Countries—countries that are both OECD countries and World Bank higher income countries. Equator Principles Designated Countries: https://equator-principles.com/designated-countries/.

3. Potential Conservation Funding From Biodiversity Offsets

We estimated the potential offset funding if policies and financial performance standards supported offset implementation to address all adverse residual impacts in all countries. As noted above, we estimated the area potentially requiring offsets to be 11.6 million ha/year. Of this area, approximately 1.5 million ha/year are in higher income countries and 10.1 million ha/year are in middle-to-lower income countries. We applied the per-hectare offset cost estimate for higher income countries of $100,000/ha to the 1.5 million ha area that would require offsets in these countries. Likewise, we applied the per hectare offset cost estimate for middle-to-lower income countries of $1,500/ha to the 10.1 million ha area that would require offsets in these countries. Using this method, we estimated that the potential level of conservation funding from biodiversity offsets could be as high as US$ 168 billion/year.

We also estimated the potential offset funding for countries with more established policies for implementing biodiversity offsets—the 42 countries with regulatory policies requiring offsets and the 66 countries with established provisions for voluntary offsets. To develop the estimate, we assumed that these 108 countries fully implement mitigation policies in a manner that addresses all residual impacts. We applied the per-hectare cost estimates for higher income and middle-to-lower income countries. Using this approach, we estimated that the potential level of conservation funding from biodiversity offsets would be as high as US$ 162 billion. This estimate is close to the estimate for all countries (US$ 168 billion) because almost all higher income countries are included in the 108 countries with offset policies and provisions, and higher income countries have higher per-hectare offset costs.

FS7: Sustainable Supply Chains

Lower estimate: US$ 10.9 billion/year
Upper estimate: US$ 17.0 billion/year

Global sustainable supply chains have been disaggregated into five subsectors of sustainable commodities markets. These are (1) sustainable forestry products, (2) sustainable agricultural products, (3) sustainable fisheries and seafood products, and (4) sustainable palm oil. For all of

these commodities there is an assumption that 1–1.5 % of the sustainable market is reinvested into biodiversity conservation initiatives in that sector. The lower estimate assumption of 1 % is based on the forestry sector reinvestment in biodiversity conservation initiatives, which has more data and is further explained below, whereby it is assumed sustainable supply chain investments in this commodity sector are representative of other sectors. The upper estimate assumption 1.5 % is used as a reasonable assumption above the lower estimate to account for heterogeneity in biodiversity investment across the sectors.

The CAGR reported for this category in Table A.3.5 has been calculated from the projected total spending in 2030 and are estimated as explained below.

FS8: Green Financial Products—Private Equity Impact Investing

Lower estimate: US$ 12.3 billion/year
Upper estimate: US$ 16.9 billion/year

The lower estimate of 2030 private equity impact investments flow was calculated by applying the average growth rate of private investment in conservation from 2005 to 2015 (16.6 %) as obtained from the State of Private Investment in Conservation 2016.[828] This gives a lower 2030 estimate of US$ 12.3 billion per year.

The upper estimate of 2030 private equity impact investments flow was calculated by applying a CAGR of 17 % . This is based on the average annual growth from 2015 to 2019 reported in the Global Impact Investing Network (GIIN) Annual Impact Investors surveys.[829, 830] This gives an upper estimate of US$ 16.9 billion per year.[831]

