

2023



State of Finance for Nature

The Big Nature Turnaround
Repurposing \$7 trillion to combat nature loss

© 2023 United Nations Environment Programme

ISBN: 978-92-807-4108-7

This publication may be reproduced in whole or in part and in any form for educational or non-profit services without special permission from the copyright holder, provided acknowledgement of the source is made. The United Nations Environment Programme would appreciate receiving a copy of any publication that uses this publication as a source. No use of this publication may be made for resale or any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to unep-communication-director@un.org.

Disclaimers

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory or city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

Mention of a commercial company or product in this document does not imply endorsement by the United Nations Environment Programme or the authors. The use of information from this document for publicity or advertising is not permitted. Trademark names and symbols are used in an editorial fashion with no intention on infringement of trademark or copyright laws.

The views expressed in this publication are those of the authors and do not necessarily reflect the views of the United Nations Environment Programme. We regret any errors or omissions that may have been unwittingly made.

© Maps, photos and illustrations as specified

Suggested citation: United Nations Environment Programme (2023). *State of Finance for Nature: The Big Nature Turnaround – Repurposing \$7 trillion to combat nature loss*. Nairobi. <https://doi.org/10.59117/20.500.11822/44278>

Production: Nairobi, Kenya

URL: <https://www.unep.org/resources/state-finance-nature-2023>



Acknowledgments

Authors

United Nations Environment Programme

Nathalie Olsen, Ivo Mulder, Qian Hang, Georgia Maria Malandrino, Aurelia Blin

Global Canopy

Andrew Mitchell, Pei Chi Wong

The Economics of Land Degradation Initiative

Waltraud Ederer, Nina Bisom

With technical guidance from the SFN Technical Advisory Group

Andrew Deutz (The Nature Conservancy), Courtney Lowrance (Citi), Giulia Carbone (WBCSD), Juliano Assunção (Climate Policy Initiative), Onno Van den Heuvel (UNDP Biofin), Pdraig Oliver (UNFCCC), Snorre Gjerde (Norway Sovereign Wealth Fund)

With data collection, analysis and modelling by Vivid Economics by McKinsey

Ashley Gorst, Juliette Perche, Jason Eis, Deven Azevedo, Deepika Sehdev

With thanks for review and feedback from

Aeree Kim (UNEP), Arindam Jana (UNEP), Baris Karapinar (UNEP), Caroline King-Okumu (UNEP WCMC), Claire Potdevin (UNEP), Dianna Kopansky (UNEP), Gabriela Prata Dias (UNEP), Georgia Savvidou (Chalmers University of Technology), Gonzalo Oviedo (Independent Consultant), Himanshu Sharma (UNEP), Jessica Smith (UNEP), Johannes Kruse (GIZ), Jonathan Gheysens (UNEP), Lera Miles (UNEP-WCMC), Marisol Estrella (UNEP), Martin Halle (UNEP), Mirey Atallah (UNEP), Raphaela Deau (UNEP), Romie Goedicke (UNEP), Ruth Do Coutto (UNEP), Sharon Gil (UNEP)

Graphic Design

OneStop.Swiss

Disclaimer

The authors would like to thank the technical advisory group members, webinar participants and reviewers for their valuable contributions. However, the content and the positions expressed are those of the authors and do not necessarily reflect the perspectives of those who provided input nor of the organisations to which they are affiliated.

With financial support from:



Federal Ministry
for Economic Cooperation
and Development



THE GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG



MINISTERO DELL'AMBIENTE
E DELLA SICUREZZA ENERGETICA

In support of:



UNITED NATIONS DECADE ON
**ECOSYSTEM
RESTORATION**
2021-2030

Glossary

Billion	Short scale billion – a thousand million (1,000,000,000 which is 10 ⁹)
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (United Nations Convention on Biological Diversity [UNCBD]).
Biodiversity offset	Measurable conservation outcomes that result from actions designed to compensate for significant residual biodiversity loss that arise through development projects (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES]).
Biodiversity credit	An asset created through investments in the restoration, conservation and development of biodiversity in a specific landscape (United Nations Development Programme [UNDP]).
Capital expenditure (investments)	Expenditure used to purchase and create assets that generate services for more than one year.
Conservation agriculture	Involves the practical application of three principles: no or minimum mechanical soil disturbance, biomass mulch soil cover and crop species diversification, as well as the complementary agricultural practices of integrated crop and production management (Kassam <i>et al.</i> 2018).
eNGO	Environmental non-governmental organisation
Finance gap	The difference between current financial flows and future investment needs to achieve climate, biodiversity and land degradation neutrality targets.
Finance flows	Annual capital and operating expenditure
Natural capital	The world's stocks of natural assets, which include geology, soil, air, water and all living things. It is from natural capital that humans derive a wide range of services, often called "ecosystem services", which make human life possible (UNCBD).
Nature	All the existing systems created at the same time as the Earth, all the features, forces and processes, such as the weather, the sea and mountains (UNCBD).
Nature-based solutions (NbS)	Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits (United Nations Environment Assembly [UNEA]).
Nature-harming/negative finance flows	Nature-negative financial flows refer to finance flows for activities that could potentially have a negative effect on nature (Deutz <i>et al.</i> 2020).

Nature-positive

A high-level goal and concept describing a future state of nature (e.g. biodiversity, ecosystem services and natural capital) that is greater than the current state.

Nature-related risk

Potential threats posed to an organisation linked to its and other organisations' dependencies on nature and nature impacts. These can derive from physical, transitional and systemic risks. Climate Disclosure Standards Board (CDSB; 2021) Framework application guidance for biodiversity-related disclosures; The Taskforce on Climate-Related Financial Disclosures (TCFD; 2017) Final report: recommendations on climate-related financial disclosures

Net zero

A state in which the greenhouse gases going into the atmosphere are balanced by removal from the atmosphere.

Protected area

A protected area is a clearly defined geographical space that is recognised, dedicated and managed through legal or other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values (UN Environment Programme World Conservation Monitoring Centre [UNEP WCMC] 2016).

Restoration

The UN Decade on Ecosystem Restoration definition includes activities to prevent, halt and reverse degradation and can be understood as a continuum of practices not limited to rehabilitation and ecological restoration but including other practices such as ecosystem management (The World Bank [WB] 2022a).

Sustainable Land Management

"The use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (World Overview of Conservation Approaches and Technologies [WOCAT] 2023). Sustainable land management (SLM) in chapter 4 includes both conservation and regenerative agricultural practices.

Trillion

Short scale trillion – a thousand (short scale) million (1,000,000,000,000 which is 10^{12})

Table of Contents

Acknowledgements		iii
Glossary		v
Foreword		ix
Executive Summary		x
Chapter 1	The case for a big nature turnaround	1
1.1	The consequences of insufficient action	2
1.2	The big nature turnaround	3
1.3	Nature-based solutions contribution to Rio Convention targets	4
1.4	SFN analysis and what is new in this report?	6
Chapter 2	How much finance is driving negative impacts on nature	7
2.1	Public nature-negative finance	8
2.2	Private nature-negative finance	12
2.3	Methodology, data and limitations	13
2.4	Concluding remarks	14
Chapter 3	How much finance is directed to nature-based solutions	15
3.1	Current finance flows to nature-based solutions	16
3.2	Current public finance to nature-based solutions	17
3.3	Current private finance to nature-based solutions	20
3.4	Methodology, data and limitations	25
3.5	Concluding remarks	26
Chapter 4	How much investment in nature-based solutions is needed to reach Rio Targets	27
4.1	Annual investment needs and opportunities	28
4.2	Nature-based solutions finance needs by region	31
4.3	Who will finance the required investment in nature-based solutions?	33
4.4	The Forecast Policy Trajectory – a more likely scenario?	34
4.5	Benefits of nature-based solutions investment	35
4.6	Methodology, data and limitations for nature-based solutions investment needs	37
4.7	Concluding remarks	38
Chapter 5: Key findings and recommendations		39
5.1	Key findings	41
5.2	Recommendations	44
	Greening finance – eliminating nature-negative finance	44
	Financing green – scaling public funding and private investment into nature-based solutions	46
	A just transition to a green and inclusive financial system for vulnerable groups, women and Indigenous Peoples	50
5.3	Concluding remarks	51
References		52
A1. Methodology and data		62
A1.1	Public nature-negative finance flows	62
A1.2	Private nature-negative finance flows	63
A1.3	Public finance flow to nature-based solutions	66
A1.4	Private finance flow to nature-based solutions	69
A1.5	Future nature-based solutions investment needs	72
A2. Physical benefits		83
A2.1	Greenhouse gases removals	83
A2.2	Biodiversity	85
References for Technical Annex		86

List of Figures

Figure 1.1	Land restoration and the Rio Conventions
Figure 2.1	Environmentally harmful subsidies, \$ trillion (2023 US\$)
Figure 2.2	Environmentally harmful subsidies to fossil fuels, \$ billion (2023 US\$)
Figure 2.3	Comparing public environmentally harmful subsidy estimates
Figure 2.4	Nature-negative private finance by sector, \$ billion (2023 US\$)
Figure 3.1	Public and private finance flows to NbS in 2022, \$ billion (2023 US\$)
Figure 3.2	Breakdown in public finance flows to NbS, \$ billion (2023 US\$)
Figure 3.3	Funding for biodiversity protection as a share of national budgets (by region)
Figure 3.4	Private finance flows to NbS, by channel, \$ billion (2023 US\$)
Figure 3.5	Private finance flows to sustainable supply chains, \$ billion (2023 US\$)
Figure 3.6	Farmer private investment in conservation agriculture by region
Figure 3.7	Mapping sources and categories of finance to NbS
Figure 4.1	Additional annual investment needs to reach Rio targets, \$ billion (2023 US\$)
Figure 4.2	Cumulative additional land area by NbS 2025–2050, Rio-aligned, Mha
Figure 4.3	Cumulative additional area by NbS category 2025–2050, Rio-aligned, Mha
Figure 4.4	Additional NbS investment needs per year by region, Rio-aligned, \$ billion (2023 US\$)
Figure 4.5	Additional NbS investment needs from public and private sources, Rio-aligned, \$ billion (2023 US\$)
Figure 4.6	Cumulative investment needs, 2020–2050, \$ trillion (2023 US\$)
Figure 4.7	Forecast global Biodiversity Intactness Index (BII) by scenario
Figure 4.8	GHG removals from NbS to meet Rio targets, GtCO ₂ e/year
Figure 4.9	Model (MAGPIE) inputs and outputs
Figure 5.1	Current finance flows to NbS, nature-negative finance and investment needs
Figure A1.1	Hierarchy of data used to estimate nature-negative finance flows by sector and activity
Figure A1.2	Share of production processes with high or very high impact on nature by sector
Figure A1.3	NbS included in investment needs analysis
Figure A1.4	MAGPIE: structure of the optimisation process

List of Tables

Table 3.1	Comparing SFN and OECD analysis of NbS and biodiversity in ODA
Table 4.1	Cumulative NbS investment needs by region
Table A1.1	Public finance flows – description of data used
Table A1.2	Scaling factors used to adjust domestic sectoral expenditure to NbS
Table A1.3	Scaling factors to identify NbS in ODA budgets
Table A1.4	Private NbS finance flows data description
Table A1.5	Private NbS finance flows assumptions
Table A1.6	Rio-aligned and Forecast Policy Trajectory scenario descriptions
Table A1.7	Scenario modelling assumptions
Table A1.8	NbS types and definitions
Table A1.9	Costs estimated in MAGPIE
Table A1.10	Investment needs analysis and approach outside MAGPIE
Table A1.11	Off modelling analysis data sources
Table A2.1	GHG abatement potential by NbS

List of Boxes

Box 1	Exploring Rio Convention synergies in restoration - a case study from Rwanda
Box 2	Note on public nature-negative finance
Box 3	Official Development Assistance funding for NbS and biodiversity
Box 4	Finance for biodiversity protection
Box 5	Sustainable and certified commodity markets
Box 6	Agri-food sector impact investing for conversion free supply chains
Box 7	Biodiversity credits

Foreword

Inger Andersen

Executive Director, UN Environment Programme



Nature is the beating heart of human wellbeing and prosperity. Yet the triple planetary crisis – the crisis of climate change, nature and biodiversity loss and pollution and waste – is causing nature to atrophy, and with it our chances of ending poverty, hunger and inequity through the sustainable development goals. Nations have recognized this. In response, they have built an interlocking framework of multilateral agreements: from the Paris Agreement to the Kunming-Montreal Global Biodiversity Framework to land degradation neutrality targets and more.

Despite commitments made under these agreements, however, governments continue to provide subsidies and tax rebates to economic activities that drive the triple planetary crisis and deplete natural capital. The third edition of the State of Finance for Nature shows that an annual US\$7 trillion in public and private capital flows into nature-negative activities – in sectors including fossil fuels, agriculture and construction. Only US\$200 billion per year goes towards nature-based solutions that promote a stable climate, and healthy land and nature. These numbers must be flipped by reducing nature-negative investments and instead investing in nature-based solutions – with custodians of the land, such as Indigenous Peoples, among the chief beneficiaries.

Niki Mardas

Executive Director, Global Canopy



Protecting nature has huge benefits across the board, including for climate mitigation and adaptation. Governments should prioritize funding for public goods, alongside incentives and regulations that catalyze private finance for sustainable land management and restoration. Innovative financial instruments such as green bonds, blended finance and debt for nature swaps can further boost private sector action. At the same time, we need to see a just transition to an inclusive financial system that protects the human right to safe, clean, healthy and sustainable environment.

Jochen Flasbarth

State Secretary in the Federal Ministry for Economic Cooperation and Development (BMZ), Germany.



There are encouraging signs. Just a few months ago, The Taskforce on Nature-Related Financial Disclosures released recommendations to guide businesses and financial institutions to report and act on nature-related dependencies, impacts, risks and opportunities. Emerging national laws like the Kenyan Restoration Act and the Indian Restoration Law show a growing emphasis on legal frameworks for the restoration and protection of nature. However, action must accelerate and spread across the globe. This report is a clear call for governments and the private sector to repurpose nature-negative investments and scale up investment in nature. It is a call the world must heed.





Executive Summary

Executive Summary

The State of Finance for Nature (SFN) annual report series tracks finance flows to nature-based solutions (NbS) and compares them to the finance needed to maximise the potential of NbS to help tackle climate, biodiversity and degradation challenges. For the first time, this edition estimates the scale of nature-negative finance flows from both public and private sector sources globally. The figure is daunting – almost US\$7 trillion per year - and is likely to be an underestimate given it includes only direct impacts. Private finance flows that have a direct negative impact on nature are US\$5 trillion, which is 140 times larger than private investments into NbS.

On the public side, environmentally harmful subsidies have increased 55 per cent to US\$1.7 trillion since the last report, despite government commitments and driven by fiscal support for fossil fuel consumption. The combined impact of public and private nature-negative finance flows is enormously destructive and undermines potential increases in finance for NbS. However, this misalignment represents a massive opportunity to turnaround private and public finance flows to align them with Rio Convention targets.

Meanwhile, NbS remain severely underfunded. Current finance flows to NbS are US\$200 billion, only a third of levels needed to reach climate, biodiversity and land degradation targets by 2030. Governments continue to provide most funding for NbS (82 per cent). Despite the irrefutable need for action and growing commitments, e.g. zero-deforestation pledges in the agri-food sector, NbS finance has increased only 11 per cent since the 2022 edition.

NbS provide critical investment opportunities as they are cost-effective and provide multiple benefits. Investment opportunities in sustainable land management can increase fourfold by 2050 based on long-term profitability of sustainable food and commodity production - critical to catalyse private investment. Protection of diverse ecosystems is highly cost-effective and represents 80 per cent of additional land area needed for NbS while absorbing only 20 per cent

of additional NbS finance by 2030. Given the scale of degradation globally, restoration provides massive opportunities to strengthen ecosystem function and resilience to deliver the ecosystem services that people rely so heavily upon.

However, despite the sizeable investment potential of NbS, the single most impactful action to reduce and halt nature loss is the realignment of nature-negative finance flows. Due to their massive scale, realignment of public and private nature-negative finance flows will have a very significant impact and is necessary to avoid undermining investment in NbS. While more public finance for NbS is critical, more action is needed to repurpose harmful subsidies. In parallel, governments need to put in place regulation and economic incentives to turn private finance flows away from nature harming activities and toward nature and nature-based solutions. Meanwhile, the financial sector and the business community at large cannot wait for a fully developed enabling policy environment. There is much they can and must do now to urgently transform unsustainable business models.

In short, a major turnaround for nature is needed. Unless the real economy and financial system reduce financing of nature-negative activities (i.e. greening finance), actions to scale up investment in NbS (i.e. financing green) will be insufficient to tackle the climate, biodiversity and degradation crises.

Current finance flows to NbS of US\$200 billion are massively outweighed by finance flows with direct negative impacts on nature of almost US\$7 trillion

\$200 billion Total finance flows to NbS

PUBLIC

\$200bn

Almost US \$7 trillion

\$1.7 trillion

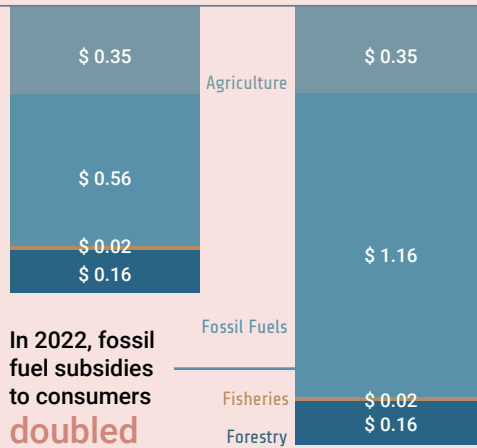
public funding to environmentally harmful subsidies

x10 bigger than public finance flows to NbS (US\$165 billion)

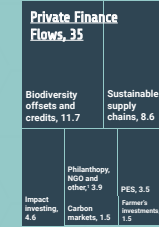
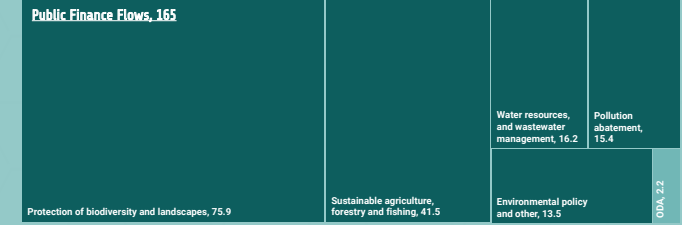
55% increase from 2021

2021 \$ 1.09tn

2022 \$ 1.69tn



- Governments provide \$165 billion - 82% of NbS finance



Private sector provides \$35 billion - 18% of NbS finance

Less than 1% of private nature-negative finance flows

>50% via biodiversity offsets and sustainable supply chains

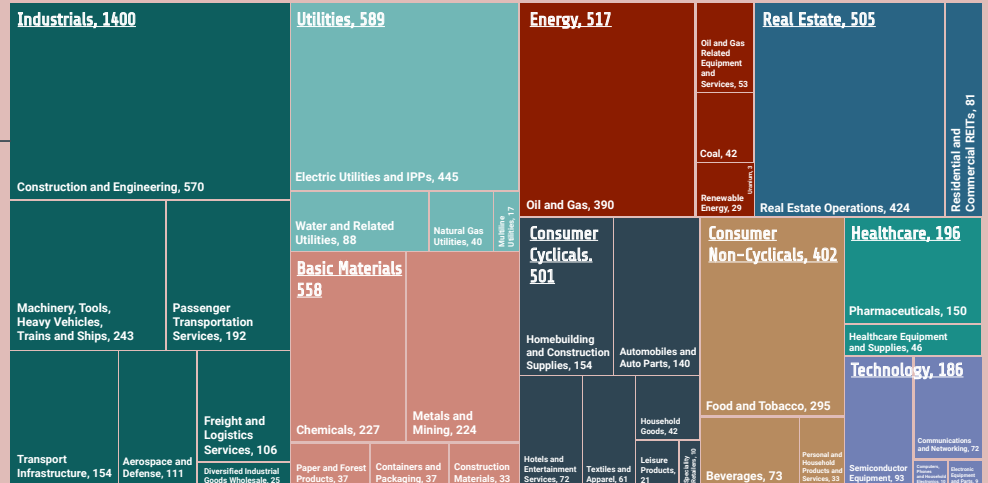
PRIVATE

\$5 trillion

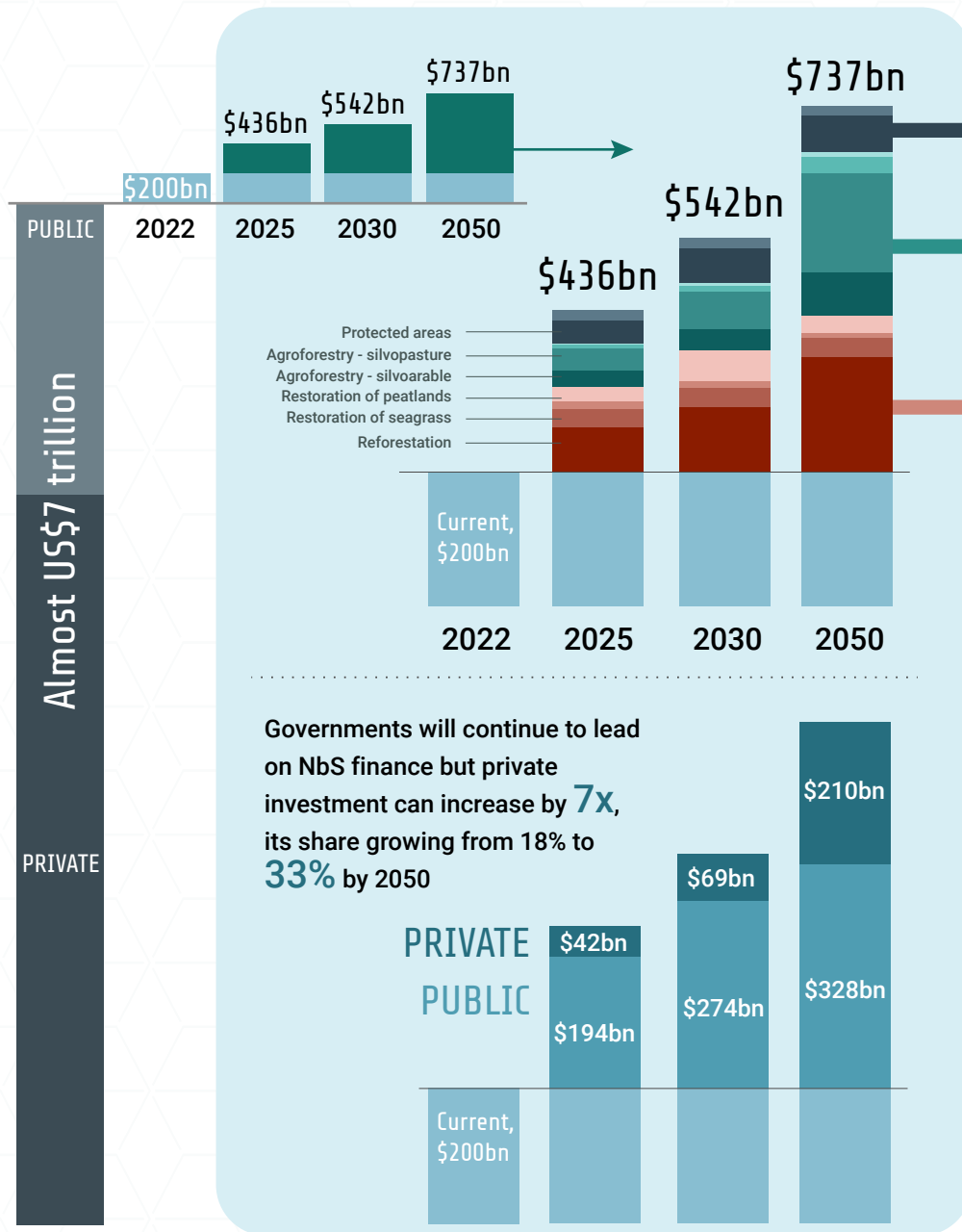
of private finance flows with a direct negative impact on nature

x140 bigger than private finance to NbS (US\$35 billion)

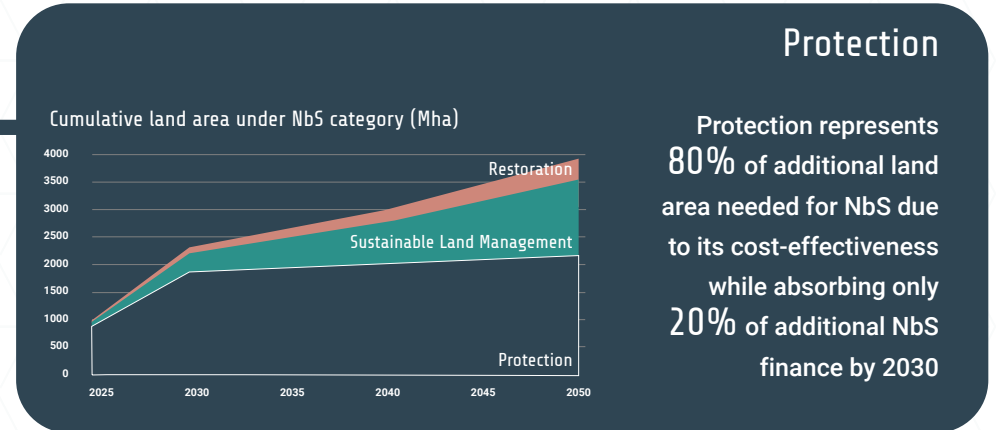
=5% of global GDP



Annual NbS investment to meet Rio targets needs to almost triple from US\$200 billion to US\$542 billion by 2030



NbS provide cost-effective opportunities to deliver on Rio targets



Sustainable Land Management

Investment in sustainable land management with revenue streams to increase **4x** from US\$63 billion in 2025 to **US\$241 billion** in 2050 providing big opportunities to scale private investment

Restoration

Investment needs for restoration double from US\$125 billion in 2025 to **US\$227 billion** in 2050 due to extent of land degradation

But without a big turnaround on nature-negative finance flows, increased finance for NbS will have limited impact



1 The case for a big nature turnaround

In the time between the 2022 edition of State of Finance for Nature (United Nations Environment Programme [UNEP] 2022a) and this 2023 edition, the planet has experienced the hottest period ever recorded in June, July and August 2023 on the back of the unfolding climate crisis and this year's El Niño phenomenon (Gayle 2023). The United Nations (UN) Secretary General, Antonio Guterres, has referred to humanity's inaction to tackle the most defining challenges of the 21st century in stark terms: "we are on a highway to climate hell with our foot still on the accelerator" (UN 2022b) and "we must end the senseless and suicidal war against nature" (UN 2022a). Underpinning such remarks is a growing body of science and evidence on accelerating biodiversity loss and land degradation, rising emissions and temperature increases and impacts on economic growth, food security, human health and well-being (Ripple *et al.* 2019; Bradshaw *et al.* 2020).

Despite global agreements to tackle climate change (Paris Climate Agreement), halt

biodiversity loss (Global Biodiversity Framework [GBF]), reverse land degradation (United Nations Convention to Combat Desertification [UNCCD] Land Degradation Neutrality [LDN]) and other crises, implementation is far from sufficient (UNCCD 2023b). The underlying drivers of climate change, biodiversity loss and land degradation include global systems of production, energy and infrastructure that extract from nature in pursuit of economic growth without regard to ecological limits. Seventy-five per cent of energy consumed still comes from fossil fuels. Thirty-seven per cent of global land area is used for agriculture, one of the largest drivers of biodiversity loss with agricultural expansion linked to 90 per cent of deforestation (Food and Agriculture Organisation [FAO] 2020; Portfolio Earth 2021). Governments continue to provide massive subsidies and tax rebates for economic activities that lead to climate change, biodiversity loss and land degradation while failing to embed environmental costs in the price of goods and services.

1.1 The consequences of insufficient action

The consequences of insufficient action to tackle climate change, biodiversity loss and land degradation are becoming clearer.

Even though greenhouse gas emissions need to fall by 45 per cent this decade, emissions of carbon dioxide, methane and nitrous oxide reached their highest levels ever in 2021 (World Meteorological Organisation [WMO] 2023). Without immediate reductions in emissions, many people will by 2070 be exposed to average annual temperatures warmer than nearly anywhere today. These conditions are currently experienced by just 0.8 per cent of global land areas, and they mostly occur in the hottest parts of the Sahara Desert. By 2070, these conditions could spread to 19 per cent of global land areas, potentially affecting over three billion people (Xu *et al.* 2020) and leading to mass involuntary migration and serious socio-economic upheaval. Extreme weather events, including floods, droughts, wildfires, storms and extreme temperatures, are increasing in frequency and intensity (The Intergovernmental Panel on Climate Change [IPCC] 2021). By mid-century, the world stands to lose 11–14 per cent of GDP based on the current trajectory of 2°C to 2.6°C (Swiss Re Institution 2021).¹

Since 1954, the rate of biodiversity loss due to human activity has been greater than at any other time in human history due to habitat loss from infrastructure and agriculture, over-exploitation, pollution, invasive species and climate change (Centre for Sustainable Systems 2023). World Wildlife Fund (WWF)'s Living Planet Report 2022 reveals an average decline of 69 per cent in wildlife populations since 1970 (WWF 2022). More than 50 per cent of the human population lives within 3km of a freshwater body – this human proximity has resulted in a severe decline of 83 per cent in freshwater wildlife populations since 1970. Without immediate action, accelerated biodiversity loss will result in the collapse of ecosystem services such as wild pollination and the provision of food and timber, thereby causing a dramatic loss in global GDP of US\$2.7 trillion by 2030 (The World Bank [WB] 2021).

UNCCD estimated that up to 40 per cent of the planet's land is degraded, impacting half of the human population and risking half of the world's GDP (US\$44 trillion; UNCCD 2022). If this trend continues, 95 per cent of land could become degraded by 2050 (UN 2019). This crisis not

¹ A carbon tax of US\$100/tCO₂e in the utilities, materials and energy sectors would decrease earnings per share by 40-80 per cent

only jeopardizes the world's ecosystems but also poses a significant threat to billions of people. Over 100 million hectares (twice the size of Greenland) of healthy, productive land was lost between 2015–2019, directly affecting 1.3 billion people living on degraded land (UN 2023), especially women smallholder farmers who make up the largest share of the impoverished rural population (Gurung 2023). Unsustainable land-use practices are leading to increased degradation and loss of soil fertility with devastating effects on the delivery of ecosystem services and food security (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2018). Negative environmental, socio-economic and health effects caused by the current agri-food system are estimated at US\$19.8 trillion, more than twice the market value of global food consumption (Riemer *et al.* 2023).

Expected impacts in low-income and lower-middle-income countries are staggering with anticipated falls in GDP of over 10 per cent (WB 2021). Women and other vulnerable groups are particularly at risk, especially those living in regions with high levels of inequality (United Nations Development Programme [UNDP] 2016). Women and other vulnerable groups, for example, Indigenous Peoples, are often marginalised in terms of political and economic empowerment and have limited access to the finance and technology which are crucial for resilient, sustainable and secure livelihoods. Marginal and degraded lands are often inhabited by the most vulnerable populations. Consequently, as critical resources diminish, poverty in rural communities increases, amplifying the vulnerability and insecurity experienced by women (Bechtel 2010) and Indigenous Peoples.

1.2 The big nature turnaround

This looming existential crisis puts humanity at a crossroads between the current path of climate change, biodiversity loss and land degradation and a path to a future in which ecosystems are protected and restored and the planet remains habitable, providing the foundation for sustainable and equitable economic growth. Now is the time to implement global commitments to reverse biodiversity loss and land degradation as well as to urgently reduce emissions while scaling up efforts to support adaptation and mitigation, particularly for vulnerable communities. If we can achieve the targets we set, what does the future look like?

The Paris Agreement has spurred investment in low-carbon and nature-based solutions, although much action is still needed. Net-zero goals are being set by governments and businesses. United Nations Framework Convention on Climate Change (UNFCCC; 2023) has estimated that by 2030, zero-carbon solutions could be competitive in emission-heavy sectors representing 70 per cent of global emissions. UNEP's Emission Gap Report (2023b) estimates a 66 per cent chance that climate change is limited to 2°C throughout the century if all the nationally determined contributions (both unconditional and conditional) and net-zero targets are achieved. More is needed, but progress has been made.

The current trend of rapid biodiversity loss will continue, with 37 per cent of species threatened or extinct by 2100, unless dramatic action in line with the GBF is taken. However, this share could

drop to 25 per cent if conservation investments are immediately increased (Isbell *et al.* 2022). Biodiversity provides enormous economic benefits – Campaign for Nature (CFN) estimated the economic benefits from achieving the 30x30 target of up to a US\$454 billion increase in annual revenues from protected areas and nature, agriculture, forestry and fisheries (Waldron *et al.* 2020).

The economic benefits of sustainable land management could be as high as US\$75.6 trillion annually, with improved food production worth up to US\$1.4 trillion (Economics of Land Degradation [ELD] 2015). Restoring natural ecosystems can be very cost effective – restoring grasslands can have a benefit/cost ratio as high as 35 (De Groot *et al.* 2013). Working towards LDN not only brings economic opportunity but promotes biodiversity while protecting and enhancing carbon stores. Restoration promotes sustainable livelihoods by supplying clean water, providing biomass fuel and producing forest products.

Social and gender equity could be improved through policy and institutional adjustments that promote equity in the implementation of NbS. Indigenous Peoples, women and other vulnerable groups can be empowered by expanding access to financial resources, enabling them to scale transformative change through regenerative practices and their connection to nature. Financial access and land rights for marginalised groups remain a significant challenge to be addressed.

1.3 Nature-based solutions contribution to Rio Convention targets

This report estimates finance flows to activities identified as nature-based solutions (NbS) using the definition agreed at the United Nations Environment Assembly 5 (UNEA5): “actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits” (UNEA 2022).

NbS are powerful tools to tackle climate change and biodiversity loss while enhancing ecosystem conditions and resilience and human well-being. Some NbS can simultaneously deliver benefits for climate, biodiversity, ecosystems and people. For example, the improved management of peatlands, which contain up to one-third of the world’s soil carbon while covering only three to four per cent of its land area, has disproportionate benefits for climate change mitigation and adaptation while providing critical habitat for species and maintaining soil fertility and other critical ecosystem services that support human well-being (UNEP 2022a).

In this report, an activity is considered an NbS if it positively contributes to biodiversity and/or sequesters/stores greenhouse gases (GHG) and/or restores degraded land and seascapes. As such, the scope of NbS in this report is relatively broad and based on a pragmatic approach. The scope of current finance flows to NbS is shaped by data availability and the ability to identify NbS activities and finance within available data on sustainable supply chains, impact investing, etc. The analysis does not include finance for climate change adaptation unless it also delivers on climate change mitigation.² To capture the benefits to people required for NbS, modelling of NbS interventions in the estimation of future investment needs consider social and environmental safeguards. Data, methods and assumptions are described in the text or in the technical annex.

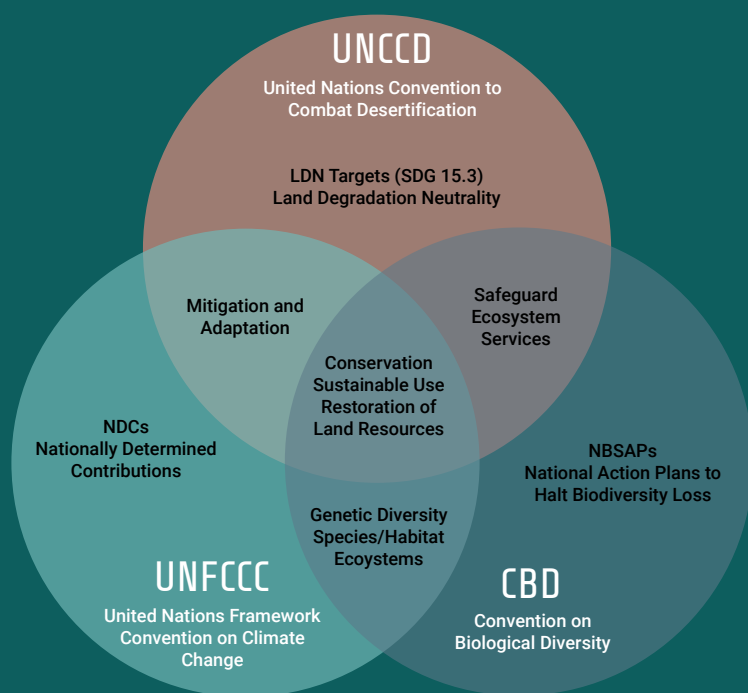
² UNEP’s Adaptation Gap report focuses on climate change adaptation, has a chapter on finance and explores the sectoral distribution of finance targeting both adaptation and mitigation simultaneously (identified as cross-cutting) between 2017 and 2021 (UNEP 2023a).

Box 1. Exploring Rio Convention synergies in restoration - a case study from Rwanda

Bringing together national action plans siloed under the UNCCD, CBD and UNFCCC frameworks provides the opportunity to align targets and commitments for land restoration, realise multiple benefits and maximise returns on investment (Figure 1.1; UNCBD 2022; UNCCD 2023a). A case study from Rwanda provides evidence of the economic benefits of an integrated versus a siloed approach to land restoration across the Rio Convention (ELD 2023).

To achieve its 2030 targets, Rwanda needs to invest US\$300 million per year in land restoration, conservation and sustainable land management. Coordinated action can increase both the effectiveness and efficiency of interventions to implement Land Degradation Neutrality (LDN), National Biodiversity Strategies and Action Plans (NBSAPs) and Nationally Determined Contributions (NDCs). In Rwanda, coordinated action of land-based activities under the Rio Conventions can reduce transaction costs of the current siloed approach by almost 56 per cent or US\$45.6 million per year. Efficiency gains from coordinated action especially arise through joint monitoring and evaluation, resourcing, capacity building and the raising of awareness. More efficient implementation translates into higher return on investment from land restoration, which can provide an incentive for funding activities under LDN, NBSAP and NDC (ELD 2023).

Figure 1.1. Land restoration and the Rio Conventions



Source: UNCCD (2023a).

1.4 SFN analysis and what is new in this report?

The State of Finance for Nature (SFN) report series explores the potential for nature to contribute to tackling global crises. The report focuses on current levels of NbS implementation and finance and how much finance for NbS is needed to reach specific Rio targets – limit climate change to 1.5°C, protect 30 per cent of land and sea by 2030 (30x30 target) and reach land degradation neutrality (LDN) by 2030. The NbS finance gap is the difference between current finance flows and the Rio-aligned scenario NbS finance needs.

The analysis aims to inform policymakers, businesses and financial institutions about what the actual disbursement amounts are to NbS and how much additional finance is needed for NbS.

Calculating finance flows to NbS is challenging. The methodology, assumptions and data sources used in this report series are continuously improved but remain a “work in progress”. New to this edition are:

1. **Estimation of private finance flows that negatively impact nature:** This report provides for the first time, an analysis of *private finance flows* that negatively impact nature, with the caveat that only *direct* (scope 1) nature-negative impacts are estimated. Indirect impacts that negatively affect nature are not included. With this addition, SFN 2023 provides a broader overview of public and private nature-negative capital flows in addition to public and private finance flows to NbS.
2. **Expanded scope of activities included in public finance flows that negatively impact nature:** This analysis includes forestry subsidies in addition to public subsidies that can negatively impact nature in the agriculture, fisheries and energy sectors. This provides a better overview of how much public money works against the Sustainable Development Goals and the Rio Conventions.
3. **Expanded scope of activities included in private finance flows to NbS:** The SFN 2023 analysis has expanded the scope of activities to include private finance flows to biodiversity credits and private investments by farmers into conservation agriculture.³
4. **Investment needs estimated by NbS, source (public vs private) and region:** Investment needs modelling is undertaken to understand how much finance should go to *different types of NbS* to meet climate and biodiversity targets most cost effectively. Investment needs are disaggregated by region and by source (public or private), indicating where finance needs to be prioritised.
5. **Extended scenario analysis:** As the analysis of current finance flows to NbS and investment needs has in previous editions estimated a large finance gap, a new scenario reflecting the (lower) probability of policy implementation and market trends is introduced in Chapter 4. The forecasted policy trajectory scenario is based on the Inevitable Policy Response – Forecast Policy Scenario (FPS) + Nature scenario developed by UN-backed Principles for Responsible Investment (UN PRI) for use by investors.

³ Conservation agriculture involves the application of three principles: no or minimum mechanical soil disturbance, biomass mulch soil cover and crop species diversification in conjunction with complementary agricultural practices of integrated crop and production management (Kassam *et al.* 2018).

2

How much finance
is driving negative
impacts on nature?

Finance flows to economic activities that harm nature are very large and continue to grow. While there is widespread recognition of the large scale of nature-negative finance flows globally, there are few estimates of the volume of these finance flows due to lack of data and agreed methodologies.

This chapter provides estimates of finance flows from public and private sources that damage nature and affect livelihoods and vulnerable populations. This includes a review of data and estimates of environmentally harmful public subsidies. Despite committing through the Rio Conventions to reduce emissions and tackle biodiversity loss and land degradation, governments continue to support unsustainable agriculture, forestry, fishery and fossil fuels production and consumption through environmentally harmful subsidies.

In addition, for the first time, private finance flows with direct negative impacts on nature have been quantified. Many economic activities are based on inaccurately valued and priced natural capital, and incentives for protection and sustainable use are often lacking. As a result, natural capital continues to be severely depleted.

There is an important conceptual distinction between NbS and nature-negative. Nature-negative finance flows are not the negative equivalent of positive finance flows to NbS. NbS are activities *using nature* to tackle climate and biodiversity loss while the estimation of nature-negative flows from private sources considers sectors and activities with a negative impact on nature, not just those that are nature based. As a result of these conceptual differences, a net finance flow to NbS cannot be derived.

Annual finance flows from public and private sources that have direct negative impact on nature are estimated at almost US\$7 trillion per year. The combined impact of public and private nature-negative finance flows is enormously destructive and undermines potential increases in finance for NbS. This chapter identifies the sources and volumes of these nature-negative finance flows so that they can be better understood and reformed.

2.1. Public nature-negative finance⁴

Tracked nature-negative public finance flows are estimated at US\$1.7 trillion in 2022, a 55 per cent increase from 2021 levels (Figure 2.1) and more than 10 times greater than public finance flows to NbS (US\$165 billion). This increase is despite documented inefficiencies and negative impacts on nature and climate of environmentally harmful subsidies and despite commitments to reform and repurpose environmentally harmful subsidies under the Rio and other Conventions. This estimate includes measured public subsidies for nature-negative activities in 2022 in four sectors:

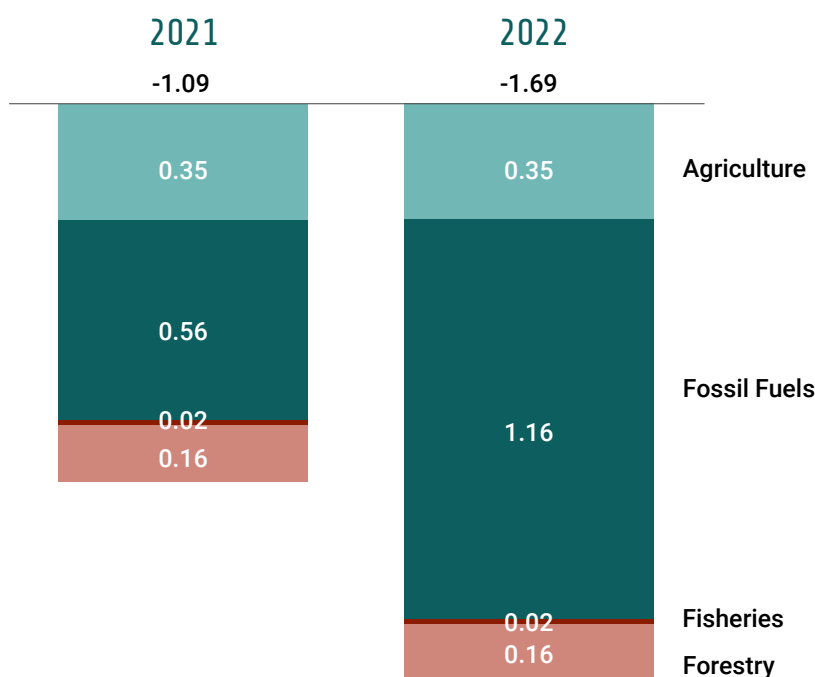
- Agriculture – price incentives in and fiscal transfers to the agriculture sector.
- Fossil fuels – consumption subsidies across oil, electricity, gas and coal contributing to climate change, land conversion and pollution.

- Fisheries – support for fishing capacity to develop beyond the maximum sustainable yield of fish stocks.
- Forestry – support for logging and timber products that incentivises harvest above sustainable rates.

In 2022, roughly 90 per cent of tracked negative public flows were directed towards energy (US\$1.16 trillion or 69 per cent) and agriculture (US\$0.35 trillion or 20 per cent).

⁴Full details of data and methodology are in the technical annex.

Figure 2.1. Environmentally harmful subsidies, \$ trillion (2023 US\$)



Sources: FAO, UNDP and UNEP (2021), IEA (2023), OECD (2020, 2022e), Environmental Markets Lab (2018), Skerritt and Sumaila (2021), WB (2021), Koplow and Steenblik (2022).

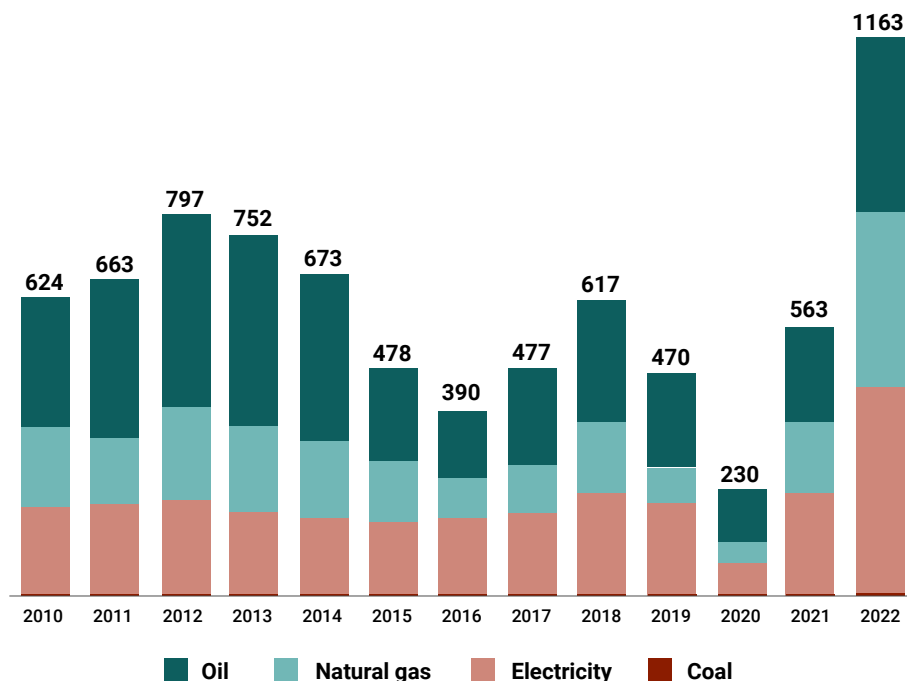
Globally, fossil fuel subsidies to consumers doubled from US\$563 billion in 2021 to US\$1.16 trillion in 2022 (Figures 2.1 and 2.2) based on IEA data.⁵ This dramatic increase is primarily driven by subsidies to protect consumers from high fossil fuel prices due to the Russian invasion of Ukraine. In addition to this increase in fossil fuel consumption subsidies, IEA has estimated extra spending of US\$500 billion to lower energy costs in 2022, with roughly US\$350 billion of that amount spent in Europe (IEA 2023). This is more than the additional spend in other advanced economies, emerging markets and developing economies combined. Similarly, gas and electricity subsidies have doubled due to policies to shield consumers from high fossil fuel prices and are concentrated in emerging markets and developing economies (IEA 2023).

Figure 2.2 indicates that fossil fuel subsidies to consumers are highly variable over time. The doubling of subsidies between 2021 and 2022 should be seen in the context of the very high

fossil fuel prices resulting from the Russian invasion of Ukraine and the consequent global energy crisis. Nevertheless, evidence suggests that governments continue to prioritise the shielding of consumers over phasing out subsidies in the context of high and volatile fossil fuel prices. This wedge between market and consumer prices for fossil fuels slows a much-needed reduction in consumption and production of fossil fuels and, thereby the transition to renewable energy while absorbing scarce public money (IEA 2023).

⁵ Country-level results have not yet been released for 2022 by the OECD/IEA. However the IEA preliminary assessment notes that in 2022 many fossil fuel exporters kept domestic prices lower than international benchmarks, which is counted as a subsidy. The IEA (2023) data used here is the preliminary estimate for 2022 fossil fuel subsidies, and it may be updated later in 2023. IEA data focuses on consumer subsidies.

Figure 2.2. Environmentally harmful subsidies to fossil fuels, \$ billion (2023 US\$)



Source: IEA (2023)

The Production Gap Report (UNEP 2023c) estimates that fossil fuel production will be much higher than production levels consistent with limiting climate change to 1.5°C for coal (460 per cent), oil (29 per cent), and gas (82 per cent). This disconnect between governments' climate and nature pledges and fossil fuel production and associated subsidies is a major driver of the persistence of very large nature-negative finance flows.

Environmentally harmful subsidies to agriculture are estimated at over US\$345 billion, reflecting that agriculture receives the highest level of support of the land-use sectors considered.⁶ An analysis of data covering 54 countries estimated total support to the agricultural sector of US\$817 billion per year between 2019 and 2021, mostly via support to producers (71 per cent). In contrast, budget support for public goods and services, which are key to the development of NbS-based infrastructure and services, received only 13 per cent of total support to the agriculture sector

(OECD 2022e). Based on current trends, support to producers could reach almost US\$1.8 trillion by 2030, channelling limited public funds away from social spending and investment into NbS (UNEP, UNDP and FAO 2021).

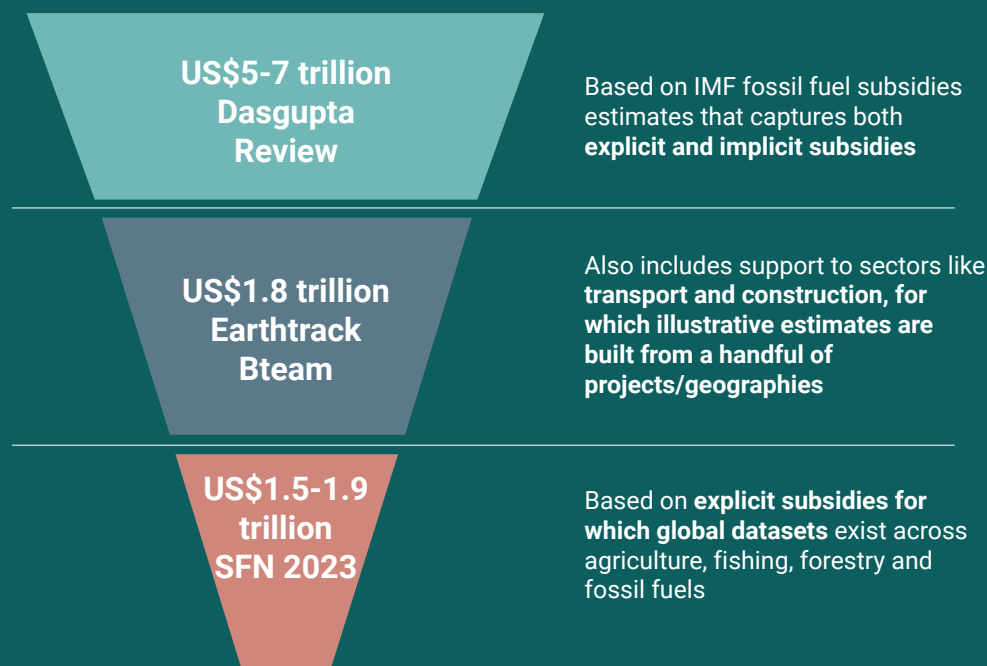
In addition to absorbing limited fiscal resources, poorly designed subsidies can incentivise behaviours harmful to nature. Price incentives for certain products (e.g. beef, rice, milk) using different fiscal subsidies (e.g. coupled subsidies, which are linked to the use of inputs, such as fertilisers, or to the volume of production of outputs) are known to have a potential negative impact on nature. A World Bank (2023) analysis has recently demonstrated the causal link between agricultural subsidies and global deforestation, estimating that agricultural price supports are responsible for the annual loss of 2.2 million hectares of forest.

⁶ Note that the estimates for subsidies to agriculture, forestry and fishing are for 2021; 2022 data was not available at the time of analysis.

Box 2. Note on public nature-negative finance

Nature-negative activity is defined here as “any activity with a direct negative impact on nature” – including a negative impact on biodiversity, land quality or climate change interconnected with the societal repercussions for the most disadvantaged.⁷ SFN estimates of public nature-negative finance flows differ from some other studies due to differences in scope and methods (Figure 2.3). Taking these differences into account, estimates across studies are likely to be consistent. This report focuses on estimates of targeted subsidies in the agriculture, forestry, fishery and fossil fuels sectors. The Dasgupta Review, for example, looks more broadly at explicit and implicit subsidies and captures undercharging for environmental costs and general consumption taxes (Dasgupta 2021). Similarly, the inclusion of implicit subsidies leads to large differences in estimates of fossil fuel subsidies with the estimate used here of US\$1.4 trillion consistent with IEA (2023) and IISD (2023), while the International Monetary Fund, which includes implicit subsidies, estimates them at US\$7 trillion in 2022.

Figure 2.3. Comparing public environmentally-harmful subsidy estimates



⁷ Definition based on Deutz *et al.* (2020): Nature-negative financial flows refer to financial flows for activities that could potentially have a negative effect on nature. Financial flows in the form of subsidies are those that induce production or consumption activities that exacerbate nature loss.