TABLE A 3.5 Overview of Future Flows from Sustainable Supply Chains

Contribution to Biodiversity	Lower estimate US$ bn/yr (2030)	Upper estimate US$ bn/yr (2030)	Notes
Sustainable forestry products	3.7	5.5	For sustainable forestry products in 2030, US$ 365bn is used as the global value of market opportunities[823] (The Business Commission).
Sustainable agriculture products	6.7	10.0	For sustainable agricultural products in 2030, US$ 665bn is used as the global value of market agricultural opportunities (The Business Commission).
Sustainable seafood products	1.6	2.6	The global seafood market[824] (gross value at first point of sale) is US$ 409.0 billion.[825] Of the total global seafood market, 25 % is certified or green-rated, resulting in US$ 102.2 billion. The lower limit estimated percentage growth in the global sustainable seafood market[826] 2018–2030 is 4.0 % . The upper limit estimate percentage growth is 2018–2030 is 4.97 % .
Sustainable Palm Oil	0.4	0.6	For sustainable palm oil products by 2030, the 2019 market valuation of US$ 16.3 billion has been converted using a growth rate of 9.17 % per year. This growth rate has been obtained from the 2019 Market Size Forecasters report on sustainable palm oil, which projects growth of the market to 2026, resulting in US$ 27.6 billion. This value has assumed to also be applicable to the years 2027–2030 giving a market size in 2030 of US$ 39.194 billion.[827]
Total	**12.3**	**18.7**	

Appendix A.4. Methodology for Estimating the Reduction in Harmful Subsidies by 2030

This report has approached the closing of the biodiversity financing gap through two avenues: first, by increasing the private, public, and blended investment allocated to positive biodiversity outcomes; and second, by reducing the need to invest in biodiversity conservation in the first place. This second path requires the decrease of production subsidies that incentivize negative biodiversity outcomes.

Three major areas of harmful subsidies have been identified below.

TABLE A 4.1 Current Flows of Harmful Subsidies to Biodiversity

Ref #	Subsidies	Subsidies Most Harmful to Biodiversity—Amount [US$ bn/yr] 2019	Subsidies Potentially Harmful to Biodiversity—Amount [US$ bn/yr] 2019
HS1	Support to agricultural production	230.0	451.0
HS2	Support to fisheries production	15.9	36.1
HS3	Support to forestry production	28.0	55.0

Global annual production subsidies from the agricultural, fisheries, and forestry sectors potentially harmful to biodiversity were in the order of US$ 274–542 billion in 2019. Although this report addresses harmful subsidies from agriculture, forestry, and fisheries, it does not address the reform of fossil fuel subsidies due to its indirect relation with biodiversity conservation activities. This does not mean that the annual US$ 396–478 billion in fossil fuels production subsidies are unimportant; the potential impacts of these subsidies on biodiversity, resulting from widespread conversion of natural vegetation for energy development and transmission and from increases in atmospheric and ocean temperatures associated with fossil fuel use, are highly likely to exacerbate and accelerate global biodiversity loss in addition to driving human-induced climate change.

HS1: Support to Agricultural Production

Potentially harmful subsidies in 2019: US$ 451 billion/year
Most harmful subsidies in 2019: US$ 230 billion/year

The US $230–451 billion agricultural subsidies estimate used herein is derived from the OECD's 2019 Producer Support Estimates (PSE) database, which covers 22 OECD countries as well as 12 emerging economies: Argentina, Brazil, China, Colombia, Costa Rica, India, Kazakhstan, Philippines, Russia, South Africa, Ukraine, and Vietnam.[832] The OECD's 2013 report on Policy Instruments to Support Green Growth in Agriculture describes that market price support mechanisms and payments based on commodity output are the potentially most harmful subsidies to biodiversity.[833] OECD countries made significant efforts to reduce the most harmful agriculture, from over 74 % of the total in 1995–1997 to 50 % in 2009–2011. However, the potentially most harmful subsidies to biodiversity have remained relatively constant at an average of 51 % between 2011 and 2018. The total agricultural subsidies supported in 2009–2010 was US$ 345 billion, and emerging economies represented 26 % of the total financial contributions. In 2017–2019 the total support increased to US$ 451 billion, and these countries represented 47 % of the total agricultural subsidies and 46 % of the most harmful subsidies.[834]

HS2: Support to Fisheries

Harmful subsidies: US$ 36.1 billion/year
Most harmful subsidies: US$ 15.9 billion/year

The US$ 16–36 billion fisheries subsidies estimate was re-estimated from Sumaila et al.'s research on global subsidies.[835] The OECD has estimated that support payments lowering the cost of variable inputs are potentially the most harmful to biodiversity and represent about 40–44 % of the total fisheries subsidies. The OECD have estimated that support payments lowering the cost of variable inputs, including payments contingent on the purchase of gear, bait, ice, vessels, and use of port services, are potentially the most harmful to biodiversity and represent roughly 40–44 % of the total fisheries subsidies. This report uses 44 % as the proportion of fishery subsidies that are more harmful to biodiversity.