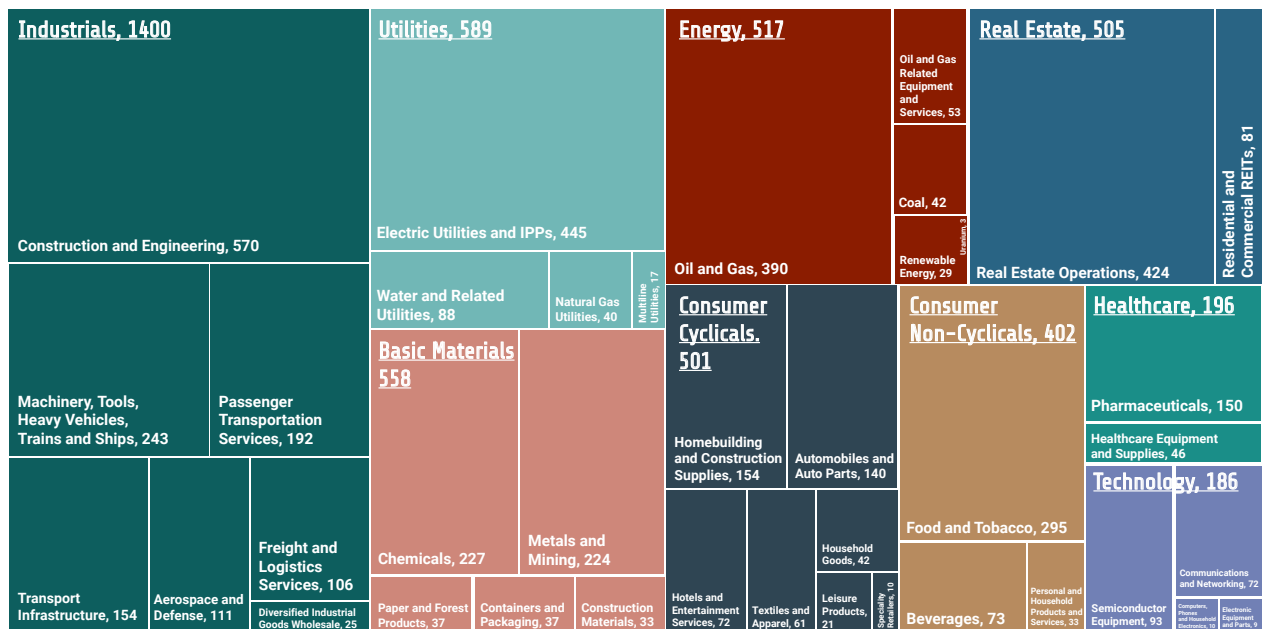
2.2. Private nature-negative finance

Private finance flows to activities with direct negative impacts on nature were estimated to be at least US\$5 trillion in 2022. This is 140 times greater than current private finance flows to NbS.

Nature-negative private finance flows were identified across most economic sectors. The five industries receiving the most financing were construction and engineering, electric utilities

and independent power producers, real estate operations, oil and gas, and food and tobacco (Figure 2.4). These industries received 43 per cent of nature-negative financial flows but represented only 16 per cent of total private investment flows. Therefore, actions to address impacts on nature and climate by these industries would have a disproportionate effect on preventing and reversing nature-negative impacts.

Figure 2.4. Nature-negative private finance by sector, \$ billion (2023 US\$)



Sources: ENCORE, Refinitiv

These estimates of nature-negative private finance flows are likely to be underestimated as the methodology focuses on direct impacts only. Indirect impacts such as supply chain and finance sector exposure to nature-negative activities were not included.

Sector focus:

- **Industrials** finance activities with high nature-negative impacts (US\$1.4 trillion), thereby contributing to air and soil pollution and the clearing of natural habitats.
- **Basic materials:** Metals and mining is a key industry for the climate transition but is also investing US\$224 billion a year with

substantial nature-negative impacts, including degradation and fragmentation of habitats.

- **Energy:** High levels of finance (US\$517 billion) continue to flow to oil, gas and coal production, which have negative impacts on climate, nature and people, including on human health.
- **Consumer non-cyclicals:** While direct finance flows to this sector are a relatively small share (8 per cent) of total nature-negative finance, food, agriculture, forestry and fishing generate large nature-negative impacts.

In the agriculture, forestry, fishing and food sectors and value chains, downstream activities, such as manufacturing, retail and distribution, which have typically been thought to have lighter direct nature impacts, received most of the private investments (83 per cent) compared to upstream activities.⁸ Conversely, upstream activities related to primary production of raw materials potentially drove the largest direct

impacts but were a much smaller share of finance flows (17 per cent).

These findings indicate that there is scope for greater investment in sustainable production modes in upstream activities in these sectors as well as for prevention and mitigation of nature-negative impacts and risks to livelihoods security.

2.3. Methodology, data and limitations

Public nature, negative-finance flows were estimated using existing research and data on environmentally harmful subsidies in agriculture (FAO, UNDP and UNEP 2021; OECD 2022a), fossil fuels (IEA database), fisheries (Sumaila *et al.* 2019; Skerritt and Sumaila 2021) and forestry (Koplow and Steenblik 2022). Where 2022 data was not available, the most recent estimate was used as a proxy and converted to 2023 USD. Further details on methodology and data sources can be found in the technical annex.

Nature-negative-finance flows from private sources were estimated based on the following methodology:

- Data was collected on corporate loans, bonds and equity proceeds in 2022 with coverage of approximately US\$14.5 trillion as classified by the Refinitiv Business Classifications (TRBC) economic sectors and activities.
- Two approaches were used to estimate sector-level and activity-level flows, which returned similar outcomes, thereby providing more confidence in how sectors with direct nature-negative impacts were identified.
 - ENCORE⁹ tool was used to calculate the share of production processes with high or very high impacts on nature within each subindustry.
 - All industry activities were reviewed and tagged as nature-negative based on literature and expert insights.
- Aggregate negative finance flows across tagged sub-industries and activities.

The estimates are approximate due to challenges in tracking nature-negative finance flows. First, there are significant gaps in the data, particularly the absence of comprehensive and detailed private finance flow data and inadequate sector-level granularity on nature-negative activities and impacts. Consolidated private finance data exists at a high granularity level but is frequently not publicly available. Data on public finance flows (e.g. OECD and IMF COFOG) tend not to provide breakdowns of sector-level spending to isolate nature-negative expenditures. Estimation of environmentally harmful subsidies is available only for some sectors, leading to an underestimate of nature-negative public finance.

Second, the absence of a widely accepted classification system or green taxonomies at the sector level prevents easy identification of nature-negative, positive or neutral, and NbS activities and spending. While several national or regional taxonomies have been or are being developed to help identify green activities (e.g. EU Green Taxonomy, Common Framework of Sustainable Finance Taxonomies for Latin America and the Caribbean), they tend to focus on climate mitigation and adaptation rather than NbS or nature.

Finally, there is not yet widespread application of tools and frameworks to assess the scope of activities affecting nature. Economic sectors that have a negative impact on climate can be identified based on their emissions intensity. However, measuring effects on nature is more complex. While there is an increasing number of high-quality frameworks and tools to measure nature impacts, dependencies and risks, application of these is nascent.

⁸ Only direct impacts from downstream activities have been captured. Indirect nature impacts from downstream activities in supply chains have not been quantified. For example, water pollution as a direct result of manufacturing would be captured but not deforestation from commodity production in the manufacturer's supply chain.

⁹ENCORE – Exploring Natural Capital Opportunities, Risks and Exposure is a web-based tool which assesses nature-related risks.

2.4. Concluding remarks

This analysis underscores the urgent need to reduce and re-orient finance flows that negatively impact nature and society. In addition to enhancing capital flows to NbS activities and assets, strategies to achieve nature-positive outcomes need to transform existing economic structures and activities that drive nature-negative impacts and exacerbate poverty, hunger and gender inequalities.

Given the magnitude of government support that harms nature, economic activity will continue to do so unless environmentally harmful subsidies are reformed and repurposed so that subsidies support activities that benefit nature. There is a wealth of evidence and knowledge on how to tackle environmentally harmful fiscal policies. What is needed is political will. The imperative of subsidy reform needs to transcend partisan politics to feature in the agendas of all political parties.

This analysis indicates that private finance flows that harm nature are orders of magnitude greater than private finance to NbS. While voluntary actions by businesses and financial institutions are important, they have been and are likely to remain insufficient. Therefore, governments need to regulate and provide incentives to ensure alignment of private finance with nature-positive activities and outcomes.

On the positive side, the next chapter analyses volumes and channels of current finance flows to NbS from both public and private sources.

3

How much finance
is directed to NbS

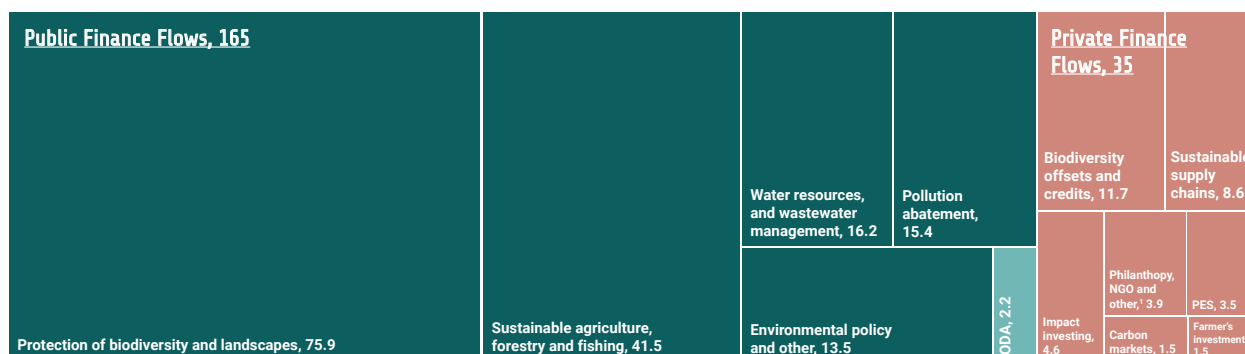
This chapter provides an overview of current finance flows to NbS from public and private sources. It is critical to quantify finance flows to NbS via different channels, for example, public funding of protected areas, payments for ecosystems services and sustainable supply chains, to understand what funds are being disbursed for NbS.¹⁰

3.1. Current finance flows to nature-based solutions

This analysis estimates that total annual finance flows to NbS in 2022 were roughly US\$200 billion (Figure 3.1). As in previous editions, public finance remains the main source of finance at 82 per cent (US\$165 billion) of total NbS finance flows. Over 71 per cent (US\$117 billion) of public finance for NbS is directed to biodiversity and landscape

protection and to sustainable agriculture, forestry and fishing. Private finance for NbS remains modest at US\$35 billion (18 per cent of total finance flows to NbS). More than half (57 per cent) of private NbS finance is channelled through biodiversity offsets and credits and sustainable supply chains.

Figure 3.1. Public and private finance flows to NbS in 2022, \$ billion (2023 US\$)



Note: 1. The "other" grouped with philanthropy and conservation NGOs is private finance mobilised through the Global Environment Facility (GEF), Green Climate Fund (GCF) and Development Assistance Committee (DAC).

Sources: OECD (2023e); IMF (2021); OECD (2023a; 2023b; 2023c; 2023d; 2023e) (ODA, Philanthropy, private finance mobilised by ODA); Financial reports from five NGOs: CI (2022), RSPB (2022), TNC (2022), WCS (2022) and WWF (2022); FAO (2018b; 2018c); Rainforest Alliance (2022a; 2022b); RTRS (2022); Solidaridad (2019); De Jong (2019); GIIN (2020); Capital for Climate NbS Funds (2023); Impact Yield (2023); Partnership for Forests (2023); Ecosystem Marketplace (2022); Kassam *et al.* (2019)

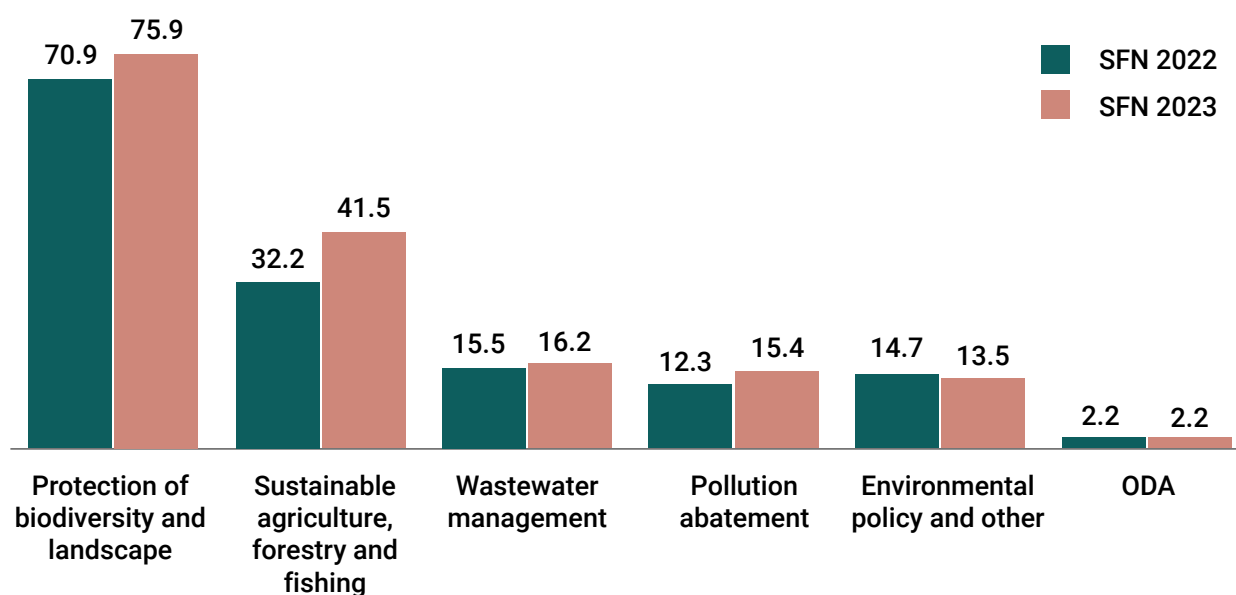
¹⁰ This analysis only includes expected and actual disbursements, rather than commitments, to ensure estimates are based on real finance flows.

3.2. Current public finance to nature-based solutions

Total traceable finance flows to NbS in 2022 increased by 11 per cent (US\$20 billion) relative to 2021 levels. This increase is largely attributable to a US\$17 billion increase in public funding of NbS, almost half through increased funding (US\$9 billion) for sustainable agriculture, forestry and fishing (Figure 3.2). This was driven by post COVID-19 “Build Back Better” spending and targeted conservation spending by the US Department of Agriculture. In fact, 76 per cent of finance flows for sustainable agriculture, forestry and fishing comes from China, the US, Canada, Japan and Turkey. It is thus not surprising that significant increases in any of these countries are reflected in global estimates.

As noted earlier, the largest share of public NbS finance (US\$76 billion or 46 per cent) goes toward protection of biodiversity and landscapes. This has grown by 7 per cent from US\$71 billion to US\$76 billion since SFN 2022. More than half of finance for NbS to tackle biodiversity loss originates in four countries (US, France, Italy and Germany) – the global increase is related to increased spending in the US on wildlife conservation and in the EU under the EU biodiversity strategy to 2030. China also has significant expenditure on biodiversity, with roughly US\$35 billion spent since 2017 (China, Ministry of Foreign Affairs 2020).

Figure 3.2. Breakdown in public finance flows to NbS, \$ billion (2023 US\$)







Note: An additional nine countries were included in SFN 2023. Therefore SFN 2022 numbers were revised to include those nine countries for comparison.

Sources: United States of America, Fish and Wildlife Service (2022); European Commission (2023); China, Ministry of Foreign Affairs (2020); United States of America, Department of Agriculture (2022a and 2022b); FAO, UNDP and UNEP (2021); IEA (2023); OECD (2020; 2023a; 2023c; 2023e); Environmental Markets Lab (2018); Skerritt and Sumaila (2021); Interpol (2020); WB (2021)

Box 3. Official Development Assistance funding for NbS and biodiversity

SFN estimates for public development finance to NbS delivered via Official Development Assistance (ODA) differ from estimates of biodiversity-related ODA from some other studies (OECD 2022b; TNC 2023) due to differences in scope and methodology, despite using the same data source (OECD Creditor Reporting System). Table 3.1 summarises key differences.

Table 3.1. Comparing SFN and OECD analysis of NbS and biodiversity in ODA

SFN 2023	OECD
 US\$2 billion, 2021 price Development finance targeting NbS	US\$10 billion (2011-20 average), 2020 price Development finance for biodiversity-related objectives
 ODA disbursement to public sector	ODA commitments with Rio Markers
 Estimates development finance going to NbS	Estimates development finance marked at source for biodiversity
 Per cent share of relevant sectors, using scaling factors	Total flows to biodiversity related markers

Source: OECD (2022b).

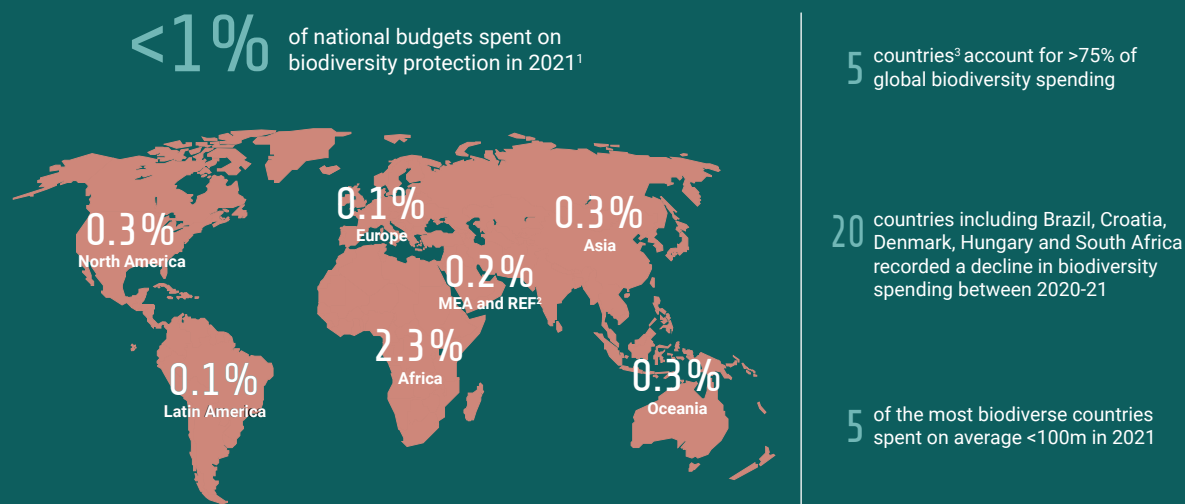
On scope, the OECD estimates development finance that is marked for biodiversity at the source. SFN tracks public development finance to NbS. As there are no markers for NbS, the SFN analysis applies scaling factors. These scaling factors represent the percentage of investment in the sector that can be confidently considered as NbS.¹¹ A further adjustment is made for uncertainty to reflect the level of confidence in identifying NbS related expenditures. SFN aggregates the scaled value of expenditures on biodiversity and additional sub-sectors, for example, forestry and fishing, and the mitigation of the impacts of fuelwood and mineral exploitation.

ODA estimates also differ due to what is being measured. For all finance flows, including ODA, SFN measures actual and expected disbursements. While OECD CRS data provides both commitment and disbursement level data, studies on biodiversity finance in the OECD (2022b) and TNC (Deutz *et al.* 2020) focus on commitments.

¹¹ See technical annex for detail on scaling factors

Box 4. Finance for biodiversity protection

Figure 3.3. Funding for biodiversity protection as a share of national budgets (by region)



Note: 1. Average share across all countries for which data was available; 2. Middle eastern and reforming economies; 3. US, China, Italy, France and Germany.

Sources: Mongabay (2016); Seidl *et al.* (2020); Nature Based Solutions Initiative (2022); BIOFIN (2022).

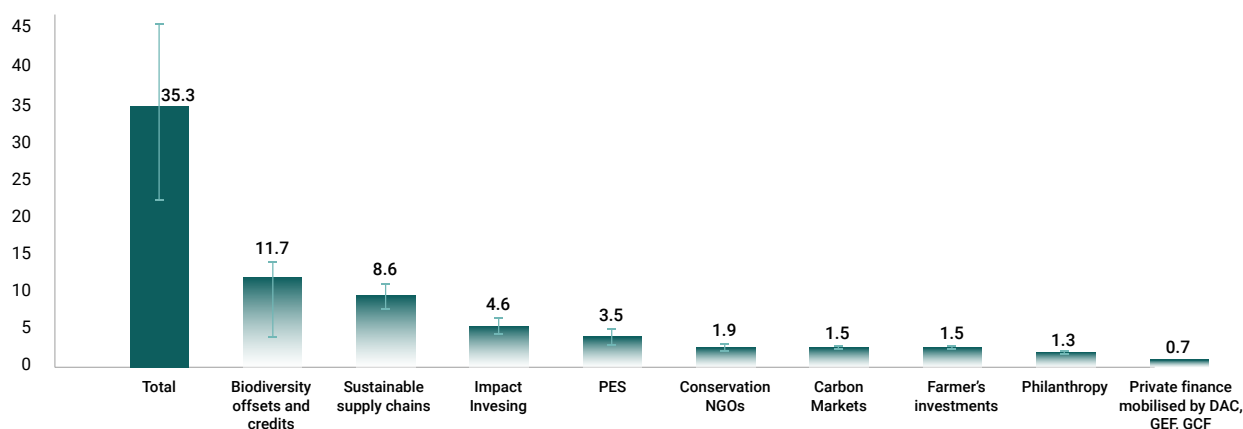
Despite global commitments for protection of biodiversity, a large financing gap remains:

- SFN 2023 and related biodiversity finance analyses estimate current public biodiversity finance between **US\$80-120 billion**
- **US\$100-200 billion** is the current biodiversity funding gap annually for the 30x30 biodiversity target
- **>190** countries have committed to the 30x30 target (50 in 2021, and rest in 2022), establishing more ambitious targets and higher financing needs for the future

3.3. Current private finance to nature-based solutions

Flows of private finance into NbS are estimated at US\$35 billion in 2022, equivalent to 18 per cent of total finance for NbS globally. Private NbS finance flows have increased by US\$3 billion (10 per cent) since SFN 2022 due to growth in biodiversity offset markets, sustainable supply chains and impact investment. Figure 3.4 provides a breakdown of the NbS finance channels for which there is data. Over half (57 per cent) of private finance flows were via biodiversity offsets and credits¹² and sustainable supply chains. While small in absolute numbers, the fastest growth was seen in philanthropy (39 per cent increase from US\$0.96 billion to US\$1.34 billion driven by support for 30x30) and private finance mobilised by ODA (31 per cent increase from US\$0.55 billion to US\$0.72 billion) via blended finance deals, for example, blue bonds and rhino bonds.¹³

Figure 3.4. Private finance flows to NbS, by channel, \$ billion (2023 US\$)



Sources: OECD (2023b; 2023d; 2023f); CI (2022); RSPB (2022); TNC (2023); WCS (2023); WWF (2022); FAO (2018b; 2018c); Rainforest Alliance (2022a; 2022b); RTRS (2022); RSPO (2022); Solidaridad (2019); De Jong (2019); GIIN (2020); Capital for Climate (2023); Impact Yield (2023); Partnership for Forests (2023); Ecosystem marketplace (2021); Kassam *et al.* (2018); Bennett *et al.* (2017); Hamrick (2017).

¹² Biodiversity offsets represent compensation for negative impacts on biodiversity.

¹³ Blue bond - A debt instrument issued by governments, development banks or others to raise capital from impact investors to finance marine and ocean-based projects that have positive environmental, economic and climate benefits (WB 2018). Rhino bond - The world's first Wildlife Conservation Bond, which was issued by the World Bank to help increase the population of the endangered Black Rhino species in South Africa (WB 2022b).

Biodiversity offsets and credits

This report estimates that roughly US\$11.7 billion was invested in biodiversity offsets in 2022.¹⁴ Mandatory biodiversity offsetting schemes, such as Biodiversity Net Gain in the UK (Natural England 2022) or the New South Wales (NSW) Biodiversity Offset Scheme in Australia, are emerging as a key regulatory requirement. This estimate is likely to be an underestimate as only a subset of schemes provides accurate reporting. More than 100 countries have policies on biodiversity offsetting (Biodiversity Consultancy 2016). In the US, the Clean Water Act compensatory mitigation requirements stimulated the creation of mitigation banking programmes that annually issue more than one million water and stream credits. Mitigation banking is expected to grow by 13 per cent per year over the next five years (Facts and Factors 2022).

In the mitigation hierarchy, biodiversity offsets are defined as a last resort mechanism, which comes after avoiding, minimising and rehabilitating (Kujala *et al.* 2022). However, there are concerns that biodiversity offsets do not provide “net biodiversity gains” and that they can provide disincentives to reduce the footprint of economic activities on nature (Hahn *et al.* 2022). This analysis includes biodiversity offsets, with the rationale that, in their absence, there would be a greater loss of biodiversity. Mandatory offsetting schemes help to ensure that biodiversity loss is less than it would be if these schemes were not in place.

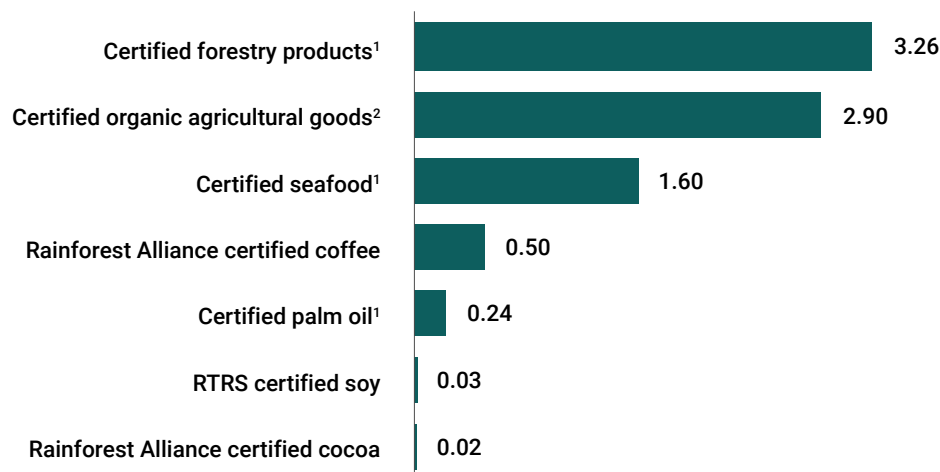
Sustainable supply chains and conservation agriculture

Private investment in sustainable supply chains provides the second largest finance flow at US\$8.6 billion in 2022. Sustainable supply chain certification is a major market with a third of cocoa and half of coffee production under some sustainability certification, and demand is increasing (Centre for Promotion of Imports 2020). Direct investment of farmers into conservation agriculture provides a further US\$1.5 billion per annum, bringing total finance flows to sustainable agriculture to US\$10.1 billion per annum. While a significant share of total private finance to NbS, private finance to sustainable agriculture is only a fraction of the value of agricultural commodity markets of US\$4 trillion annually (US\$1.3 trillion is traded globally; Taskforce on Nature Markets 2022). This small share stands in stark contrast to the evident need and potential of transforming food systems.

Finance flows to sustainable supply chains are estimated based on volume and value of certified forest and agricultural and seafood products. Investment into certified forest products is the largest source of finance for sustainable supply chains at US\$3.26 billion (almost 40 per cent). The certified forest products market is valued at roughly US\$220 billion (UNDP 2020). FSC is a major player – in 2017, 12 per cent of global wood production was sourced from FSC certified forests (FSC 2018). The second largest market absorbing investment is certified organic agricultural goods at US\$2.9 billion per year, roughly one-third of total investment in certified products globally.

¹⁴ This estimate is based on a subset of biodiversity offset flows included in the Forest Trends 2016 survey of four major mitigation banking programs and 103 compensation funds programs.

Figure 3.5. Private finance flows to sustainable supply chains, \$ billion (2023 US\$)



Note: 1. Estimate has not been updated since SFN 2022 due to a lack of data. 2. Certified agricultural good reflects the organic agriculture market based on Statista (2022).

Sources : Rainforest Alliance (2022a; 2022b) ; RTRS (2022) ; Solidaridad (2019) ; De Jong (2019) ; UNDP (2020) ; Deutz *et al.* (2020); Naphade (2020); Statista (2022); FAO (2018a; 2018b); Allied Market Search (2021); Expert Market Search (2022); Research and Market (2022).

Investment trends in markets for coffee, palm oil, soy and cocoa are important as production of these commodities can significantly contribute to deforestation. Figure 3.5 illustrates that finance flows to certified deforestation-free coffee, palm oil, soy and cacao together are relatively low at US\$790 million in 2022, less than 10 per cent of annual investment in sustainable supply chains. The volume of annual investment is also small relative to the value of the certified market, which is small relative to global production volumes and value.

Box 5 provides some key statistics on the sustainable market size relative to wider commodity markets. The share of commodity markets that is certified varies from 1 per cent for soybeans to 6–8 per cent for Rainforest Alliance coffee and cacao. Increasing pressure on producers to reduce impacts on deforestation, for example, via the EU Deforestation Regulation, has increased efforts to avoid deforestation and to document this avoidance via certification. For example, the Roundtable for Sustainable Palm Oil certification has gained traction, increasing the area certified by 66 per cent between 2017 and 2022 (Roundtable for Responsible Soy [RSPO] 2022). Nevertheless, far higher levels of investment into credibly certified deforestation – and conversion-free production – and away from activities that finance deforestation is urgently needed, in tandem with enabling public policies.

Box 5. Sustainable and certified commodity markets



The size of the certified forest products market is estimated at ~US\$220 billion.



About 5 per cent of the seafood market is certified as Marine Stewardship Council (MSC), with an estimated market size of ~US\$5 billion.



The market size of Rainforest Alliance certified coffee and cocoa was estimated at US\$40 billion and \$1.5 billion respectively. Certified production represent about 6-8 per cent of global production volumes.



About 5 per cent of global palm oil production volume is certified under RSPO, with a market value estimated at US\$15.8 billion in 2019.



About 1 per cent of global soybean production volumes was certified under the RTRS in 2022. The sustainable soybean market was estimated at around US\$2.2 billion.

Sources: UNDP (2020); Naphade (2020); Rainforest Alliance (2022a; 2022b); Netherlands, Ministry of Foreign Affairs (2021); Bermudez *et al.* (2022).

Farmer private investment in conservation agriculture

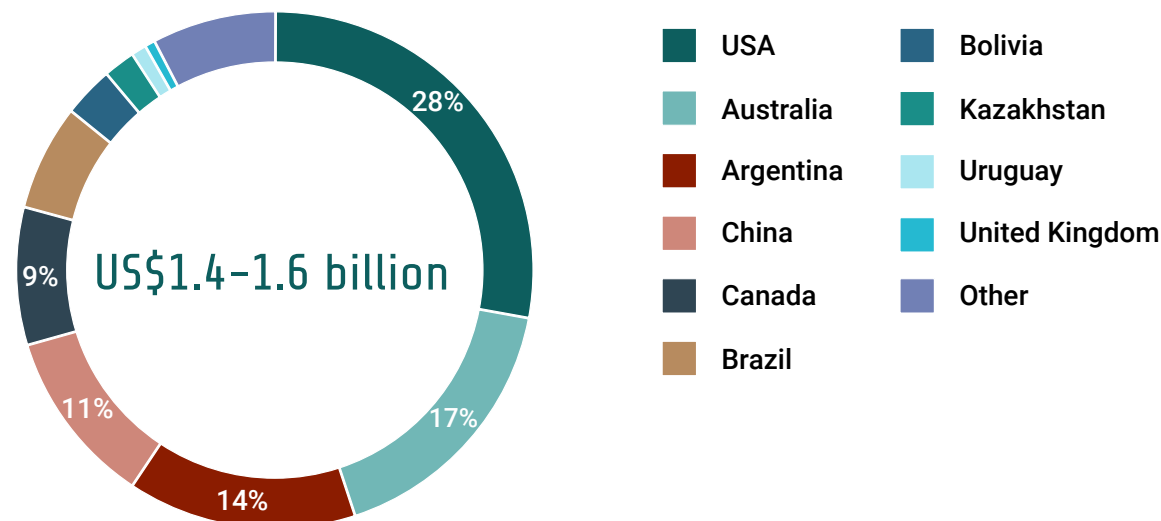
For the first time, this edition estimates private finance flows to NbS via farmer investment in conservation agriculture. Farmer use of their own profit to invest in conservation practices¹⁵ is distinct from sustainable supply chain finance, which is based on downstream corporate investment in supply chains. No publicly available data sets exist on farmer investment into conservation agriculture. This analysis uses a bottom-up approach based on annual growth in areas under conservation agriculture, average capex per hectare and the share of total

agricultural investment from farmer retained profits (see technical annex for details).

The results indicate that US\$3.9-4.2 billion is invested annually into conservation agriculture. Of this total, US\$1.4-1.6 billion is financed by farmer retained profit. Figure 3.6 highlights countries with high levels of farmer investment in conservation agriculture. Together, the US, Australia and Argentina account for over half of private investment into conservation agriculture.

¹⁵ These investments are like the economic decisions of households/individuals on climate finance that are tracked in the Climate Policy Initiative Global Landscape of Climate Finance reports. Households and individuals accounted for about 20 per cent of total private climate finance in 2019/2020 (CPI 2021).

Figure 3.6. Farmer private investment in conservation agriculture by region



Note: Only conservation agriculture on cropland is considered here as global data on the extent of broader regenerative practices are not publicly available.

Sources: Kassam *et al.* (2019); Wilkinson (2020); Elwin *et al.* (2023).

Tackling social and gender inequity in agriculture

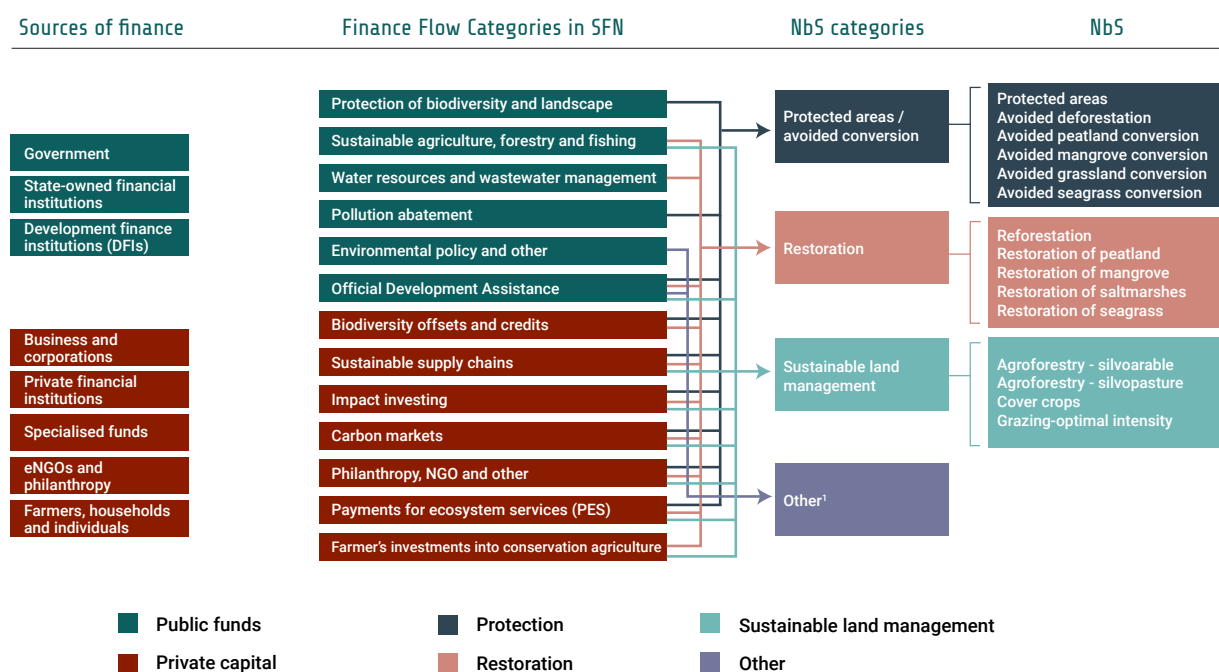
Obstacles to equal participation in agri-food systems impedes productivity and contributes to wage disparities. For example, women in agriculture often receive lower wages and have lower productivity than men, primarily due to discriminatory social norms that restrict women from some agricultural activities and technologies. They have limited access to assets and resources like irrigation, livestock and land ownership, finance and technology. In many countries, land ownership and legal protection are limited for vulnerable groups, which has consequences for access to technical support, critical financing for inputs and access to markets. Addressing social and gender disparities in agri-food systems is essential to advance not only social and gender equality but also to promote global food security and nature and climate-positive economic growth. Women and Indigenous Peoples hold valuable ancestral knowledge about such matters as crop diversity and regenerative practices.

For example, closing the gender gap in farm productivity and wage disparity could boost global GDP by 1 per cent (almost US\$1 trillion) and reduce global food insecurity by 2 per cent, benefitting 45 million people (FAO 2023). Providing financial support and credit access to rural women and other marginalised groups can support the transformation of the agri-food system into one that is more productive, regenerative and equitable.

3.4. Methodology, data and limitations

SFN tracks finance flows from major public and private sources to NbS categories. Ideally, with complete and detailed data, finance flows would be tracked across all sources, instruments and use of proceeds by ecosystems and NbS type. However, due to limited data and granularity, SFN looks at financial flows across sources and categories of finance as well as NbS types, as illustrated in Figure 3.7.¹⁶

Figure 3.7. Mapping sources and categories of finance to NbS



Note: 1. The "other" category captures activities that directly support NbS implementation, such as technical assistance and environmental policy development.

Most governments and companies do not yet report financial data using NbS or nature tags. However, the UN Statistical Division and the OECD are exploring how to better capture environmental spending in national expenditure data (United Nations Statistics Division [UNSD] 2022; OECD 2023e). Joint UNEP–University of Oxford work

on the Sustainable Budgeting Approach also aims to provide more granular data on public finance flows that are relevant for nature and have positive, negative or neutral impacts on natural capital. These efforts may allow future SFN reports to disaggregate NbS financial flows in greater detail.

¹⁶ The flows depicted by the arrows are illustrative but not exhaustive; that is, there are links between types of finance flows and types of NbS that may not be indicated.

SFN 2023 calculates a “best estimate” of NbS finance flows in 2022:

- When 2022 data was unavailable, data from previous years was used as a proxy.
- In the absence of NbS-tagged financial datasets, SFN 2023 combined finance flow data with informed assumptions about NbS relevance to estimate NbS finance flows.¹⁷
- The risk of double counting when finance flows are included in multiple categories within data sets was minimised by triangulating data between sources and definitions.
- Changes in estimates over time are real changes and are presented in 2023 USD. When there were changes in scope, methodology or data in SFN 2023, estimates in SFN 2022 were recalculated on the same basis so they remain comparable.

Public funding for NbS from governments and public financial institutions was estimated based on domestic expenditures across five governmental budget lines, the largest of which was protection of biodiversity and landscapes as well as sustainable agriculture, forestry and fishing.

The situation is more complex for data on private finance flows to NbS. Due to the format of available data, private finance flows to NbS were estimated based on finance flows from businesses and corporations, private financial institutions, specialised funds, eNGOs and philanthropy, and farmers, households and individuals. Data sources are listed in the annex.

When tracking investments into NbS, it is critical to recognize gender dimensions, including women’s contributions. National statistics should be moving towards gender-disaggregated data at the sector level, including participation rates, access to resources, decision-making power and the impacts of nature-based solutions on different genders. It also helps in tracking progress and identifying areas that require specific interventions.

3.5. Concluding remarks

This chapter has documented the volume and channels of finance flows to NbS. Total finance flows to NbS have been estimated at US\$200 billion in 2022. Public finance remains the main source, with 82 per cent (US\$165 billion) of the total flow. ODA flows have stagnated, and the share of ODA going to nature remains small (1 per cent in total finance flow to NbS).

Private finance to NbS has remained low. The largest component, biodiversity offsets, is driven by regulatory requirements, which can be effective in generating the needed change in business and finance. While sustainable supply chains provide significant private finance to NbS, the share of organic products and deforestation and conversion-free products in agricultural production remains very small, indicating that many unrealised opportunities remain.

While there has been increased finance flowing to NbS, these flows are vastly overshadowed by the nature-negative finance flows (chapter 2). Finance flows to NbS are less than three per cent of the volume of nature-negative finance flows. The contrast is starker for private NbS finance flows, which are less than one per cent of private nature-negative finance flows. Unless nature-negative finance is tackled and redirected, increases in NbS finance will have only marginal impacts.

The next chapter looks at how NbS can contribute to meeting global goals around climate, biodiversity and land degradation and the associated investment needs. Current finance flows are compared to investment needs to estimate the finance gap that is preventing achievement of the Rio targets.

¹⁷ See technical annex for assumptions and adjustment factors

4

How much investment in NbS is needed to reach Rio Targets

This chapter estimates how much investment in NbS is needed to use the potential of ecosystems (the Agriculture, Forestry and Other Land Use contribution) to reach Rio Convention targets to limit global warming to below 1.5°C, halt biodiversity loss by ensuring that 30 per cent of land and sea is protected by 2030 and reach land degradation neutrality by 2030. Investment needs are calculated for different types of NbS, suggesting how much money needs to be invested and where. Further granular analysis by region provides information on the different needs and opportunities for protected areas¹⁸ and other protection-related NbS,¹⁹ ecosystem restoration²⁰ and sustainable land management.²¹

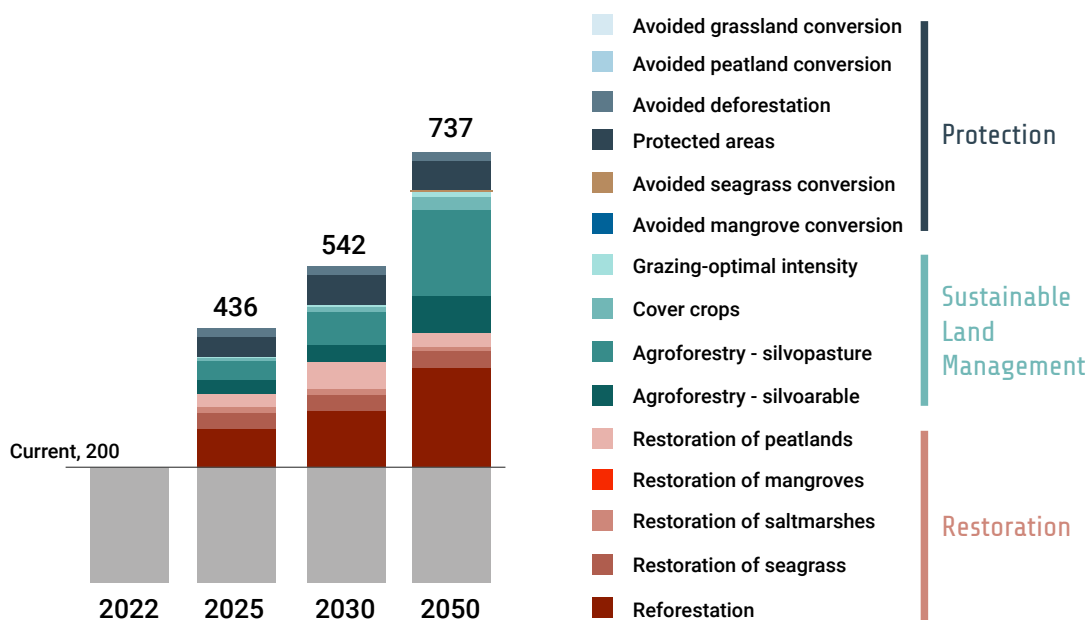
Based on modelling of potential financial returns of NbS, this report estimates the likely relative share of public and private finance for NbS over time. Investment needs are compared to current finance flows to estimate the gap between current finance and what is needed. Note that investment in NbS needs to enhance gender equality, reduce poverty, increase resilience and empower marginalised communities. Although not explicitly analysed in SFN 2023, urban-NbS will become increasingly important as currently 56 per cent of the global population lives in urban areas and the urban population is forecast to, which will double by 2050 (WB 2023b).

4.1. Annual investment needs and opportunities

Annual financial flows to NbS need to more than double by 2025 (from US\$200 billion to US\$436 billion) and nearly triple to US\$542 billion by 2030 to reach climate, biodiversity and land degradation targets.

Figure 4.1 depicts the additional finance needed for NbS each year from 2025–2050. This analysis assumes that current finance flows are committed to current projects and that future projects required to meet Rio Convention targets will require *additional* finance.

Figure 4.1. Additional annual investment needs to reach Rio targets, \$ billion (2023 US\$)



¹⁸ A protected area is a clearly defined geographical space that is recognised, dedicated and managed through legal or other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values (UNEP WCMC 2016).

¹⁹ Protection-related NbS refers to NbS activities that avoid conversion and degradation of ecosystems.

²⁰ The UN Decade on Ecosystem Restoration frames restoration as activities to prevent, halt and reverse degradation. Restoration is based on a continuum of practices for rehabilitation and ecological restoration and includes ecosystem management (WB 2022a).

²¹ Sustainable land management in this report uses the WOCAT definition that has been agreed upon by governments through the IPCC Special Report on Climate Change and Land (WOCAT 2023): "The use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (WOCAT 2023). SLM in chapter 4 includes both conservation and regenerative agricultural practices.

The 16 NbS included in the analysis are grouped into three NbS types or categories – sustainable land management, restoration and protection (Figure 4.1). While this pragmatic grouping of NbS supports analysis and the development of policy recommendations, the distinction between restoration, protection and SLM is admittedly artificial, as there is significant overlap between categories. The five NbS treated as restoration (reforestation, restoration of peatlands, mangroves, seagrass and saltmarshes) are those NbS that have the primary objective of restoration. However, some NbS classified here as SLM have restorative functions, for example, cover crops and improved grazing improve soil fertility and reduce erosion. Restoration can also occur in areas under protection.

Sustainable land management investment needs are based on the potential expansion of agroforestry (silvopastoral and silvoarable), covers crops and optimal grazing intensity practices. Its relative contribution to achieving environmental targets increases over time.

Annual investment opportunities in SLM increased fourfold from US\$63 billion in 2025 to US\$241 billion by 2050. The share of finance for SLM also increases over time relative to restoration and protection, with 27 per cent of additional NbS finance going to SLM in 2025, increasing to 45 per cent by 2050. **As many NbS based on SLM generate financial revenues, SLM provides an important opportunity for private investment and is thereby critical to scale NbS finance.**

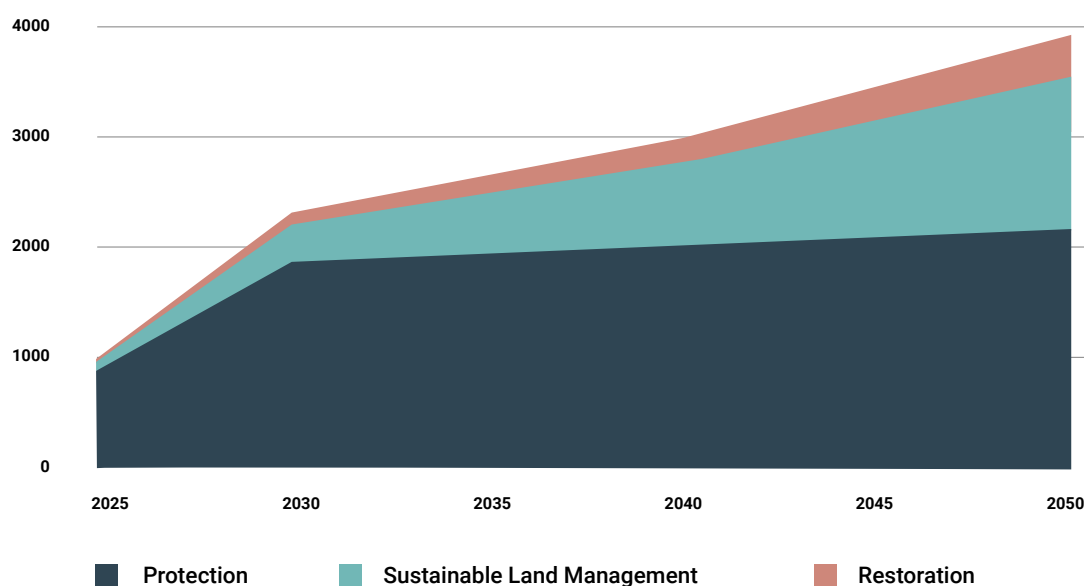
Due to their relatively high cost, restoration NbS potentially require the highest levels of

investment at US\$125 billion per year by 2025 and over US\$177 billion per year by 2030. Three of the five types of NbS that will absorb the most finance are based on restoration: reforestation, seagrass and peatland restoration. Restoration can be costly due to high levels of inputs and the high opportunity costs of switching land use. For example, the costs of transitioning from cropland to forest include the foregone financial returns from using the land for crop production. As a result, restoration may absorb over half of NbS finance each year until 2030.

Of the additional US\$342 billion needed annually by 2030 for NbS, protection-related NbS (including protected areas and avoided conversion of forests and other ecosystems) absorb US\$66 billion (roughly 20 per cent of additional NbS finance). Additional finance for protection-related NbS needs to increase quickly from US\$48 billion in 2025 to US\$66 billion in 2030 as countries implement the 30x30 target. Finance for protection-related NbS includes the establishment of new protected areas and avoided conversion of key ecosystems, for example, avoided deforestation and degradation of peatlands and mangroves. Finance for protection is likely to remain roughly constant after 2030 once the 30x30 target has been met.

Quantifying the financial value of investment needed in NbS indicates the NbS that are likely to absorb most of the financing. To understand the physical scale of implementation of different types of NbS, Figure 4.2 provides an overview of the cumulative additional areas needed for protection, sustainable land management and restoration and how that evolves over time.

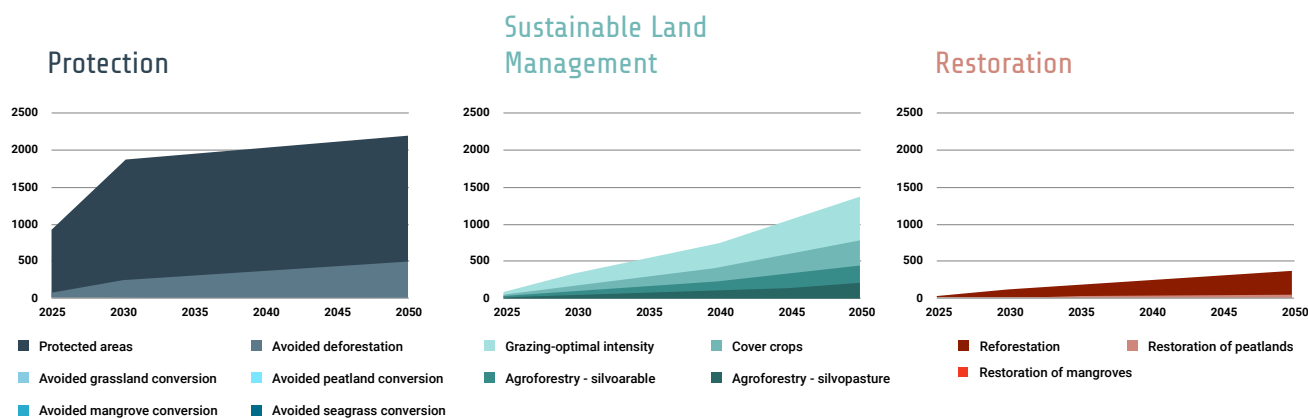
Figure 4.2. Cumulative additional land area by NbS 2025–2050, Rio-aligned, Mha



Protection-related NbS represent roughly 80 per cent of additional land area needed for NbS by 2030 while absorbing only 20 per cent of additional NbS finance due to its cost-effectiveness. Per hectare costs are significantly lower for protection than for restoration, which is, on average, six times more costly (Cook-Patton *et al.* 2021). Protection is preferred if possible because restoration is not consistently able to return ecosystems to their full function (Holl and Brancalion 2020) and may not yield the same biodiversity benefits as protection. Figure 4.3

indicates that to meet the 30x30 target, land and seascape protection (including avoided conversion of forests, mangroves, peatlands and seagrass ecosystems) needs to rapidly increase to roughly 900 million hectares by 2025 and to 1.9 trillion hectares by 2030. Figure 4.3 illustrates that protected areas are the dominant form of protection-related NbS, with avoided deforestation of a smaller but increasing importance after 2030. Once 30 per cent of land and seascapes are protected by 2030, further expansion of areas to be protected may slow.

Figure 4.3. Cumulative additional area by NbS category 2025–2050, Rio-aligned, Mha



Note: The land required for protected areas in this chart represents the estimated additional land required to meet 30x30 targets and so does not include land currently under protection.

The area under sustainable land management can expand significantly from 80 million hectares in 2025 to 335 million hectares by 2030 and 1.4 billion hectares by 2050. This expansion is based on improving the management of unsustainably managed lands and seas for food and commodity production. Converting areas of livestock production to optimal grazing is essential to ensure production of livestock products that minimises loss of biodiversity and GHG emissions due to ecosystem conversion. The area under improved grazing can potentially expand by a further 40 million hectares in 2025, reaching over 150 million hectares by 2030 and almost 600 million hectares by 2050. The area under agroforestry can potentially increase from 27.5 million hectares in 2025 to 113 million hectares by 2030 and over 450 million hectares by 2050. The planting of trees in crop and livestock production systems supports the transition of food systems to more resilient diverse systems with livelihood, biodiversity and climate benefits. Cover crops provide a cost-effective means to

reduce soil erosion and promote soil fertility and biodiversity – the 14 million hectares under cover crops by 2025 can expand to 65 million hectares by 2030 and 340 million hectares by 2050.

While absorbing over half of annual NbS finance by 2030, the cumulative area under restoration (roughly 370 million hectares) is only 9 per cent of total NbS area by 2050. Restoration NbS includes reforestation and peatland and mangrove restoration (saltmarsh and seagrass areas are very small). Figure 4.3 illustrates the dominance of reforestation in the restoration portfolio. Over time, the area dedicated to NbS restoration increases, while protection stabilises. This can be due to expected declines in the cost of restoration associated with higher carbon prices for reforestation and better technology. Restoration will be the “optimal” solution in some areas in the future due to, for example, its high carbon capture benefits.

Together, SLM and restoration NbS will cover 1.7 billion hectares by 2050. Restoration may also occur in protected areas, a potential overlap not currently modelled. In short, this analysis provides very conservative estimates of investment opportunities for restoration NbS. Nevertheless, it is likely that the area dedicated to ecosystem restoration NbS will be smaller than protection NbS given the large difference in costs.