This global estimate includes the US$ 5 billion in most harmful subsidies (2015–2017 average) from 28 OECD countries and 9 non-OECD countries: Argentina, Brazil, China, Costa Rica, Indonesia, Malaysia, Peru, Philippines, and Chinese Taipei, detailed in the OECD's 2019 Fisheries Support Estimate (FSE) database.[836] The non-OECD, emerging market countries represent more than 55 % of the global fisheries subsidies.

HS3: Support to Forests

Harmful subsidies: US$ 55.0 billion/year
Most harmful subsidies: US$ 28.0 billion/year

Reliable global estimates of subsidies to the forestry sector have not been generated for more than two decades. The US$ 28–55 billion estimates were derived from the van Beers and de Moor research on global subsidies estimated for 1998.[837] The absence of consistent and comprehensive data on forestry sector subsidies represents a significant limitation on the attempt to quantify the extent of these subsidies globally. At the global level, not accounting for regional fluctuations, values have been assumed to be constant and therefore have been adjusted for inflation to estimate 2019 figures.

In a lower policy ambition scenario, it is assumed that only the most harmful subsidies are reformed and redirected away from harming biodiversity activities, leaving only those that are classed as potentially harmful. It is assumed that in the high policy ambition scenario, all potentially harmful subsidies are redirected away by 2030.

TABLE A 4.2 Most Harmful Subsidies Reform by 2030

Ref #	Subsidies	Most harmful subsidies reform—Remaining subsidy amount [2030 US$ bn/yr]	Potentially harmful subsidies—Remaining subsidy amount [2030 US$ bn/yr]	Target CAGR 2019–2030
HS1	Support to agricultural production	0	221.0	-6.3 %
HS2	Support to fisheries	0	20.2	-5.1 %
HS3	Support to forestry	0	26.9	-6.3 %
	Total	**0**	**268.1**	

APPENDICES

Appendix B: Double Counting Risks

Specific double counting risks are present between the following categories.

Domestic Budgets and Tax Policy and ODA—ODA to recipient countries could form part of the recipient domestic budgets and tax policy, and these countries may subsequently count the disbursement of these ODA funds as domestic spending. This would lead to double counting between ODA outflows and domestic budgets and tax policy from recipient countries.

Philanthropy and Foundations and Conservation NGOs—Philanthropic and foundation donations form part of conservation NGO budgets. Therefore, by adding these two categories there is a potential for double counting.

Domestic Budgets and Tax Policy and Green Financial Products—Green Debt—Governments can raise funds through issuing sovereign debt for green or biodiversity conservation purposes. This could then be counted as part of domestic budgets and tax policy; however, it is assumed that municipal and sovereign bonds are issued for specific projects and assets rather than to bolster government coffers, thereby mitigating the risk of double counting.

Green Financial Products—Green Debt and Private Equity and Sustainable Supply Chains—Corporate spending on sustainable supply chains can come from either internal funding, such as reinvested turnover or redirected current spending, or from external funding such as debt or equity. As such there is a risk that a portion of green debt and equity flows are specifically for sustainable supply chains.

Domestic Budgets and Tax Policy and Natural Infrastructure—The majority of natural infrastructure spending on watershed investments has been made by the public sector, and so there is a risk of double counting these flows with domestic budgets and tax policy. However, the domestic budgets and tax policy calculated covers flows identified as relevant to biodiversity conservation. This report assumes that natural infrastructure investments in watersheds would be identified as infrastructure or as water utility services by governments, thereby evading the risk of double counting.

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