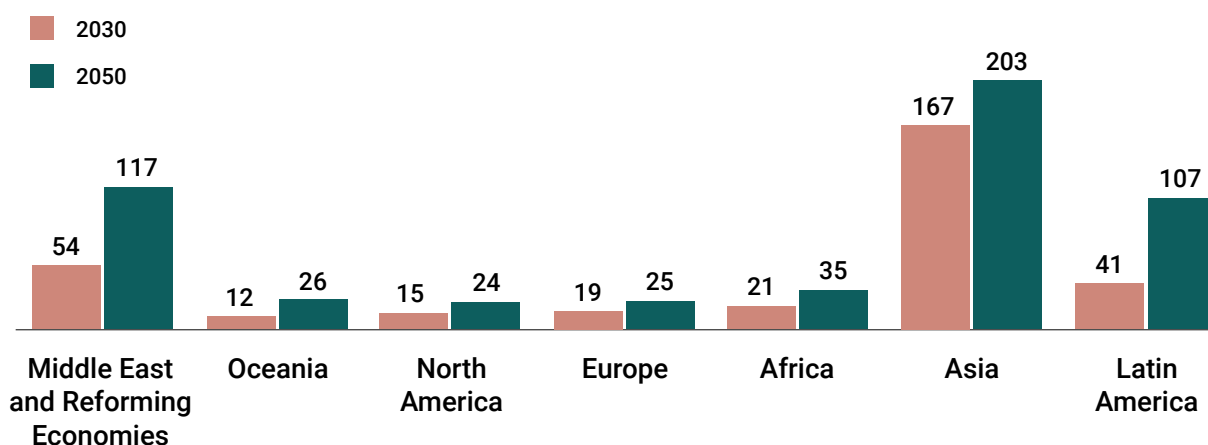
As MAgPIE models the most cost-effective land use given specific economic, environmental and policy constraints, lower cost protection and SLM are prioritised. Protection is prioritised by treating the 30x30 target as an input into the model, which then optimises food production and carbon sequestration subject to a set of variables (population growth and diets, carbon price, etc). It is possible that the relative benefits of restoration are underestimated here.

4.2. Nature-based solutions finance needs by region

To better target finance flows, the analysis looks at the regional distribution of investment opportunities. As noted, MAgPIE seeks the lowest cost land-use pathway that satisfies economic, demographic and policy constraints. It optimises land use to satisfy multiple constraints, including urban growth, population growth, demand for food and materials and increasing carbon prices. It also accounts for existing commitments (NDCs, 30x30), baseline land use, opportunity costs and deforestation rate. While a range of factors helps to explain regional differences, three factors are particularly important: national commitments, baseline land use and the opportunity cost of land.

In Africa, NbS opportunities are predominantly protection-related and, therefore, financing needs appear to be relatively low. Baseline land use – particularly high rates of deforestation – provides significant opportunities for cost-effective avoided deforestation through protection. Moreover, restoration is particularly high cost in Africa relative to protection due to the high opportunity cost of land driven by relatively rapid population and GDP growth. Under alternative scenarios, NbS finance needs in Africa may be higher given the high mitigation potential assessed in other studies (Roe *et al.* 2021).

Figure 4.4. Additional NbS investment needs per year by region, Rio-aligned, \$ billion (2023 US\$)










Modelling suggests that investment needs are likely to be greatest in Asia with an additional US\$167 billion per year needed per year by 2030, rising to US\$203 billion per year by 2050 (Figure 4.4). The Middle East and Reforming Economies and Latin America also absorb relatively high levels of NbS finance.

Cumulative additional investment needs are relatively high in Asia, at US\$1,037 billion by 2030 (Table 4.1). This is driven by ambitious restoration commitments in NDCs of some Asian countries. China has committed to plant 70 billion trees by 2030 (WEF 2022c), and India's NDC commits to expand forested land by 30 million hectares by 2030 (Carbon Brief 2022).

Table 4.1. Cumulative NbS investment needs by region

With Rio alignment, NbS finance need is greatest in developing and emerging economies. Regions where NbS opportunities are predominantly protection-related have a relatively low finance need.

	Largest NbS by land area	Cumulative finance need by 2030 (US\$ billion), Rio-aligned	Key facts
Asia	 Reforestation Agroforestry	1,037	US\$430 billion for 170Mha of reforestation by 2050 Consistent with reforestation ambition in Asia, e.g. China's commitment to plant 70 billion trees by 2030 (WEF 2022) and India's NDC committing to expand forested land by 30Mha by 2030 (Carbon Brief 2022)
Middle East and Reforming Economies	 Agroforestry	323	US\$180 billion investment required for agricultural NbS Russia and Kazakhstan have highest crop and grassland carbon sequestration potential (Rose et al. 2022)
Latin America	 Reforestation	238	US\$60 billion investment needed to reforest 100Mha by 2050 Requires significant scale-up from current commitments, e.g. Brazilian commitment to reforest and restore 18Mha by 2030 (Simpkins et al. 2022)
Africa	 Avoided deforestation Protected areas	128	Investment required is primarily into low-cost protected areas and avoided deforestation NbS expansion is constrained due to competition from urban expansion and conventional agriculture
Europe	 Agroforestry	111	US\$40 billion investment required for agriculture NbS Aligns with EU Soil Strategy for 2030 and proposed EU Soil Health Law (European Commission 2022)
North America	 Protected areas Agroforestry	90	US\$40 billion investment required for protected areas to achieve North America's targets Canada and US committed to 30x30, requiring protected area expansion of 340Mha (Government of Canada 2022; Natural Resources Defense Council 2022)
Oceania	 Agroforestry	71	US\$30 billion investment required for agriculture NbS Potential of agriculture NbS recognised in Australia's NDC, including soil organic carbon as a key mitigation measure (Rose et al. 2022)

Note: The regions presented are aggregated from regions in MAGPIE.²²

²² Middle East and Reforming Economies include United Arab Emirates; Armenia; Azerbaijan; Bahrain; Belarus; Algeria; Egypt; Western Sahara; Georgia; Iran (Islamic Republic of); Iraq; Israel; Jordan; Kazakhstan; Kyrgyzstan; Kuwait; Lebanon; Libya; Morocco; Republic of Moldova; Mongolia; Oman; Palestine, State of; Qatar; Russian Federation; Saudi Arabia; Sudan; Syrian Arab Republic; Tajikistan; Turkmenistan; Tunisia; Ukraine; Uzbekistan; Yemen. List of states or areas for other regions can be found in the technical annex.

4.3. Who will finance the required investment in nature-based solutions?

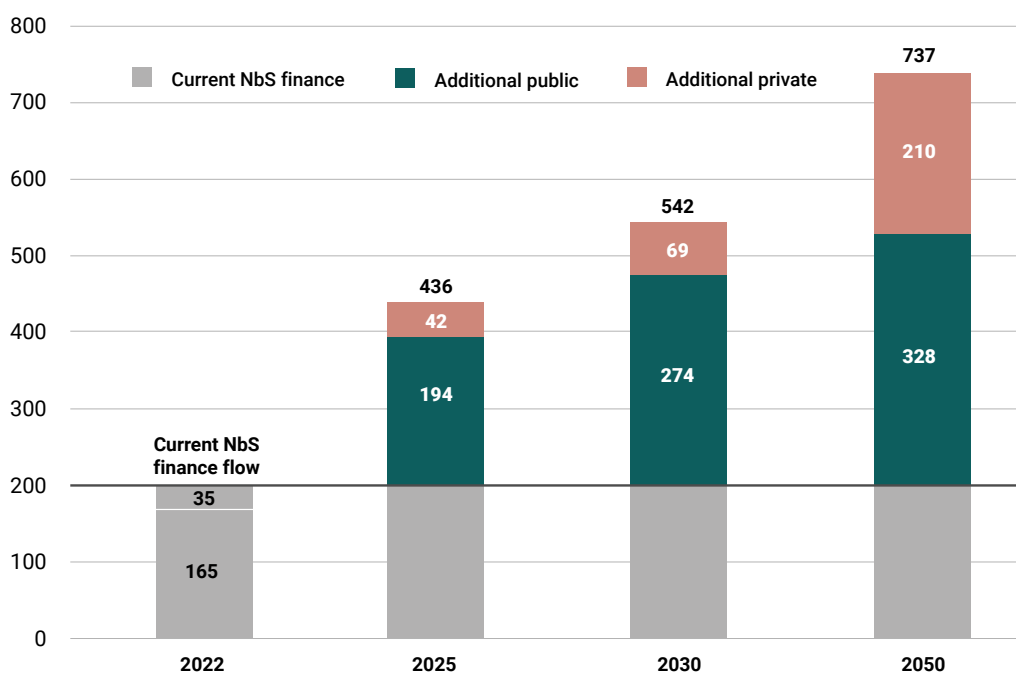
In recent years, there has been a strong push for the private sector to increase funding for biodiversity, restoration and climate action given perceived limits to the ability of governments to increase direct public investment. In response, some research (Kedward *et al.* 2022) has looked at the business case for private investment and has found critical limitations and a continued strong case for public investment in public goods.

This analysis of investment needs considers whether finance for different types of NbS is likely to be provided by public or private sources. The private–public finance split is assessed by analysing how NbS returns, country market risk scores, NbS readiness levels and risk associated with project lifetimes will evolve over time. A model is then calibrated to historical relationships between these variables and financing from a range of public and private instruments to assess projected finance from private and public sources.

Figure 4.5 presents an overview of additional NbS finance needed annually from public and private sources. While both public and private NbS finance flows are likely to steadily increase to 2050, private sources will provide a growing share of total NbS finance.

By 2030, annual private finance can potentially increase by almost US\$70 billion on top of current flows of US\$35 billion per year (18 per cent of total NbS finance). **Total annual NbS finance from private sources will then reach over US\$100 billion by 2030, almost three times current levels.** An additional US\$210 billion/year would bring total (current and forecast) private NbS finance to almost US\$250 billion per year by 2050 (roughly 33 per cent of total needed NbS finance).

Figure 4.5. Additional NbS investment needs from public and private sources, Rio-aligned, \$ billion (2023 US\$)



However, given the scale of investment needed and characteristics of NbS, public investment will continue to play a critical role. Government spending on NbS should quickly more than double from current levels (US\$165 billion/year) to US\$359 billion/year by 2025 (an increase of US\$194 billion) and to triple to US\$439 billion/year by 2030 (an increase of US\$274 billion). **While the relative share of private finance increases over time from 18 per cent to 33 per cent, government expenditure will continue to provide most of the finance for NbS and, therefore, must dramatically increase to ensure Rio targets are met.**

The dominance of public funding for NbS to address climate, biodiversity loss and land degradation is likely to continue. Features associated with investing in NbS may limit uptake

by private actors, including the high opportunity cost of land, high market risk in countries with high NbS potential, high transaction costs as well as the public goods nature of many ecosystem services provided by NbS. However, lessons can be learned from climate finance. While climate finance remains insufficient to fully implement mitigation and adaptation targets, high levels of public investment and incentives have been successful in catalysing private climate finance. Half of climate finance came from private sources in 2020 and recent analysis suggests the private sector could deliver 70 per cent of investment needed to meet net zero goals (UNFCCC 2021). However, much more is needed.

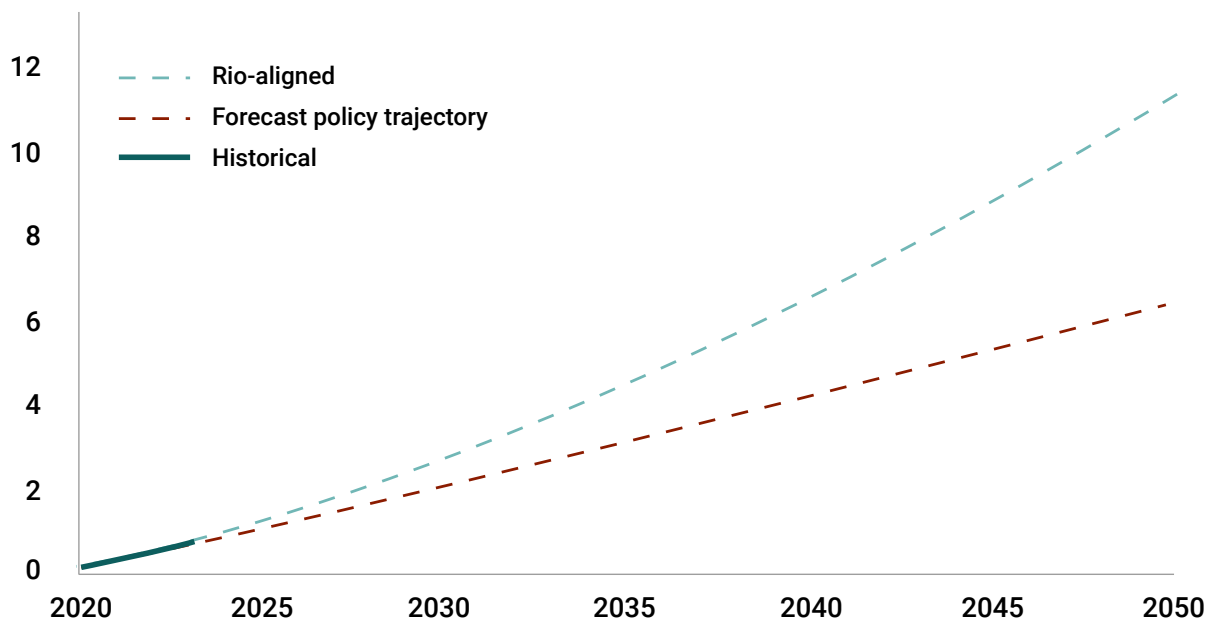
4.4. The Forecast Policy Trajectory: a more likely scenario?

Most countries have agreed to the goals and targets of the Paris Agreement, GBF and UNCCD. However, national commitments and actions to implement those targets are not well-aligned with global targets. For example, current emissions reductions in NDCs fall well short of emissions reductions needed under the Paris Agreement and point to a 2.8°C temperature rise by the end of the century (UNEP 2023b). A new scenario is thus introduced to reflect the inadequacy of current climate, biodiversity and restoration commitments.

The Forecast Policy Trajectory scenario (FPS) is based on the Inevitable Policy Response – FPS + Nature scenario developed by UN-backed Principles for Responsible Investment (UNPRI) for use by investors (UNPRI 2023). Based on current commitments, the likelihood of policy implementation and market trends, this scenario models how countries fall short of protected area, restoration and climate commitments. This scenario analysis is based on the MAgPIE model combined with additional analysis.

Finance flows for NbS under this scenario are only sufficient to support the protection of 20 per cent of land by 2030. Only 6 per cent of global land area is under restoration by 2050. Figure 4.6 illustrates the forecast policy trajectory, that is, the likely trajectory of NbS finance if countries do not take strong and urgent action to align national commitments with full implementation of the Rio Convention targets. A cumulative shortfall of roughly US\$600 million by 2030 grows to almost US\$5 trillion by 2050 with serious implications for actions needed to tackle climate change, biodiversity loss and land degradation.

Figure 4.6. Cumulative investment needs, 2020–2050, \$ trillion (2023 US\$)



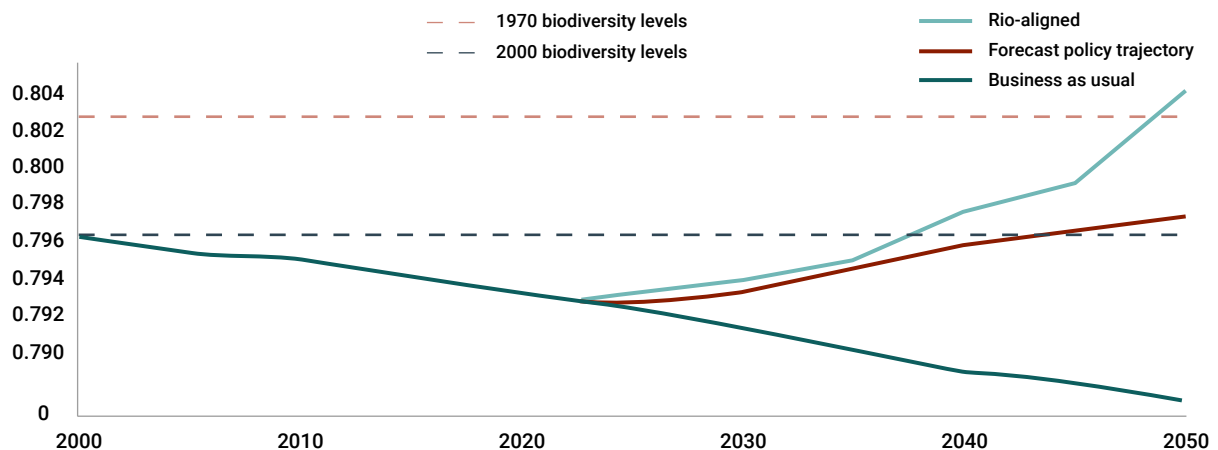
Under the Forecast Policy Trajectory, there is significantly less investment in agroforestry and restoration, particularly in peatland restoration, which has very high carbon sequestration potential compared to other NbS (Tanneberger *et al.* 2020). This is due to their relatively high cost, reliance on carbon prices and policy. The smaller volumes of NbS finance have less impact on investment in activities to avoid deforestation as protection is relatively low cost.

4.5. Benefits of nature-based solutions investment

If investment in NbS increases to the scale recommended here, NbS can significantly contribute to meeting biodiversity and climate targets. Land use and biodiversity modelling suggests that if successfully implemented, the Rio Conventions would return the planet to the average biodiversity levels of the 1970s. The Biodiversity Intactness Index (BII) in Figure 4.7 illustrates historical and projected biodiversity intactness.²³

²³ BII estimates how much of an area's natural biodiversity remains by assessing the average abundance of native terrestrial species compared to their abundance in the absence of pronounced human impacts (De Palma *et al.* 2021). BII proxies for global change in ecosystem services or nature outcomes. The BII level is extrapolated backwards to 1970 based on the rate of change modelled in BAU.

Figure 4.7. Forecast global Biodiversity Intactness Index (BII) by scenario

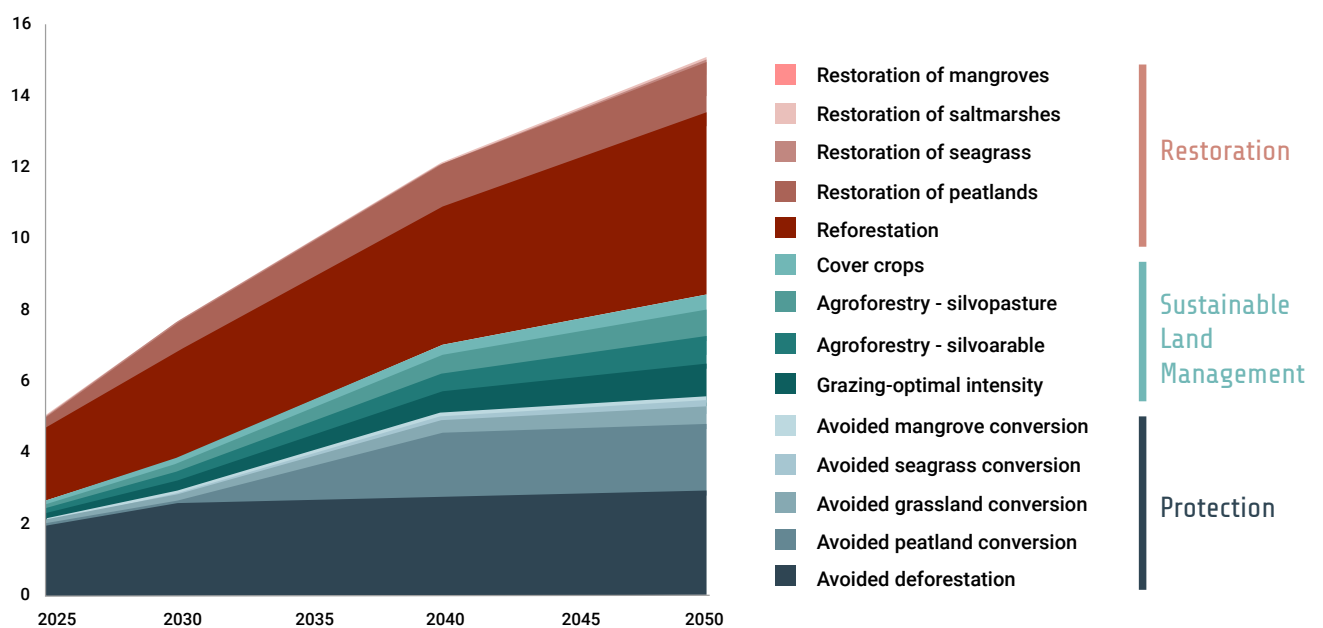


Source: UN PRI (2023)

In the Rio-aligned scenario, net deforestation would end, and reforestation would scale significantly by 2030, resulting in 7.7 GtCO₂e per year in GHG removals. More costly NbS, such as peatland restoration and agroforestry, would scale significantly to 2050, contributing to a total of 15GtCO₂e per year in removals. There is growing evidence that nature can contribute significantly

to climate mitigation (Deng *et al.* 2022) - the NbS included in this analysis can produce GHG removals to close over one third of the emissions gap of 22GtCO₂e in 2030 (UNEP 2023b) to the limit climate change to below 1.5°C.

Figure 4.8. GHG removals from NbS, GtCO₂e/year



4.6. Methodology, data and limitations for nature-based solutions investment needs

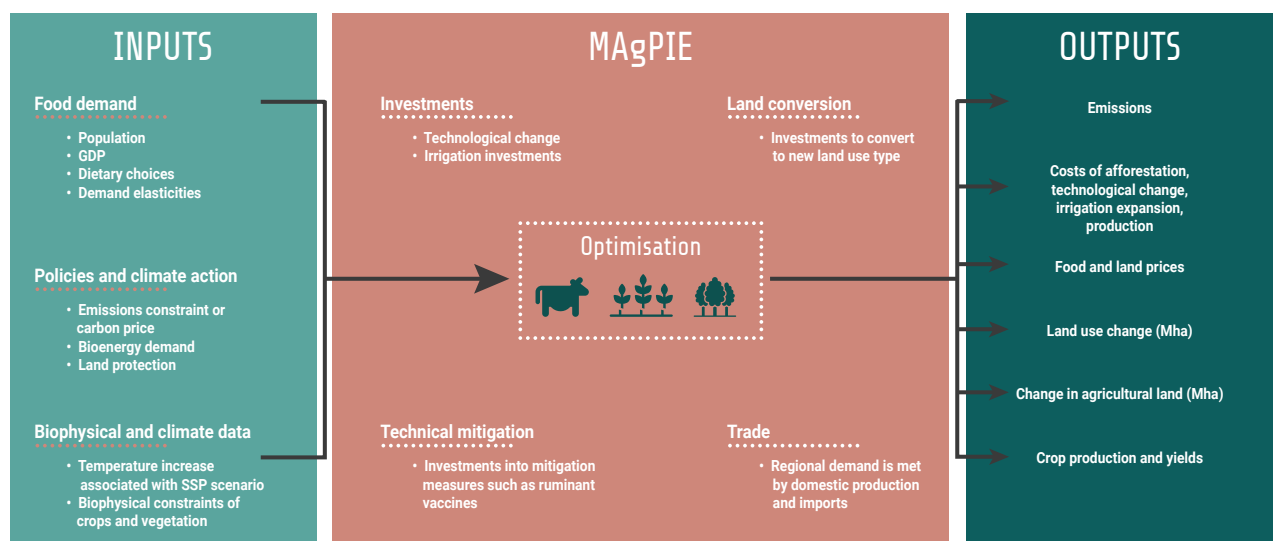
SFN combines land use modelling and supplementary analysis based on scientific literature to estimate investment needs for NbS. To note:

a. This analysis focuses on the 'Rio-aligned' scenario to quantify how much needs to be invested to reach the 30x30 target, use the full potential of NbS to limit global warming to 1.5°C and reach land degradation neutrality by 2030. An alternative Forecast Policy Trajectory scenario is used to explore how current progress on national and

international commitments, market trends and the probability of policy implementation affect mobilisation of finance for NbS and associated outcomes.

b. The investment needs analysis is based on MAGPIE, a global land use allocation model developed by the Potsdam Institute for Climate Impact Research that explores land competition dynamics in the context of carbon policy scenarios (Figure 4.9). The model derives total land available for different uses from 2023 to 2050 and the associated costs of NbS implementation.

Figure 4.9. Model (MAGPIE) inputs and outputs



c. MAGPIE's costs and land use change outputs are used to calculate annual and cumulative finance needed for NbS from 2023 to 2050.

d. Additional analysis based on scientific literature provides estimates of feasible areas for mangrove, seagrass, saltmarsh and peatland restoration and protection as well as regenerative agriculture.

e. Cost and area data (constrained by MAGPIE variables where possible) are used to calculate capital investment and operations expenditure from 2023 to 2050.

Further detail is provided in the technical annex.

A weakness of the model is that it does not capture the effects of climate change. For example, while climate change is a big driver of biodiversity loss, the model does not capture how an increase in wildfires, extreme flooding and droughts will affect investment needs. A further limitation is the high level of uncertainty around the potential for restoration in marine ecosystems. Compared with terrestrial NbS, there is more uncertainty around both potential area and costs of marine ecosystem restoration. Finally, SFN 2023 provides estimates of investment needs for the 16 NbS activities with the greatest potential impact.

Future editions can be expanded to include a broader range of NbS, such as NbS in urban areas including green roofs, natural stormwater management and urban forests, which contribute significantly to reaching climate, biodiversity and restoration targets.

4.7. Concluding remarks

This chapter sets out finance needed for NbS to ensure they are used to their full potential to help tackle climate change, biodiversity loss and land degradation. Current annual NbS finance flows of US\$200 billion will need to almost triple to US\$542 billion by 2030 and to US\$737 billion by 2050. While restoration and SLM absorb most NbS finance flows, the area that needs to come under protection is far greater than for restoration and SLM. Public finance, currently at 82 per cent of the total, will need to dramatically increase given the nature of NbS. While there is scope for much increased investment from the private sector, the nature of NbS markets is likely to limit private investment to about a third of investment needed for NbS by 2050. Chapter 5 explores actions needed and the policy implications of the findings.



5

Key findings and recommendations

This report provides policy makers, businesses and financial institutions with an evidence-based snapshot of the very large scale of nature-negative finance flows, which at almost US\$7 trillion per year dwarfs finance flows to NbS of US\$ 200 billion per year (Figure 5.1). Urgent action to tackle nature-negative flows is critical. Unless the real economy and financial system reduce the financing of nature-negative activities (“greening finance”), actions to scale up investment in NbS (“financing green”) will be insufficient to reach Rio targets and transform the economic system to be more nature-positive and equitable.

Nevertheless, investing in NbS enables the use of nature’s potential to help cost-effectively tackle climate change, biodiversity loss and land degradation. Current investment is far from what is needed. Tripling NbS finance flows to US\$542 billion by 2030 can make a massive contribution to reach Rio targets. The solution requires a new *dual approach* scaling up public and private investment into NbS whilst reducing nature-negative capital flows from both public and private sources.

The first requirement is to continue to upscale investment into NbS for climate and nature conservation and restoration. This is often the only tangible funding available to directly stem the tide of nature’s loss and to protect, maintain and restore vital ecosystems. This report documents the huge opportunities for impact by investing in protection, sustainable land management and restoration. The science, evidence, frameworks and policy tools as well as financial innovation are well-developed. What is needed now is implementation by governments, businesses and financial institutions.

Second, greater emphasis is needed to create incentives to realign finance away from nature-negative activities and towards creating nature-positive outcomes. Investment opportunities in NbS are increasing through the transformation of the global food system, extractive sectors, real estate and infrastructure, sectors that are mostly closely linked to nature’s loss. These opportunities will be at least as large as those that have emerged in response to the climate crisis.

5.1. Key findings

This section provides an overview of the key findings and messages, followed by high-level recommendations on required action. Recommendations are high level as further work is required to identify the policy and financial instruments with the greatest ability to catalyse finance for NbS and effectively tackle nature-negative investment.

Nature-negative finance flows

Annual finance flows from public and private sources that have a direct negative impact on nature are estimated at almost US\$7 trillion per year.

Private nature-negative finance

For the first time, global private finance flows that have a *direct* negative impact on nature have been estimated, and they are very large indeed at US\$5 trillion per year (around 5 per cent of global GDP).

- Private nature-negative finance flows are 140 times larger than tracked private investments into NbS.
- This is likely to be an underestimate as nature-negative finance with indirect impacts is not included.
- The five industries channelling most of the negative financial flows – construction, electric utilities, real estate, oil and gas, and food and tobacco – represent 16 per cent of overall investment flows in the economy but 43 per cent of nature-negative flows.

Public nature negative finance

Tracked nature-negative public finance flows, estimated at almost US\$1.7 trillion in 2022, are more than 10 times greater than public finance flows to NbS (US\$165 billion).

- Almost 90 per cent of tracked negative public flows (EHS) are directed to fossil fuels (66 per cent) and agriculture (20 per cent).
- Fossil fuel subsidies to consumers *doubled* from US\$563 billion in 2021 to US\$1,163 billion in 2022.
- In addition to the US\$600 billion increase in fossil fuel consumption subsidies, IEA estimates extra spending of US\$500 billion to lower energy costs in 2022, with US\$350 billion in Europe following the Russian invasion of Ukraine.

Current finance flows to NbS

SFN 2023 estimates that total annual finance flows to NbS in 2022 were roughly US\$200 billion - only one third of NbS finance needed by 2030.

- NbS finance has increased by 11 per cent since SFN 2022.
- Governments continue to lead, providing 82 per cent (US\$165 billion) of total NbS finance flows. Nevertheless, public finance flows to NbS were less than one-tenth of public spending on environmentally-harmful subsidies in 2022.
- Private finance for NbS remains modest at US\$35 billion (18 per cent of total NbS finance flows). Over half is channelled through biodiversity offsets and sustainable supply chains.
- Private finance flows to NbS are less than one per cent of private finance flows that have a direct harmful impact on nature.

Future investment needs and opportunities

Finance flows to NbS must almost triple from current levels (US\$200 billion) to reach US\$542 billion per year by 2030 and to quadruple to US\$737 billion by 2050 to meet Rio Convention targets.

- Annual NbS investment opportunities in sustainable land management can increase fourfold from US\$63 billion in 2025 to US\$241 billion by 2050.
- As many SLM NbS generate financial revenues, SLM provides an important opportunity for private investment and is critical to scale private NbS finance.
- Restoration NbS potentially requires the highest levels of investment at over US\$177 billion per year by 2030, which is over half of annual NbS finance due to its relatively high cost and the global extent of degradation.
- Protection-related NbS represent roughly 80 per cent of additional land area needed for NbS by 2030 while absorbing only 20 per cent of additional NbS finance. This reflects the increase in area of protection needed to reach the 30x30 target and the relative cost effectiveness of protection.

Both public and private finance flows to NbS will need to dramatically increase to close the finance gap between current finance flows and the investment needed to meet Rio targets.

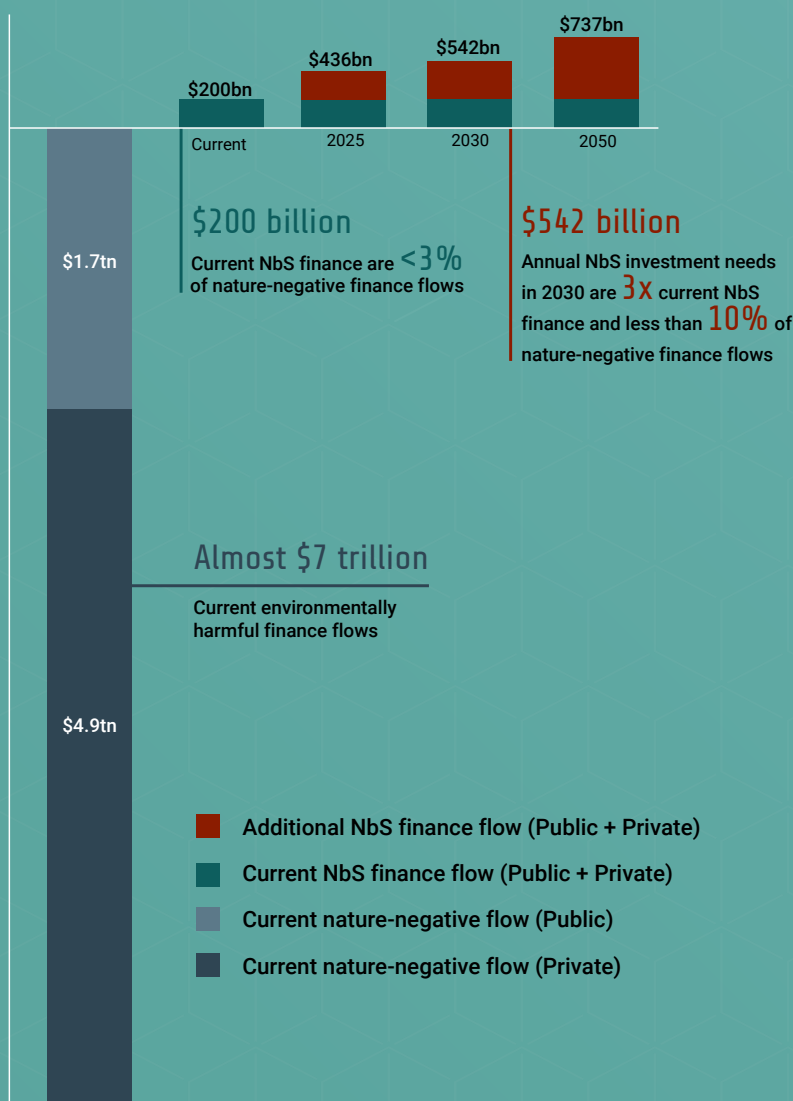
- While both public and private NbS finance flows will steadily increase to 2050, private finance can potentially increase its share of NbS finance from 18 per cent currently to 33 per cent by 2050.
- Total annual NbS finance from private sources can reach over US\$ 100 billion by 2030, almost three times current levels.
- Public investment will continue to play a critical role. Government annual expenditure on NbS needs to quickly increase from current levels (US\$165 billion) to US\$359 billion (an increase of US\$194 billion) by 2025 and to US\$439 billion (an increase of US\$274 billion) by 2030.

Synthesis

Governments are very unlikely to meet their international climate, nature and land degradation targets based on current funding commitments, likely policy implementation and market trends. Current funding commitments, likely policy implementation and market trends.

Figure 5.1 provides an overview of some of the key findings. US\$7 trillion per year in nature-negative finance flows vastly overshadow efforts to increase finance for NbS, which is currently at US\$200 billion per year. Finance flows to NbS are also much smaller than investment needs and opportunities, which call for the tripling of NbS finance by 2030 to meet Rio targets. The next section focuses on high-level recommended actions to put us on a pathway to a nature and climate positive future, for which investing in NbS is essential.

Figure 5.1. Current finance flows to NbS, nature-negative finance and investment needs



Sources: OECD (2020; 2022a; 2023e); IMF (2021); OECD (2023b; 2023d; 2023f); ODA, Philanthropy, private finance mobilised by ODA; Financial reports from five NGOs: CI (2022), RSPB (2022), TNC (2022), WCS (2022) and WWF (2022); FAO (2018b; 2018c); Rainforest Alliance (2022a; 2022b); RTRS (2022); RSPO (2022); Solidaridad (2019); De Jong (2019); GIIN (2020); Hand *et al.* (2020); Capital for Climate NbS Funds (2023); Impact Yield (2023); Partnership for Forests (2023); Funds for Nature (2023); Ecosystem Marketplace (2022); Kassam *et al.* (2019); Bennett *et al.* (2017); Hamrick (2017); United States of America, Fish and Wildlife Service (2022); European Commission (2023); China, Ministry of Foreign Affairs (2020); United States of America, Department of Agriculture (2022a; 2022b); FAO, UNDP and UNEP (2021); IEA (2023); Environmental Markets Lab (2018); Skerritt and Sumaila (2021); Interpol (2020); WB (2021); Koplou and Steenblik (2022); ENCORE; Refinitiv.

5.2. Recommendations

Building on SFN 2022, recommendations focus on:

- a) Greening finance – Reducing public and private nature-negative finance flows
- b) Financing green – Scaling public funding and private investment into NbS
- c) Green and inclusive financial systems – Ensuring a just transition to a green and inclusive financial system for vulnerable groups, women and Indigenous Peoples

Greening finance – eliminating nature-negative finance



Tackling nature-negative finance flows is the single most impactful intervention that can be made in the nature–climate space. Much of the funding required for NbS deployment can be secured in this way, whilst at the same time, ensuring a just transition. Despite clear commitments, nature-negative activities are financed by trillions of dollars each year, many times finance flows to NbS.

Business and finance – Transforming business as usual with assessment and disclosure frameworks

To tackle private nature-negative finance flows, disclosure frameworks are instrumental. They act as a guide through the maze of emerging pressures for reform driven by COPs and pending regulator activity. For example, the recently launched TNFD provides practitioners with a new language of risks, dependencies, impacts and opportunities. However, frameworks alone are not sufficient to change behaviour unless those that disclose get benefits over those that do not. Such benefits might include lowering the costs of capital to disclosers as well as compliance and reputational benefits.

The International Sustainability Standards Board (ISSB) of the International Financial Reporting Standards has created S1 (general) and S2 (climate) standards, now adopted by the International Organization of Securities Commissions, indicating how global standards can merge. This is also likely to happen for nature. TCFD will be absorbed into ISSB in 2024. The ISSB has already announced that it will consider nature as a possible next global standard, building on the work of the TNFD. A social standard may also follow. Together, these can create a welcome level playing field for business on ESG and can stimulate private sector flows towards Rio Convention targets and SDG goals. Market leaders should continue to push for regulation and mandatory higher standards to level the playing field.

It is also critical for finance and business to commit to targets that reduce biodiversity and climate impacts. An increasing amount of guidance and tools are available to support this process, including the Science-based Targets Network (SBTN) and Business for Nature's Assess, Commit, Transform and Disclose (ACT-D) framework that help companies to assess, commit, transform and disclose impacts on nature. The UNEP Finance Initiative has recently launched the Principles for Responsible Banking Nature Target-Setting Guidance that provides a practical framework for banks to address nature loss and align with the Global Biodiversity Framework.



Governments – Realign and repurpose harmful subsidies to become climate, degradation and nature positive (socially just)

Governments should place greater emphasis on realigning public subsidies away from climate- and nature-negative incentives and towards NbS, climate and nature-positive ones. There are internationally agreed upon targets to reform subsidy regimes, including target 18 in the GBF to eliminate, phase out or reform incentives that are harmful to biodiversity by at least US\$500 billion a year. There is a wealth of evidence and experience on the need to reform harmful subsidies and how to do it. However, there has been limited success to date due to political and social barriers to reform. Vested interests, for example, large-scale farms and businesses, frequently benefit from subsidy regimes and are effective lobbyists.

The World Bank (2023a) surveyed all cases of subsidy reform globally, including successes, failures and reform reversals. Experience suggests that to be successful, governments should prioritise subsidy reform that:

- protects the poor and addresses gender inequalities
- builds public acceptance
- provides the time needed for people and businesses to adjust
- shows clearly how repurposed revenue is being spent

Upon taking office earlier this year, Nigeria's president eliminated the fuel subsidies that cost the nation US\$522 million per month. Fuel prices shot up by 175 per cent overnight and have increased further since. Removing subsidies and having people pay market prices for energy has focused attention on more efficient sources of energy. As a result, Nigeria is projected to reach 1.6 gigawatts of solar capacity within a year, three times the previous forecast. In a country where 70 per cent of households are not connected to the grid and those who are suffer frequent blackouts, a faster transition to solar will have a massive impact on access to electricity. Moreover, the estimated 51 million tons of GHG emitted from Nigeria's 22 million generators would be much reduced (Ibukun 2023).

Governments – Provide an enabling policy environment for private action to tackle nature-negative finance flows

Governments must encourage and consider mandating assessment, reporting and disclosure of nature risks, impacts, dependencies and opportunities by business and finance. While voluntary action is increasing based on an improved understanding of the materiality of nature risks and impacts, it has been and is likely to continue to be insufficient.

Increased use of regulation and incentive mechanisms are critical tools for governments to shape private sector action and behaviour. Requiring due diligence and offering tax breaks for the transformation of unsustainable and nature-negative supply chains need to be scaled. Requirements for strict adherence to the mitigation hierarchy²⁴ and biodiversity offsetting for investment and development need to be widely adopted. Fiscal instruments remain critical tools to ensure that ecosystem services and biodiversity are correctly valued and managed, internalising externalised costs. Incentive structures are needed to ensure that sustainable alternatives are less costly than unsustainable business models.

²⁴ The mitigation hierarchy can be defined as: 'the sequence of actions to anticipate and avoid impacts on biodiversity and ecosystem services; and where avoidance is not possible, minimize; and, when impacts occur, rehabilitate or restore; and where significant residual impacts remain, offset' (Cross Sector Biodiversity Initiative 2013).



Financing green – scaling public funding and private investment into nature-based solutions

Government action via public finance

Embed biodiversity, restoration and climate targets in law with targets on finance

Real change will require countries to embed targets in law and put strategies in place for implementation (e.g. in National Biodiversity Strategies and Action Plans [NBSAPs] and Nationally-determined Contributions and Land Degradation Neutrality plans) with sufficient and targeted financing and policy instruments. The European Commission's Nature Restoration Law, for example, requires assessment of restoration finance needs and gaps as well as solutions to close the gaps within 12 months and includes a dedicated EU instrument (European Parliament 2023). Clarifying and enforcing land tenure rights and access to land will provide the legal basis, incentives and access to needed finance for land managers like Indigenous Peoples.

Increase domestic expenditure on NbS, particularly on NbS providing public goods

Governments provide 82 per cent of finance for NbS, and direct expenditures will continue to provide the bulk of finance for NbS. The establishment and management of protected areas will continue to rely on public funding, and protected areas and avoided conversion should be treated as a solutions for the cost-effective provision of critical ecosystem services, thereby providing local and global public goods. When possible, governments can increase direct funding for protection and restoration as well as promote demand for investment in NbS via green public procurement.

Increase ODA and NbS share of ODA

Given much of the responsibility for climate change, biodiversity loss and land degradation lie with the developed countries and given much of remaining biodiversity and nature-based carbon stores are located and under threat in developing countries, there is a strong case for scaling up concessional and grant development finance to developing countries. Given that NbS can deliver multiple benefits for people, climate and biodiversity in an integrated manner, they should be prioritised in ODA programming. ODA funds should also be used in a more strategic manner via blended finance structures to use scarce public money to catalyse private investment in NbS. Finally, ODA flows are small and are likely to remain small considering political pressures in donor countries. It is therefore critical to ensure that the flow of finance for NbS from developed to developing countries is not limited to ODA. Innovative financial instruments are needed to facilitate private investment in NbS where they are most cost effective.

Government action to catalyse private finance for nature-based solutions

Government policies play a key role in creating an enabling environment for the private sector to invest in NbS. Regulation and incentives are key tools for governments to direct private finance to investments in nature and climate-positive goods and services. Market signalling through green taxonomies and transparency measures through corporate sustainability reporting requirements demonstrate how governments can also play a "soft" role to entice markets to direct private finance to NbS.

Incentives and regulation to scale private investment in NbS

Incentives – Government provision of incentives for investment in NbS needs to be scaled. For example, investment in regenerative agriculture will significantly increase in response to government incentives. The US Department of Agriculture recently committed to incentivise farmers to double cover crop planting by 2030 (Plume 2022). As an example, Box 6 provides details of incentives for sustainable agriculture via rural credit programmes in Brazil.



Regulation – Government regulation can be a powerful tool when private sector action is critical. Regulation that would make biodiversity offsetting mandatory has driven private sector investment in actions to conserve and restore biodiversity in many countries, for example, in Australia and France. Both the EU and the UK ensure sustainable supply chains through due diligence legislation that tackles illegal conversion and deforestation in global supply chains by making it illegal for certain companies to use forest-risk commodities (e.g. soy, palm oil and cocoa) that have been produced on land that has been illegally converted or occupied. The Brazilian Forestry Code promotes agroforestry by mandating a minimum of 20 per cent to 80 per cent natural vegetation on farmland.

Blended finance – Governments can incentivise private investment by reducing the costs and/or risks for private entities through blended finance instruments. For example, concessional and sub-ordinate loans, credit guarantees and grants that use public capital (domestic public funding or ODA) can be used to catalyse private investment in activities that the investors would otherwise consider too risky or unfamiliar. It is most efficient to build on existing structures as it takes time to build new blended finance structures. Blended finance needs to be scaled, and this can be facilitated by developing leaner governance structures.

Other key tools for governments to catalyse private investment in NbS include supporting the development of **high-integrity nature markets** and mandatory compliance by the private sector as well as developing **green, sustainable and/or NbS taxonomies** and harmonisation across geographies and sectors. NbS may be identified through technical screening criteria and incorporated into taxonomy reporting requirements for business and finance.

Private sector action to scale nature-based solutions finance

Businesses and financial institutions need to not only assess, manage and disclose nature-negative impacts but also to increase investment in Nbs and transform economies to nature and climate positive. There exists now a critical mass of knowledge and experience of a range of mechanisms to support scaling private finance for NbS, including prioritising investment in sustainable supply chains and in high-integrity nature markets and expanding the use of innovative green financial instruments (e.g. conservation or sustainable bonds and green insurance products). NbS may be developed as an asset class in a wider portfolio of nature assets.

Investing in sustainable supply chains, prioritising conservation and regenerative practices in agriculture, forestry and fisheries

Businesses and financial institutions must build on their growing understanding of their nature-related impacts and dependencies to prioritise investment in sustainable supply chains. Large businesses and financial institutions can influence suppliers and producers that are in their supply chains. Certification and sustainability standards clearly signal where investments should go. As noted, government regulation around trade in nature-risk commodities is only going to increase, and private entities that do not quickly adapt will become obsolete.

Using tools for tracking deforestation and forest-risk commodities, such as Global Forest Watch Pro, Trase, Earth, Spott and Forest 500, can assist the food sector to eliminate deforestation from their supply chains and comply with new regulations, such as the EU's new Deforestation Regulation (EUDR).



Box 6. Agri-food sector impact investing for conversion free supply chains

Over 160 global consumer goods companies and 57 financial institutions have committed to halt forest loss associated with agricultural commodity production in the Brazilian Cerrado (Farm Animal Investment Risk and Return [FAIRR] 2017). Eighty-five per cent of conversion of native vegetation for soy – a key commodity in the Cerrado – is legal under the Brazilian forest code. While there is abundant cleared or degraded land, financial incentives are needed to prioritise the use of degraded land over native vegetation.

In 2022, the Responsible Commodities Facility (RCF) piloted annual crop finance for soy farmers of US\$11 million, with reduced interest rates in exchange for not deforesting their land (including no legal deforestation). Three retailers (that had made zero deforestation commitments) financed the scheme at below market rates, allowing interest rate reductions on crop finance loans to farmers. The RCF reached US\$47 million in 2023 and aims to scale to over US\$100 million in 2024. Similar investment schemes (Innovative Finance for the Amazon, Cerrado and Chaco [IFACC]) have been developed. However, relative to the value of the soy export market in Brazil alone (US\$28 billion in 2021), these and other sustainable supply chain initiatives are very small and need to scale quickly (IFACC 2023).

Develop nature as an asset class to create non-traditional revenue streams, for example, biodiversity and carbon credits

A key barrier to private investment in some NbS has been the absence of consistent and monetisable revenue streams. The development of carbon revenues has in some cases made investment restoration and sustainable land management financially viable. This is particularly important to cover any costs or lost productivity as, for example, food systems transition from extractive monoculture to regenerative agricultural systems.

While compliance-led biodiversity offsets are currently a large source of private finance (US\$12 billion in 2022) for NbS, the market for biodiversity credits is currently very small at around US\$2–8 million, with only a few operational schemes. However, several initiatives aim to go to market within the next two to three years and to rapidly scale financial flows through credit markets. In addition, a shift in regulatory requirements from biodiversity offsetting to biodiversity net gain is expected to stimulate rapid compliance-led growth of biodiversity credit markets.



Box 7. Biodiversity credits

Biodiversity credits only channel a few million in financial flows, but are expected to scale.



Examples of emerging initiatives

Note: Data availability on current biodiversity credits sale is limited, with only a few public records on bilateral deals. The current estimates are thus likely to be an underestimate of actual flows, but reviews from experts suggest that these remain of small scale (in millions).

Source: WEF (2022a), WEF (2022b), The Biodiversity Consultancy (2016), Manuell (2023), Reflev (2023), Taskforce on Nature Markets (2023), Bennett *et al.* (2017)

What are credits?

Biodiversity credits are a verifiable and tradeable financing mechanism rewarding positive nature outcomes. They finance actions with measurable positive outcomes for biodiversity and represent a unit of biodiversity that is being restored or preserved (WEF 2022b).

Do credits and offsets overlap?

Unlike credits, biodiversity offsets aim at compensating a negative impact on nature with an equivalent positive impact on biodiversity. However, overlap between offsets and credits may exist.

The offsets market through regulatory compensation schemes is well established.

Scale and further develop innovative financial instruments to facilitate investment in NbS, for example, sustainable/green bonds and insurance products

NbS have characteristics that prevent private investment. We have already noted the public goods nature of the services provided. Additional barriers are that NbS tend to be small and complex projects with long investment horizons, they tend to lack early-stage financing and they are often subject to regulatory uncertainty. Lack of standardisation of NbS as an asset class makes it less investible for institutional money managers with strict mandates. As a result, financing is challenging, and innovation and further development of financing structures and products is needed. Many NbS projects in the EU, for example, are financed by a combination of different products based on large debt issuances from multiple backers (European Investment Bank [EIB] 2023). Tailored structures work best for NbS because they can combine different funding, financing and revenue streams for different elements.



A just transition to a green and inclusive financial system for vulnerable groups, women and Indigenous Peoples

There are real inclusion and human rights challenges with the current approaches to incentivising conservation and restoration of nature. They frequently fail to involve all stakeholders, namely Indigenous Peoples, women and other marginalised groups, and do not work towards more just and inclusive financial systems.

Respecting human rights and role as stewards of nature

Funding for the expansion of protected areas will increase as countries implement 30x30. Given that 80 per cent of what remains of global biodiversity is found within Indigenous Lands, the 30x30 target will have a significant impact on Indigenous Peoples. The eviction of Indigenous Peoples and other human rights violations have occurred and continue to occur in the context of protected area establishment. Expansion of protection must represent best practice and apply the highest standards and environmental and social safeguards.

The scale-up of NbS finance in line with Rio targets needs to include finance for activities that enhance the role of Indigenous Peoples in the management of biodiversity and ecosystems. Indigenous groups manage half of the world's lands and, as noted, protect 80 per cent of global biodiversity, but they receive little finance to support their activities. For example, Indigenous groups have received less than 1 per cent of international climate finance over the last decade and an even smaller share has reached Indigenous Peoples organisations (Rainforest Foundation Norway 2021).²⁵ This is in large part due to the lack of tenure rights of Indigenous Peoples. Lack of tenure rights is a problem further compounded for women. While 43 per cent of farmers globally are women, only 15 per cent of land holdings are owned by women (FAO 2018a). Embedding the rights of Indigenous Peoples, women and other marginalised groups into law and policy is needed to ensure access to finance.

Governments need to lead. In addition to providing the legal and policy frameworks, public money can be used as blended and concessional finance to support the development of Indigenous Peoples- and women-led nature-based enterprise. As NbS investment scales, governments need to ensure social safeguards are embedded in incentive mechanisms to mobilise finance for NbS and social and gender impacts represented in ESG frameworks. Business and finance need to consistently apply social and environmental safeguards in line with international best practice and guidelines for responsible business conduct.

Over the last 15 years in Canada, for example, First Nations have had significant success based on Project Finance for Permanence (PFP) models that ensure stable, long-term funding for conservation projects and the development of small businesses by providing representation, flexibility and capacity building. The experience of Coast Funds in Canada has inspired similar conservation funding mechanisms in Brazil, Costa Rica, Bhutan, Colombia and Peru. At

²⁵ RFN 2021 finds that projects supporting Indigenous Peoples tenure and forest management received approximately US\$2.7 billion between 2011–2020 from bilateral and multilateral donors and private philanthropies – just US\$270 million per year. This is equivalent to less than one per cent of Official Development Assistance (ODA) for climate change mitigation and adaptation over the same period.



COP15, Trudeau announced an additional C\$800 million (US\$580 million) investment in four Indigenous-led conservation models funded through PFPs. This type of financing directly to Indigenous Peoples needs to dramatically increase. It is encouraging that the GEF's Global Biodiversity Fund was recently established with a framework that proposes to allocate 20 per cent of funding to Indigenous Peoples and with efforts to develop possible modalities and details in the coming months.

Nature markets need to be developed to work more justly and efficiently in favour of Indigenous Peoples and other marginalised groups, including women, who successfully steward nature, often facing serious challenges. The Biodiversity Credit Alliance (BCA) recently published a discussion paper to engage stakeholders in the development of biodiversity credit markets to learn from challenges encountered in carbon markets (BCA 2023).

Scaling gender opportunities – requires a multifaceted strategy that integrates gender considerations into NbS investments. Critical steps include understanding how gender affects access and rights, employing data-driven approaches, promoting gender-inclusive business practices, developing catalytic and innovative financial mechanisms and advocating for supportive policies.

5.3. Concluding remarks

This third edition of the State of Finance for Nature has for the first time estimated the global scale of public and private nature-negative finance. Until governments and private businesses and financial institutions redirect finance from nature-damaging activities at scale, the impacts of mobilising additional finance for NbS will be limited, and we will continue to erode the natural capital that provides the foundation for economies, human well-being, gender implications of climate change and planetary health.

This report also showcases how much public and private finance is currently being allocated to NbS relative to how much is needed to maintain a stable and liveable planet. NbS provide a critical tool – scaling up finance and implementation is desperately needed and is, indeed, very doable. Protection of nature is the least cost NbS with critical benefits for biodiversity and climate. Governments should prioritise public funding for public goods. Government incentives and regulation are key tools to catalyse private finance flows to sustainable land management and restoration. In addition, scaling of innovative financial instruments, for example, green bonds, blended finance funds and debt for nature swaps, can support the scaling of private action that is needed to reach Rio targets.

References

- Allied Market Search (2021). *Cocoa Market Report*. <https://www.alliedmarketresearch.com/cocoa-market-A11007#:~:text=The%20global%20cocoa%20market%20size,the%20equatorial%20regions%20of%20Americas>.
- Bechtel, J.D. (2010). *Gender, Poverty and the Conservation of Biodiversity A Review of Issues and Opportunities*. MacArthur Foundation.
- Bennett, G., Gallant, M. and Ten Kate, K. (2017). *State of Biodiversity Mitigation 2017: Markets and Compensation for Global Infrastructure Development*. http://www.forest-trends.org/wpcontent/uploads/2018/01/doc_5707.pdf.
- Bermudez, S., Voora, V., Larrea, C. and Luna, E. (2022). *Global Market Report: Cocoa prices and sustainability*. <https://www.iisd.org/system/files/2022-11/2022-global-market-report-cocoa.pdf>.
- Biodiversity Credit Alliance (2023). *Communities and Nature Markets: Building Just Partnerships in Biodiversity Credits*. Discussion paper. New York: Biodiversity Credit Alliance.
- Bradshaw, C.J.A., Ehrlich, P.R., Beattie, A., Ceballos, G., Crist, E., Diamond, J. et al. (2021). Underestimating the challenges of avoiding a ghastly future. *Frontiers in Conservation Science: Global Biodiversity Threats* 1. doi: 10.3389/fcosc.2020.615419.
- Capital for Climate (2023). Nature-based solutions investment. Exemplar funds and vehicles. <https://nbs.capitalforclimate.com/fundsandvehicles>. Accessed 13 June 2023.
- Carbon Brief (2022). *Guest post: how much could restoring forests reduce India's emissions?* 17 February. <https://www.carbonbrief.org/guest-post-how-much-could-restoring-forests-reduce-indias-emissions/#:~:text=India%20aims%20to%20expand%20forest,which%20forests%20could%20be%20restored>.
- Centre for Sustainable Systems, University of Michigan (2022). *Sustainability Factsheets – Consumption Patterns, Impacts and Solutions*. https://css.umich.edu/sites/default/files/2022-09/Bound_Factsheets_2022.pdf.
- China, Ministry of Foreign Affairs (2020). *Building a Shared Future for All Life on Earth: China in Action*. 21 September. https://www.fmprc.gov.cn/eng/wjdt_665385/2649_665393/202009/t20200921_679641.html.
- Climate Policy Initiative (2021). *Global Landscape of Climate Finance 2021*. <https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Full-report-Global-Landscape-of-Climate-Finance-2021.pdf>.
- Conservation International (2022). *Optimism in Action*. <https://www.conservation.org/about/annual-report>.
- Cook-Patton, S.C., Drever, C.R., Griscom, B.W., Hamrick, K., Hardman, H., Kroeger, T. et al. (2021). Protect, manage and then restore lands for climate mitigation. *Nature Climate Change* 11, 1027–1034. <https://doi.org/10.1038/s41558-021-01198-0>.
- Cross Sector Biodiversity Initiative (2013). *Framework for Guidance on Operationalizing the Biodiversity Mitigation Hierarchy*.
- Dasgupta, P. (2021). *The Economics of Biodiversity: The Dasgupta Review*. London.
- De Groot, R.S., Bilgaut, J.m., Van Der Ploeg, S., Aronson, J., Elmqvist, T. and Farley, J. (2013). Benefits of investing in ecosystem restoration. *Conservation Biology* 27(6), 1286-93.

- Deng, S., Deng, X., Griscom, B., Li, T., Yuan, W. and Qin, Z. (2022). *Can nature help limit warming below 1.5°C?* 13 October. <https://onlinelibrary.wiley.com/doi/10.1111/gcb.16479>.
- De Jong, B. (2019). *World Seafood Map 2019: Value Growth in the Global Seafood Trade Continues*. May. https://research.rabobank.com/far/en/documents/175201_1966414_rabobank_value-growth-global-seafood-trade_beyhan_may2019.pdf.
- De Palma, A., Hoskins, A., Gonzalez, R.E., Borger, L., Newbold, T., Sanchez-Ortiz, K. et al. (2021). Annual changes in the Biodiversity Intactness Index in tropical and subtropical forest biomes, 2001–2012. *Scientific Reports*, 11, 20249. <https://doi.org/10.1038/s41598-021-98811-1>.
- Deutz, A., Heal, G. M., Niu, R., Swanson, E., Townshend, T., Zhu, L. et al. (2020). *Financing Nature: Closing the Global Biodiversity Financing Gap*. The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability. https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf. doi: 10.3389/fcsc.2020.615419.
- Ecosystem Marketplace (2010). *State of Biodiversity Markets: Offset and Compensation Programs Worldwide*. <https://www.ecosystemmarketplace.com/wp-content/uploads/2015/09/sbdmr.pdf>.
- Ecosystem Marketplace (2022). *State of the Voluntary Carbon Markets 2021*. <https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022>.
- Elwin P., Amadi E., Mitchell E. and Hunter P. (2023). *Financial Markets Roadmap for Transforming the Global Food System*. Planet Tracker. March 2023. <https://planet-tracker.org/wp-content/uploads/2023/03/Financial-Markets-Roadmap-for-transforming-the-Global-Food-System.pdf>.
- Environmental Markets Lab (2018). Subsidy Explorer. <http://www.subsidyexplorer.org/>. Accessed 1 June 2023.
- European Commission (2022). *Soil health – protecting, sustainably managing and restoring EU soils*. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13350-Soil-health-protecting-sustainably-managing-and-restoring-EU-soils_en.
- European Commission (2023). Knowledge Centre for Biodiversity. 29 June. https://knowledge4policy.ec.europa.eu/biodiversity/eu-action-biodiversity-financing_en. Accessed 30 June 2023.
- European Investment Bank (2023). *Investing in Nature-based Solutions: State-of-play and Way Forward for Public and Private Financial Measures in Europe*. https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf.
- European Parliament (2023). *Nature Restoration Law: MEPs Adopt Position for Negotiations with Council*. 12 July. <https://www.europarl.europa.eu/news/en/press-room/20230707IPR02433/nature-restoration-law-meps-adopt-position-for-negotiations-with-council>.
- Expert Market Search (2022). *Global Soybean Market Outlook Report*. <https://www.expertmarketresearch.com/reports/soybean-market#:~:text=size%20in%202022%3F-,The%20global%20soybean%20market%20attained%20a,USD%20151.4%20billion%20in%202022>.
- Facts and Factors (2022). *Global Mitigation Banking Market is Likely to Grow at a CAGR Value of 13.10% By 2028*. <https://www.fnfresearch.com/news/global-mitigation-banking-market>.
- Food and Agriculture Organisation (2018a). *The gender gap in land rights*. <https://www.fao.org/3/I8796EN/i8796en.pdf>.
- Food and Agriculture Organisation (2018b). *The State of the World's Forest 2018- Forest Pathways to Sustainable Development*. Rome. <https://www.fao.org/3/i9535en/i9535en.pdf>.

- Food and Agriculture Organisation (2018c). *The State of World Fisheries and Aquaculture 2018 - Meeting the Sustainable Development Goals*. Rome. <http://www.fao.org/documents/card/en/c/19540EN/>.
- Food and Agriculture Organization (2020). *FRA 2020 Remote Sensing Survey*. <https://www.fao.org/forest-resources-assessment/remote-sensing/fra-2020-remote-sensing-survey/en/>.
- Forest Stewardship Council (2018). *Global Volume of FSC-certified Wood*. July. Bonn. <https://ic.fsc.org/file-download/global-volume-of-fsc-certified-wood.7812.htm>.
- Gayle, D. (2023) *Tuesday was world's hottest day on record – breaking Monday's record*. The Guardian. 5 July. <https://www.theguardian.com/environment/2023/jul/05/tuesday-was-worlds-hottest-day-on-record-breaking-mondays-record>. Accessed 1 October 2023.
- Global Impact Investing Network (2020). *Annual Impact Investor Survey 2020*. <https://thegiin.org/assets/GIIN%20Annual%20Impact%20Investor%20Survey%202020.pdf>.
- Government of Canada (2022). *Canada's conserved areas*. <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/conserved-areas.html>.
- Gurung, J. (2023). *Scaling Gender and Climate Investment Opportunities*. September. <https://www.progreen.info/sites/default/files/2023-09/scaling%20gender%20and%20climate%20investment.pdf>.
- Hahn, T., Koh, N.S. and Elmqvist, T. (2022). No net loss of biodiversity, green growth, and the need to address drivers. *One Earth* 5(6), 612-614.
- Hamrick, K. (2017). *State of Private Investment in Conservation 2016: A Landscape Assessment of an Emerging Market*. Ecosystems Marketplace, A Forest Trends Initiative. <https://www.forest-trends.org/publications/state-of-private-investment-in-conservation-2016/>.
- Holl, K.D. and Brancalion, P.H.S (2020). Tree planting is not a simple solution. *Science* 368: 6491, 580-581. <https://www.science.org/doi/10.1126/science.aba8232>.
- Ibukun, Y. (2023). *Nigeria unplugs from dirty generators in sudden solar gamble*. Bloomberg. <https://www.bloomberg.com/news/features/2023-11-06/nigeria-s-solar-gamble-forces-millions-in-lagos-to-unplug-from-dirty-generators#xj4y7vzkg>. Accessed 1 November 2023.
- Impact Yield (2023). *Impact Investing Database*. <https://impactyield.com/impact-investing-search>. Accessed 13 June 2023.
- Innovative Finance for the Amazon, Cerrado and Chaco (2023). *IFACC 2022 Market Report*. February. https://www.tropicalforestalliance.org/assets/IFACC/IFACC-2022-Market-Report_final_compressed.pdf?vid=3.
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2018). *The IPBES Assessment Report on Land Degradation and Restoration*. Bonn. <https://doi.org/10.5281/zenodo.3237392>.
- International Energy Agency (2023). *Fossil Fuel Consumption Subsidies*. <https://www.iea.org/reports/fossil-fuels-consumption-subsidies-2022>. Accessed 7 November 2023.
- International Monetary Fund (2021). *Government finance statistics. Functional expenditures (COFOG)*. <https://data.imf.org/regular.aspx?key=61037799>. Accessed 25 May 2023.
- Isbell, F., Balvanera, P., Mori, A.S., He, J., Bullock, J.M., Regmi, G.R. et al. (2022). Expert perspectives on global biodiversity loss and its drivers and impacts on people. *Frontier in Ecology and the Environment*, 21, 94-103. <https://doi.org/10.1002/fee.2536>.
- Kassam, A., Friedrich T., and Derpsch, R. (2019). Global spread of conservation agriculture. *International Journal of Environmental Studies* 76(1), 29-51. DOI: 10.1080/00207233.2018.1494927.

- Kedward, K., Emrgassen, S.z, Ryan-Collins, J. and Wunder, S. (2023). Heavy reliance on private finance alone will not deliver conservation goals. *Nature Ecology and Evolution*. <https://doi.org/10.1038/s41559-023-02098-6>.
- Koplow, D. and Steenblik, R. (2022). *Protecting Nature by Reforming Environmentally Harmful Subsidies: The Role of Business*. <https://www.earthtrack.net/document/protecting-nature-reforming-environmentally-harmful-subsidies-role-business>.
- Kujala, H., Maron, M., Kennedy, C., Beissner, K., Osborn, D., Gorden, A. et al. (2022). Credible biodiversity offsetting needs public national registers to confirm no net loss. *One Earth* 5(6), 612-614.
- Manuell, R. (2023). *Developed biodiversity market schemes have seen \$8 mln pledged for credits-report*. 23 May. <https://carbon-pulse.com/204564/>.
- Mongabay (2016). *The top 10 most biodiverse countries*. <https://news.mongabay.com/2016/05/top-10-biodiverse-countries/>. Accessed 25 May 2023
- Naphade, A. (2020). *Sustainable palm oil market analysis with key players, applications, trends and forecasts to 2026*. <http://news.marketsizeforecasters.com/sustainable-palm-oil-market-analysis-with-key-players-applications-trends-and-forecasts-to-2026>.
- Natural England (2022). *Biodiversity net gain, an introduction to the benefits*. https://naturalengland.blog.gov.uk/wp-content/uploads/sites/183/2022/04/BNG-Brochure_Final_Compressed-002.pdf. Accessed 1 June 2023.
- Nature Based Solutions Initiative (2022). *Revised climate pledges show enhanced ambition for nature-based solutions*. <https://www.naturebasedsolutionsinitiative.org/news/nbs-policy-platform-ndc-submissions>. Accessed 23 June 2023.
- Natural Resources Defense Council (2022). *Biden administration provides update on 30x30*. <https://www.nrdc.org/press-releases/biden-administration-provides-update-30x30>. Accessed 1 June 2023.
- Netherlands, Ministry of Foreign Affairs, Centre for Promotion of Imports (2021). *The European market potential for certified coffee*. 11 August. <https://www.cbi.eu/market-information/coffee/certified-coffee/market-potential>.
- Organisation for Economic Cooperation and Development (2020). *Reframing Financing and Investment for a Sustainable Ocean Economy*. https://www.oecd-ilibrary.org/environment/reframing-financing-and-investment-for-a-sustainable-ocean-economy_c59ce972-en.
- Organisation for Economic Co-operation and Development (2022a). *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*. <https://www.oecd.org/publications/agricultural-policy-monitoring-and-evaluation-22217371.htm>.
- Organisation for Economic Co-operation and Development (2022b). *Biodiversity and Development Finance: Main Trends, 2011-20*. <https://www.oecd.org/finance/biodiversity-and-development-finance-b04b14b7-en.htm>.
- Organisation for Economic Cooperation and Development (2023a). *Aid Activity Database Data Dictionary*. <https://stats.oecd.org/Index.aspx?DataSetCode=TABLE5>. Accessed 1 June 2023.
- Organisation for Economic Co-operation and Development (2023b). *Creditor Reporting System (CRS). Mobilisation*. https://stats.oecd.org/Index.aspx?DataSetCode=DV_DCD_MOBILISATION. Accessed 24 May 2023.
- Organisation for Economic Co-operation and Development (2023c). *Creditor Reporting System (CRS). Official Development Assistance*. <https://stats.oecd.org/index.aspx?DataSetCode=CRS1>. Accessed 25 May 2023.

- Organisation for Economic Co-operation and Development (2023d). Creditor Reporting System (CRS). Private Philanthropy for Development. https://stats.oecd.org/Index.aspx?DataSetCode=DV_DCD_PPF. Accessed 26 May 2023.
- Organisation for Economic Co-operation and Development (2023e). Government Expenditure by Function (COFOG). https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE11. Accessed 25 May 2023.
- Organisation for Economic Co-operation and Development (2023f). *Private Finance Mobilised by Official Development Finance Interventions. Development Co-operation Directorate*. Paris. <https://www.oecd.org/dac/2023-private-finance-odfi.pdf>.
- Partnership for Forests (2023). Funds for Nature Investor Database. <https://partnershipsforforests.com/fundsfornature/>. Accessed 25 May 2023.
- Plume K. (2022). *U.S. aims to double cover crop planting to address climate change. 10 January 2022*. Reuters. <https://www.reuters.com/markets/commodities/us-aims-double-cover-crop-planting-address-climate-change-2022-01-10/>. Accessed 20 June 2023.
- Portfolio Earth (2021). *Roots of Prosperity: The Economics and Finance of Restoring Land*. January. <https://portfolio.earth/wp-content/uploads/2021/01/Bankrolling-Extinction-Report.pdf>.
- Rainforest Alliance (2022a). *Cocoa Certification Data Report 2021*. May 2022. <https://www.rainforest-alliance.org/wp-content/uploads/2022/05/Cocoa-Certification-Data-Report-2021.pdf>.
- Rainforest Alliance (2022b). *Coffee Certification Data Report 2021*. May 2022. <https://www.rainforest-alliance.org/wp-content/uploads/2022/05/Coffee-Certification-Data-Report-2021.pdf>.
- Rainforest foundation Norway (2021). *Falling Short - Donor Funding for Indigenous Peoples and Local Communities to Secure Tenure Rights and Manage Forests in Tropical Countries (2011–2020)*. <https://www.cwis.org/wp-content/uploads/2021/06/rainforestmanagement.pdf>.
- Reklev, S. (2023). *Forecasters see rapidly growing biodiversity market as nature crisis forces response*. 10 January. <https://carbon-pulse.com/186974/>. nep.org/20.500.11822/41333.
- Research and Markets (2022). *Global Coffee Market (2022-2027) by Coffee Bean, Product Type, Product, Distribution, and Geography, Competitive Analysis and the Impact of Covid-19 with Ansoff Analysis*. <https://t.ly/hHkKO>
- Riemer, O., Shah, T.M. and Zitterbarth, S. (2023). *Current Conditions and Policy Frameworks of Agri Food Systems Transformation*. https://assets.ctfassets.net/rrir183jifda/21ZVljAdV6mZ9o5O60vab9/72f128fc5bf82e8224cbb1893057b4ea/TMG_FORESEEsseries_Report1_ConditionsAndFrameworks_2023.03.15.pdf.
- Ripple, W.J., Wolf, C., Newsome, T.M., Barnard, P. and Moomaw, W.R. (2020). World scientists' warning of a climate emergency. *BioScience* 70(1), 8-12.
- Roe, S., Streck, C., Beach, R., Busch, J., Chapman, M., Daioglou, V. et al. (2021). Land-based measures to mitigate climate change: potential and feasibility by country. *Global Change Biology*, 27, 6025–6058. <https://doi.org/10.1111/gcb.15873>.
- Rose, S., Khatir-Chhetri, A., Stier, M., Wiese-Rozanova, L., Dittmer, K.M., Shelton, S. et al. (2022). *Ambition for Soil Organic Carbon Sequestration in the New and Updated Nationally Determined Contributions: 2020-2022*. <https://cgspace.cgiar.org/bitstream/handle/10568/115887/CCAFS%20Info%20Note%20SOC%202021%20NDCs.pdf>.
- Roundtable for Responsible Soy (2022). *Management Report 2021*. https://issuu.com/rtrs/docs/rtrs_management_report_2021.
- Royal Society for the Protection of Birds (2022). *Annual Report 2021-22*. https://www.rspb.org.uk/globalassets/downloads/annual-report-2022/annual-report-2021-22_digital_full_final.pdf?sourcecode=GENWEB0059.

- Seidl, A., Mulungu, K., Arlaud, M., Van Den Heuvel, O. and Riva, M. (2020). Finance for nature: A global estimate of public biodiversity investments. *Ecosystem Services*, 46, p.101216.
- Simpkins, A., Frasson, C.N.R., Donado, H.M. and Genin, C. (2022). *Tracking Latin America's Progress on Climate Action*. 21 March. <https://www.wri.org/insights/tracking-progress-climate-latin-america>.
- Skerritt, D. and Sumaila, R. (2021). Broadening the global debate on harmful fisheries subsidies through the use of subsidy intensity metrics. *Marine Policy*. 128. 104507. 10.1016/j.marpol.2021.104507.
- Solidaridad Network (2019). *Responsible Soy – 10 Years On*. <https://www.solidaridadnetwork.org/news/responsible-soy-10-years-on>.
- Statista (2022). *Global organic food market value in 2021 and 2026*. <https://www.statista.com/statistics/869052/global-organic-food-and-beverage-market-value/> Accessed 01 July 2023.
- Sumaila, R., Ebrahim, N., Schuhbauer, A., Skerritt, D., Li, Y., Kim H.S. et al. (2019). Updated estimates and analysis of global fisheries subsidies. *Marine Policy*. 109. 10.1016/j.marpol.2019.103695.
- Swiss Re Institute (2021). *The Economics of Climate Change: No Action Not an Option*. 22 April. <https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-economics-of-climate-change.html>.
- Tanneberger, F., Appulo, L., Ewert, S., Lakner, S., O Brochain, N., Peters, J. et al. (2020). *The Power of Nature-Based Solutions: How Peatlands Can Help Us to Achieve Key EU Sustainability Objectives*. 09 October. <https://doi.org/10.1002/adsu.202000146>.
- Taskforce on Nature Markets (2022). *Global Nature Markets Landscaping Study*. December. https://assets-global.website-files.com/623a362e6b1a3e2eb749839c/638f463b2d6c475a6a32e5f6_GlobalNatureMarketsLandscapingStudy.pdf.
- Taskforce on Nature Markets (2023). *Biodiversity Credit Markets: The Role of Law, Regulation and Policy*. https://uploads-ssl.webflow.com/623a362e6b1a3e2eb749839c/6452340b9bcbb3ef3f82e6b6_BiodiversityCreditMarkets.pdf.
- The Biodiversity Consultancy (2016). *Government Policies on Biodiversity Offsets*. <https://www.thebiodiversityconsultancy.com/knowledge-and-resources/government-policies-on-biodiversity-offsets-72/>. Accessed 21 September 2023.
- The Biodiversity Finance Initiative (2019). *Indicativa de Financiamento Para a Biodiversidade – BIOFIN*. https://www.biofin.org/sites/default/files/content/knowledge_products/2_BER_Brasil_Resumo%20Executivo.pdf.
- The Biodiversity Finance Initiative (2020). *Moving Mountains - Unlocking Private Capital for Biodiversity and Ecosystems*. <https://www.biofin.org/sites/default/files/content/publications/BIOFIN%20-%20Moving%20Mountains%20-%20Unlocking%20private%20capital%20for%20biodiversity%20and%20ecosystems%20%28Web%20Version%29.pdf>.
- The Biodiversity Finance Initiative (2022). *Closing the Biodiversity Funding Gap: With Ambitious Post-2020 Global Biodiversity Framework Targets*. 25 November. <https://www.biofin.org/news-and-media/biodiversity-funding-gap-global-biodiversity-framework>. Accessed 23 June 2023.
- The Economics of Land Degradation Initiative (2015). *The Value of Land: Prosperous Lands and Positive Rewards through Sustainable Land Management*. https://www.eld-initiative.org/fileadmin/pdf/ELD-main-report_08_web-72dpi_01.pdf.
- The Economics of Land Degradation Initiative (2023). *Economics of Harmonizing Land Restoration Activities across the Rio Conventions in Rwanda and Implications for Food Security*. https://www.eld-initiative.org/fileadmin/ELD_Filter_Tool/Case_Study_Rwanda_2023/Rwanda_2023_Rio_Synergies_ELD_Case_Study_Report.pdf.

- The FAIRR Initiative (2017). *The Future of the Cerrado in the Hands of the Market: Deforestation and Native Vegetation Conversion must be Stopped*. 11 September. <https://www.fairr.org/investor-statements/cerrado>.
- The Intergovernmental Panel on Climate Change (2021). *In Climate Change 2021: The Physical Science Basis*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1513–1766, doi: 10.1017/9781009157896.013.
- The Nature Conservancy (2023). *2022 Annual Report, Progress for the Planet*. https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_AR_2022.pdf.
- The World Bank (2018). Sovereign Blue Bond Issuance: Frequently Asked Questions. 29 October. <https://www.worldbank.org/en/news/feature/2018/10/29/sovereign-blue-bond-issuance-frequently-asked-questions#:~:text=The%20blue%20bond%20is%20a,environmental%2C%20economic%20and%20climate%20benefits>.
- The World Bank (2021). *The Economic Case for Nature – a Global Earth-economy Model to Assess Development Policy Pathways*. 30 June. <https://openknowledge.worldbank.org/server/api/core/bitstreams/9f0d9a3a-83ca-5c96-bd59-9b16f4e936d8/content>.
- The World Bank (2022a). *Scaling up Ecosystem Restoration Finance: a Stocktake Report*. <https://documents1.worldbank.org/curated/en/099955011092213526/pdf/P17770602aad4701309adb08b084c12888c.pdf>.
- The World Bank (2022b). *Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities*. 23 March. <https://www.worldbank.org/en/news/press-release/2022/03/23/wildlife-conservation-bond-boosts-south-africa-s-efforts-to-protect-black-rhinos-and-support-local-communities>.
- The World Bank (2023a). *Detox Development: Repurposing Environmentally Harmful Subsidies*. 15 June. <https://openknowledge.worldbank.org/server/api/core/bitstreams/61d04aca-1b95-4c06-8199-3c4a423cb7fe/content>.
- The World Bank (2023b). Urban development. <https://www.worldbank.org/en/topic/urbandevelopment/overview#:~:text=Today%2C%20some%2056%25%20of%20the,people%20will%20live%20in%20cities>. Accessed on 21 November 2023.
- United Nations (2019). *24 Billion Tons of Fertile Land Lost Every Year, Warns UN Chief on World Day to Combat Desertification*. 16 June. <https://news.un.org/en/story/2019/06/1040561>.
- United Nations (2022a). *End Senseless, Suicidal War against Nature, Secretary-General Says at Opening of Stockholm Meeting, Urging Greater Action to Address Global Climate Crisis*. 2 June. <https://press.un.org/en/2022/sgsm21304.doc.htm>.
- United Nations (2022b). *Secretary-General's Remarks to High-Level Opening of COP27*. 7 November. <https://www.un.org/sg/en/content/sg/speeches/2022-11-07/secretary-generals-remarks-high-level-opening-of-cop27>.
- United Nations (2023). *The Sustainable Development Goals Report – Special Edition*. 10 July. <https://unstats.un.org/sdgs/report/2023/>.
- United Nations Convention on Biological Diversity (2022). *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity*. 19 December. <https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf>.
- United Nations Convention to Combat Desertification (2022). *Chronic Land Degradation: UN offers stark warnings and practical remedies in Global Land Outlook 2*. 26 April. Bonn.
- United Nations Convention to Combat Desertification (2023a). Rio Conventions. <https://www.unccd.int/convention/partners/rio-conventions#:~:text=The%20three%20global%20agreements%20%E2%80%93%20which,join%20approach%20to%20restore%20our>. Accessed 27 October 2023.

United Nations Convention to Combat Desertification (2023b). Voluntary LDN targets. <https://www.unccd.int/our-work/country-profiles/voluntary-ldn-targets>. Accessed 23 June 2023.

United Nations Development Programme (2016). *Human Development Report 2016 - Human Development for Everyone*. New York. <https://hdr.undp.org/system/files/documents/2016humandevreportpdf1.pdf>.

United Nations Development Programme (2020). *Moving Mountains: Unlocking Private Capital for Biodiversity and Ecosystems*. New York. <http://www.biodiversityfinance.org/knowledge-product/moving-mountains-unlocking-private-capital-biodiversity-and-ecosystems>.

United Nations Environment Assembly (2022). Fifth Session of the United Nations Environment Assembly (UNEA-5). <https://www.unep.org/environmentassembly/unea5>. Accessed on 27 October 2023.

United Nations Environment Programme (2022a). *Global Peatlands Assessment: The State of the World's Peatlands*. Nairobi. <https://www.unep.org/resources/global-peatlands-assessment-2022>.

United Nations Environment Programme (2022b). *State of Finance for Nature. Time to Act: Doubling Investment by 2025 and Eliminating Nature-negative Finance Flows*. Nairobi. <https://wedocs.unep.org/20.500.11822/41333>.

United Nations Environment Programme (2023a). *Adaptation Gap Report 2023: Underfinanced. Underprepared. – Inadequate Investment and Planning on Climate Adaptation Leaves World Exposed*. Nairobi. <https://www.unep.org/resources/adaptation-gap-report-2023>.

United Nations Environment Programme (2023b). *Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again)*. Nairobi. <https://www.unep.org/resources/emissions-gap-report-2023>.

United Nations Environment Programme (2023c). *Production Gap Report 2023: Phasing Down or Phasing Up? Top Fossil Fuel Producers Plan Even More Extraction Despite Climate Promises*. Nairobi. <https://productiongap.org/2023report/#2023downloads>.

United Nations Environment Programme, United Nations Development Programme and Food and Agriculture Organisation (2021). *A Multi-billion-dollar Opportunity: Repurposing Agricultural Support to Transform Food Systems*. <https://www.unep.org/resources/repurposing-agricultural-support-transform-food-systems>. Accessed 05 June 2023.

United Nations Environment Programme World Conservation Monitoring Centre (2016). *Protected Planet Report 2016: How Protected Areas Contribute to Achieving Global Targets for Biodiversity*. https://wdpa.s3.amazonaws.com/Protected_Planet_Reports/2445%20Global%20Protected%20Planet%202016_WEB.pdf.

United Nations Framework Convention for Climate Change (2023). The Paris Agreement. <https://unfccc.int/process-and-meetings/the-paris-agreement#:~:text=This%20trend%20is%20most%20noticeable,over%2070%25%20of%20global%20emissions>. Accessed 27 October 2023.

United Nations Framework Convention on Climate Change Race to Zero (2021). Net Zero Financing Roadmaps. <https://assets.bbhub.io/company/sites/63/2021/10/NZFRs-Key-Messages.pdf>. Accessed 30 June 2023.

United Nations Principles for Responsible Investment (2023). IPR Forecast Policy Scenario + Nature. <https://www.unpri.org/inevitable-policy-response/ipr-forecast-policy-scenario-nature/10966.article>. Accessed 31 October 2023.

United Nations Statistics Division (2022). *Is a Revision of COFOG Needed to Better Address the Need for Better Environmental Expenditure Data?* 27 October. https://unstats.un.org/unsd/classifications/Meetings/UNCEISC2022/UNCEISC_2022_meeting_Session_7a3_Environmental_Issues_COFOG.pdf.

- United States of America, Department of Agriculture (2022a). *USDA to invest more than \$4 billion to strengthen food system*. 8 June. <https://www.usda.gov/media/press-releases/2021/06/08/usda-invest-more-4-billion-strengthen-food-system>.
- United States of America, Department of Agriculture (2022b). *USDA announces conservation Reserve program signups for 2022*. 26 January. <https://www.fsa.usda.gov/news-room/news-releases/2022/usda-announces-conservation-reserve-program-signups-for-2022>.
- United States of America, Fish and Wildlife Service (2022). *FY2022 Interior Budget in Brief*. <https://www.doi.gov/sites/doi.gov/files/fy2022-bib-bh069.pdf>. Accessed 25 May 2023.
- Waldron, A., Adams, V., Allan, J., Arnell, A., Asner, G., Atkinson, S. et al. (2020). *Protecting 30% of the Planet for Nature: Costs, Benefits and Economic Implications*. https://www.conservation.cam.ac.uk/files/waldron_report_30_by_30_publish.pdf.
- Wildlife Conservation Society (2023). *2022 Impact Report*. https://cdn.wcs.org/2022/10/03/79thlo8qoi_WCS_Impact_Report_2022_fnl_linked_WEB.pdf?_gl=1*1o3wycp*_ga*MTY1NzQ3MTgzNS4xNjg0NzY5Njkz*_ga_BTX9HXMYSX*MTY4NDc2OTY5My4xLjAuMTY4NDc2OTY5My42MC4wLjA.
- Wilkinson, K. (ed.) (2020). *The Drawdown Review: Climate Solutions for a New Decade*. Project Drawdown. <https://drawdown.org/drawdownframework/drawdown-review-2020>.
- World Economic Forum (2022a). *Biodiversity Credits: Unlocking Financial Markets for Nature-Positive Outcomes*. https://www3.weforum.org/docs/WEF_Biodiversity_Credit_Market_2022.pdf.
- World Economic Forum (2022b). *High-level Governance and Integrity Principles for Emerging Voluntary Biodiversity Credit Markets*. https://www3.weforum.org/docs/WEF_Biodiversity_Credits_Markets_Integrity_and_Governance_Principles_Consultation.pdf.
- World Economic Forum (2022c). *China will aim to plant and conserve 70 billion trees by 2030 as part of the global tree movement*. 25 May. <https://www.weforum.org/press/2022/05/china-will-aim-to-plant-and-conserve-70-billion-trees-by-2030-as-part-of-the-global-tree-movement/>.
- World Meteorological Organisation (2023). *WMO annual report highlights continuous advance of climate change*. 21 April. <https://public.wmo.int/en/media/press-release/wmo-annual-report-highlights-continuous-advance-of-climate-change>.
- World Overview of Conservation Approaches and Technologies (2023). SLM. <https://www.wocat.net/en/slm/>. Accessed on 27 October 2023.
- World Wildlife Fund (2022). *Annual Report and Financial Statements 2021-22*. <https://www.wwf.org.uk/sites/default/files/2022-12/WWF-UK-Annual-Report-and-Financial-Statements-2021-22.pdf>.
- Xu, C., Kohler, T.A., Lenton, T.M., Svenning, J. and Scheffer, M. (2020). *Future of the human climate niche*. *PNAS: Environmental Sciences* 117 (21) 11350-11355. <https://doi.org/10.1073/pnas.1910114117>.



A Technical Annex

A1. Methodology and data

State of Finance for Nature (SFN) 2023 estimates :

- Public nature-negative finance flows
- Private nature-negative finance flows
- Public finance flows to nature-based solutions (NbS)
- Private finance flows to NbS
- Future investment needs to NbS

All estimates are adjusted to 2023 prices (International Monetary Fund [IMF] Gross domestic product [GDP] deflator), including SFN 2022 estimates to allow comparison.

A1.1. Public nature-negative finance flows

For public nature-negative flows, SFN 2023 uses publicly available data and reports on environmentally harmful subsidies in four sectors:

Agriculture

A multi-billion-dollar opportunity – Repurposing agricultural support to transform food systems (Food and Agriculture Organization [FAO], United Nations Development Programme [UNDP], and United Nations Environment Programme [UNEP] 2021).

The report emphasises that price incentives and fiscal subsidies are forms of government support that may have significant negative impacts on food systems. It finds that 87 per cent of this type of support incentivises production practices and behaviours that might be harmful to the health, sustainability, equity, and efficiency of food systems. The upper bound of potential nature

harming finance flows in agriculture is based on 87 per cent of annual average price incentive and fiscal subsidy support from 2013-2018.

Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation (Organisation for Economic Co-operation and Development [OECD] 2022). This report estimates agricultural support between 2019 and 2021 for 54 countries based on the OECD Agriculture Statistics database.²⁶ SFN aggregates support based on commodity output and input use in 2021 as the lower bound estimate of potential nature harming finance flows.

²⁶ The database measures and monitors support to agriculture, defined as the annual monetary value of gross transfers to agriculture from consumers and taxpayers arising from governments policies that support agriculture. The support is expressed in monetary terms, including Total support Estimate (TSE) transfers represent the total support granted to the agricultural sector, and consist of producer support (PSE), consumer support (CSE) and general services support (GSSE). PSE transfers to agricultural producers are measured at the farm gate level and comprise market price support, budgetary payments and the cost of revenue foregone.

Fossil Fuels

The International Energy Agency (IEA; 2023) database provides estimates of subsidies to fossil fuels, including electricity, oil, coal and natural gas, which are consumed directly by end-users or consumed as inputs to electricity generation across 49 countries.²⁷ IEA's initial estimate for 2022 fossil fuel subsidies is used

as the midpoint of public nature-negative finance flows. In SFN 2022, a combined OECD-IEA estimate was used as the upper bound, however, it is unavailable at the time of analysis. Therefore, no range is provided for fossil fuels in SFN 2023.

Fisheries

Sumaila et al. (2019) and Skerritt and Sumaila (2021) compiled information on government financial transfers to the fishing sector and estimate the likely magnitudes of fisheries subsidies in countries for which this information was not available. Sumaila et al. (2019) estimates subsidy values using 2018 data for 152 maritime countries. Skerritt

and Sumaila (2021) use the same dataset but exclude nine countries with insufficient data. In SFN, lower and upper bound estimates of capacity-enhancing subsidies are derived from the 2021 and 2019 publications respectively. Fuel subsidies are excluded as they are included in energy sector estimates.

Forestry

Koplow and Steenblik (2022) estimate environmentally harmful subsidies (EHS) in forestry based on the value of illegally harvested wood. Other types of subsidies were

excluded due to lack of data. The paper uses data from the International Criminal Police Organization and the World Bank.

A1.2. Private nature-negative finance flows

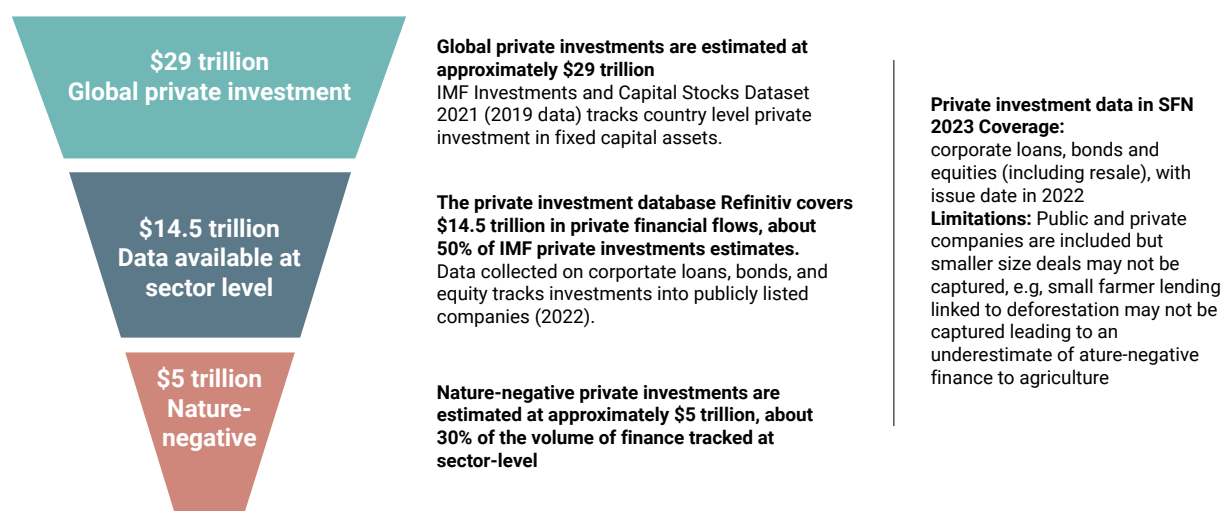
SFN 2023 applies a bottom-up approach to estimate global nature-negative private finance flows across thirteen sectors defined by The Refinitiv Business Classification (TRBC). Estimation is based on the share of activities within each sector flagged as nature-negative and covers corporate loans, bonds and equities

(including resale) with issue dates in 2022. The estimation only accounts for direct (Scope 1) impacts of economic activities to be consistent with the scope of NbS investments.²⁸ The following data and method was used to estimate nature-negative finance flows, summarised in Figure A1.1.

²⁷ The estimation of subsidies is based on the price-gap approach, which compares average end-user prices paid by consumers with reference prices that correspond to the full cost of supply. The price gap is the amount by which an end-use price falls short of the reference price and its existence indicates the presence of a subsidy.

²⁸ Nature-negative is not a negative equivalent of NbS. Nature-negative is here defined as any activities with a direct negative impact on either biodiversity, ecosystems or climate.

Figure A1.1. Hierarchy of data used to estimate nature-negative finance flows by sector and activity



Step 1: Data collection

Nature-negative private finance was calculated using an activity-tagging approach, estimating nature-negative financial flows to a sector based on the number of activities within this sector flagged as nature-negative.

To start, the 2021 IMF Investments and Capital Stocks dataset 2021 (latest data 2019), which tracks country level private investment in fixed capital assets, provides an overview of total global annual private investments estimated at approximately \$29 tn.

The private investment database (Refinitiv) provides data on corporate loans, bonds, and equities proceeds by sector and activity. The database covers US\$14.5 trillion, providing valuable detail on roughly 50 per cent of IMF private investments.

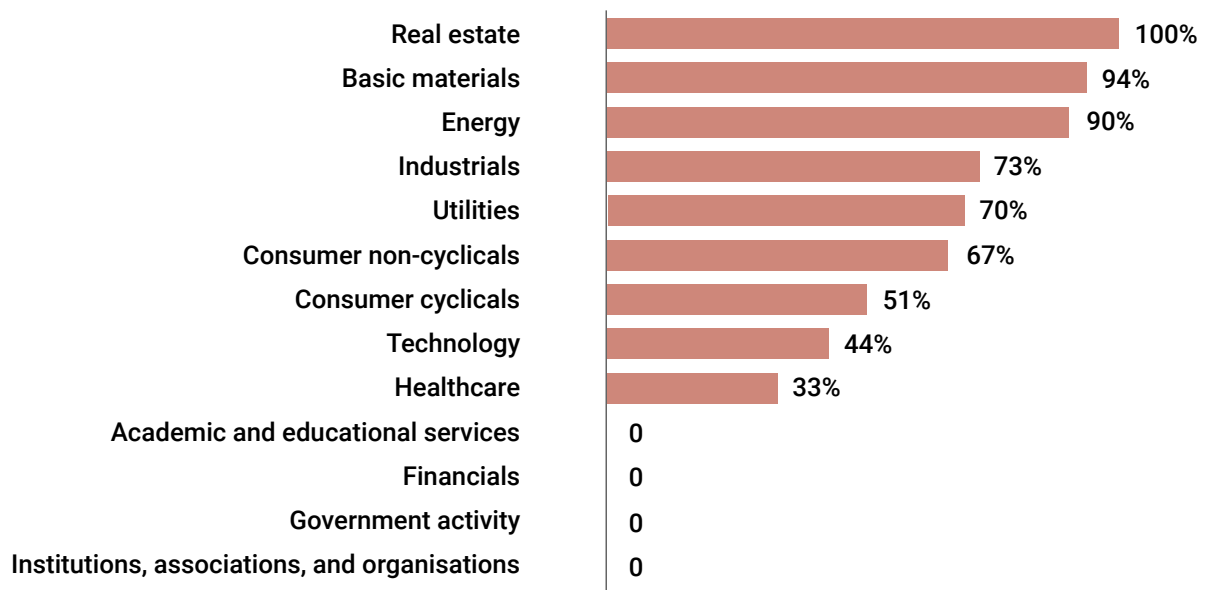
Two alternative approaches were used in step 2 to identify nature-negative finance flows at sector and activity level.

Step 2a: Using ENCORE

The tool 'Exploring Natural Capital Opportunities, Risks and Exposure' (ENCORE) was used to identify the share of production processes with high or very high impact on nature within each sub-industry.²⁹ This share was used as an initial scaling factor (Figure A1.2) to multiply with total finance flows to each sector to obtain an estimate of nature-negative finance flows by sector.

²⁹ Production processes are the level at which links with the environment are assessed in ENCORE. Production processes are different to activities in that one process can be applied to multiple industries while activities are industry-specific.

Figure A1.2. Share of production processes with high or very high impact on nature by sector



Step 2b: Activity-level tagging

In an alternative approach, all industry activities (636 activities) were reviewed and activities with a direct negative impact on nature were tagged as nature-negative based on literature and expert insights.

Step 3: Aggregation

Private nature-negative finance flows across sub-industries and activities tagged as nature-negative were aggregated.

The two approaches used in step 2 produced similar results. The main differences arise in specific industries. The activity level approach is better able to filter out activities with no direct impact on nature within certain industries that have a high impact on nature. This produced lower estimates of nature-negative finance flows for real estate (US\$170 billion lower) and fishing and farming (40 per cent lower). Moreover, the limited number of processes identified for each

subindustry in ENCORE results in the tagging of some large industries as 100 per cent nature-negative e.g. construction and engineering (an industry of the industrials sector). We will continue to explore how to improve the measurement of nature-negative impacts and finance flows in future editions.

A1.3. Public finance flow to nature-based solutions

The study estimates public finance flows to NbS using the latest data available on actual and expected disbursement. SFN 2023 aggregates public finance flows from domestic government expenditure and Official Development Assistance (ODA) data from sources listed in Table A1.1. If

2022 data is not available the most recent data is annualised and average annual disbursement is estimated. For all countries, data used is actual expenditure and excludes pledged or budgeted funding.

Domestic government expenditure

Public funding for NbS from governments and public financial institutions is estimated based on domestic expenditure across five government budget lines of the OECD's Classification of the Functions of Government (COFOG).

Domestic government expenditure was collated for over 60 countries and five sectors, which represent 76 per cent of global GDP. The OECD

COFOG was used to gather second-level domestic expenditure of government functions in 2022.³⁰ IMF's Government Finance Statistics (GFS) was the primary data source for non-OECD government expenditure (IMF 2021; OECD 2023b). Data sources are listed in Table A1.1.

Official Development Assistance (ODA)

ODA data was collected from the OECD Creditor Reporting System (CRS). The CRS tracks gross disbursements of bilateral and multilateral aid in support of environment sustainability and aid to biodiversity, climate change mitigation and desertification from the Development Assistance Committee (DAC). The data is from 2021, available for 16 sectors and covers 138 recipient countries.

³⁰ The Classification of Functions of Government (COFOG) data sets provide first- and second-level data on government expenditure data from the System of National Accounts by the purpose for which the funds are used. First-level COFOG splits expenditure data into 10 "functional" groups or sub-sectors of expenditures (such as defence, education and social protection), and second-level COFOG further splits each first-level group into up to nine subgroups. For the purpose of this report, we have extracted the second-level data and triangulated these against both OECD sectoral guidance on inclusions and exclusions within each category and subcategories, and other major reports and studies in each of the sectors that can potentially contribute to NbS, including those on biodiversity, peatland and agriculture.

Table A1.1. Public NbS finance flows – description of data used

Public finance flow	Source	Description	Year in SFN 2021	Year in SFN 2022	Year in SFN 2023	Sector	Sub-sector
Domestic government expenditure	OECD Classification of the Functions of Government (COFOG)	An international standard that breaks down government expenditure from the System of National Accounts according to the different purposes or functions for which the funds are used.	2018	2019	2021	04: Economic Affairs	0402: Agriculture, forestry, fishing and hunting 0502: Waste water management 0503: Pollution abatement 0504: Protection of biodiversity and landscape 0506: Environmental protection not elsewhere classified
	IMF Classification of COFOG		2016	2017	2021	05: Environmental Protection	
	China's National Accounts	The statistical yearbooks report annual government spending across 3 budget functions. This is mapped to COFOG categories.	N/A	N/A	2022		
	US National Accounts	Database of government spending across budget functions	2020	2021	2022	Agriculture Natural Resources and Environment	Agriculture Water resources Pollution control and abatement Conservation, land management and other natural resource spending Recreation resources
	FAO/UNDP/UNEP	Estimates of agricultural subsidies i.e. price incentives, output/input subsidies and subsidies on factors of production	N/A	N/A	2021		
	Agricultural Policy Monitoring and Evaluation	Estimates of agricultural support across sectors and countries	N/A	N/A	2021		
	Fossil Fuel Subsidies, OECD and IEA	Database provides data on fossil fuel support to end-user by country and by fuel	N/A	N/A	2021		
	SubsidyExplore.org (Environmental Markets Lab 2018) compiles data from three sources Sumaila <i>et al.</i> (2019) estimates global fisheries subsidies OECD Fisheries Support Estimate (FSE) database (2019) Schuhbauer <i>et al.</i> (2017) estimate global small-scale fisheries subsidies	Estimate of government subsidies that support: Fisheries management: Programs aimed at improving methods for fish catching and processing, improving fishery resources through scientific or technical developments. Research and development in fisheries: Including monitoring, control, surveillance programs, stock assessment and resource surveys, fishery habitat and stock enhancement programs.	N/A	N/A	2018		
Official Development Assistance	OECD Creditor Reporting System	Bilateral and multilateral aid in support of environment sustainability and aid to biodiversity, climate change mitigation, climate change adaptation and desertification from the DAC CRS database.	N/A	2019	2023	140: Water Supply and Sanitation 311: Agriculture 312: Forestry 401: General Environmental Protection	14010: Water sector policy and administrative management 14015: Water resources conservation (including data collection) 14040: River basins development 31110: Agricultural policy and administrative management 31120: Agricultural development 31130: Agricultural land resources 31140: Agricultural water resources 31192: Plant and post-harvest protection and pest control 31210: Forestry policy and administrative management 31220: Forestry development 31261: Fuelwood/charcoal 31281: Forestry education/training 31282: Forestry services 32162: Forest industries 31291: Forestry services

As there is no global database that tracks public NbS expenditure, the analysis uses scaling factors with sectoral guidance from the OECD. Scaling factors represent the share of

activities within a COFOG and ODA sector which can confidently be identified as NbS. Scaling factors for COFOG and ODA sub-sectors are summarised in Table A1.2 and A1.3.

Table A1.2. Scaling factors used to adjust domestic sectoral expenditure to NbS

COFOG sub-sector	Scaling factor	Source
0402: Sustainable agriculture, forestry and fishing	0.1	The Nature Conservancy 2020
0502: Waste water management	0.1	UN Water 2015
0503: Pollution abatement	0.2	The Nature Conservancy 2020
0504: Protection of biodiversity and landscape	0.9	UNDP 2016
0506: Environmental policy and other	0.2	The Nature Conservancy 2020

Table A1.3. Scaling factors to identify NbS in ODA budgets

ODA sub-sector	Scaling factor	Source
31110: Agricultural policy and administrative management	0.3	FAO 2018a The Nature Conservancy 2023 Expert consultation
31120: Agricultural development		
31130: Agricultural land resources		
31140: Agricultural water resources		
31210: Forestry policy and administrative management		
31220: Forestry development		
32162: Forest industries	0.2	FAO 2018b UN Water 2015
14010: Water sector policy and administrative management		
14015: Water resources conservation (including data collection)		
14040: River basins development	0.6	The Biodiversity Finance Initiative (BIOFIN) 2016
41020: Biosphere protection		
41030: Biodiversity		
41040: Site preservation	0.6	FAO 2020
41010: Environmental policy and administrative management		
41081: Environmental education/training		
41082: Environmental research		

A1.4. Private finance flow to nature-based solutions

Sources of data on private finance flows are listed below. New data has been included when available to broaden the scope (see Table A1.4).

- Carbon markets: private finance flows via carbon markets use 2021 data from Ecosystems Marketplace (2022), which tracks carbon offset transactions in voluntary carbon markets across different projects, such as forestry, renewable energy and waste disposal. A lower bound estimate is calculated for voluntary carbon market transactions of forestry, land use and agriculture projects, while an upper bound includes value of forestry, land use, agriculture and waste disposal projects.
- Sustainable supply chains: SFN 2023 makes the assumption that 1-1.5% of the certified commodity market is assumed to be invested in biodiversity-related NbS (Deutz *et al.* 2020) based on findings from the forestry sector. Included in the estimation are seven types of certified product supply chains: forestry products, palm oil, organic agricultural goods, seafood, soy, coffee and cocoa. Estimates of certified forestry products, palm oil, and seafood were extrapolated from data used in SFN 2022 as updated data was not available. Estimation of soy, coffee and cocoa was based on updated sources (annual reports 2022 from Rainforest Alliance and RTRS, market statistics on global production volumes). A new approach was used to estimate finance flows to certified organic agricultural goods, which replaced BIOFIN (2020) estimates (used for SFN 2021 and 2022) with organic market size (Statista 2022) to avoid double counting.
- Biodiversity offsets : this category refers to finance flows to programmes intended to compensate for unavoidable impacts of development projects after prevention and mitigation measures have taken place. This analysis projects 2016 values from Bennett *et al.* (2017) using two different compound annual growth rates (CAGR). A lower bound applies six per cent annual growth, starting at US\$2.6 billion in 2016. An upper bound applies 13 per cent annual growth (based on Facts and Factors' market research on the global mitigation market) starting at US\$7.3 billion (Bennett *et al.* 2017; Facts and Factors 2022).
- Biodiversity Credits: this category refers to investment in programmes intended to increase biodiversity levels (net gain). Biodiversity credits were not included in previous editions. Only a few credit schemes are in place in 2022. A Terrasos estimate is used as a lower bound. An upper bound is based on the higher BloombergNEF estimate (Carbon Pulse 2023).
- Impact investing: this category includes private or public equity and debt investments intended to generate positive, measurable ESG impact alongside a financial return. Sources include State for Private Investment in Conservation (SOPIC) report (2016 extrapolated to 2022), Global Impact Investing Network (GIIN) survey (2020), Impact yield (2023), Funds for Nature (2023), Capital for Climate (2023). A lower estimate is from SFN 2022 but extrapolated to 2023. The upper bound uses the amount invested from the GIIN survey and the upper limit of percentage of the Assets Under Management (AUM) reported for 92 funds in funds for nature, capital for climate and impact yield.
- Philanthropy: Data is sourced from OECD CRS up to 2021 (includes Bezos Earth Fund) (OECD 2023a). Upper limit: Disbursements tagged to biodiversity plus biosphere protection. Lower limit: Disbursements tagged to biodiversity only.
- Conservation non-governmental organisations (NGOs): Data is sourced from annual expenditure reported by the largest conservation NGOs, including Conservation International and affiliates, Royal Society for the Protection of Birds (RSPB), The Nature Conservancy, Wildlife Conservation Society (WCS), and World Wildlife Fund (WWF). Any funding received from public institutions and philanthropy is excluded to avoid double counting.
- Payments for ecosystem services (PES): voluntary finance flows between ecosystem service users and providers conditional on agreed rules of resource management for generating ecosystem services (Wunder 2015). Data is obtained from the OECD: Tracking Economic Instruments and Finance for Biodiversity study which captures PES

based on a survey conducted in late 2020 including 153 PES programmes in 37 countries (OECD 2021). To estimate the share of private payments, we calculated the market value share of PES mechanisms that are user-financed and compliance-financed based on data from Salzman *et al.* (2018) and downscale the figure from OECD (2021) by 22 per cent to 44 per cent to derive a lower and upper bound estimate respectively.

- Private finance mobilised by official development finance interventions: Data is sourced from OECD, including CRS private finance mobilization from all donors (including multilateral agencies such as Global Environment Facility [GEF], Green Climate Fund [GCF] and the World Bank) tagged to General Environmental Protection sector. Upper limit: total mobilised to General Environmental Protection. Lower limit: only climate finance mobilised to General Environmental Protection.³¹
- Farmer's investments into conservation agriculture: this element is new. Farmer's investments into conservation agriculture are estimated bottom-up with a three-step methodology: Step 1. Calculate growth in hectares under conservation agriculture per year, Step 2. Multiply with upper and lower bound average capex per hectare for conservation agriculture, Step 3. Multiply calculated total investment from step 2 with the share of total agricultural investment from farmer's retained profits. The share used is 37 per cent, taken from Planet Tracker analysis (Kassam *et al.* 2019).

³¹ Since private finance mobilised for the ocean economy include flows towards all ocean-based industries and some of them may not be NbS relevant (e.g. renewable marine energy), this analysis estimates the average share of sustainable ocean economy ODA relative to ocean economy ODA between 2010 and 2019, equal to 34%, and scales down the size of private finance by this share to derive an upper bound of private finance in marine NbS. The lower bound scales down ocean economy flows more conservatively, by 10%.

Table A1.4. Private Nbs finance flows data description

Private finance flow	Source	Description	Year in SFN 2021	Year in SFN 2022	Year in SFN 2023
Carbon markets	Ecosystems Market Place 2022	Transactions from voluntary carbon markets and investments in Reducing Emissions from Deforestation and forest Degradation (REDD+) programmes	2019	2020	2021
Sustainable supply chains	Certified forestry products: (i) OECD (2020a): A comprehensive overview of global biodiversity finance (ii) Breukink <i>et al.</i> 2015 Certified Palm oil: 2019 Global Market Report: Palm Oil (Voora <i>et al.</i> 2019) Certified agricultural goods: BIOFIN 2020 Certified seafood: (i) FAO 2018b and (ii) De Jong 2019 RTRS certified soy: Solidaridad Network 2020. Certified coffee: Rainforest Alliance 2022b. Certified cocoa: Rainforest Alliance 2022a.	Investments into biodiversity conservation from sustainable-certified commodity markets The estimates follow the approach outlined in Deutz <i>et al.</i> (2020) where 1-1.5% of the certified commodity market is assumed to be invested in biodiversity-related activities based on findings from the forestry sector	a) 2015 b) 2019 c) 2019 d) 2018 e) Not reported f) Not reported g) Not reported	a) 2015 b) 2019 c) 2019 d) 2018 e) 2019 f) 2020 g) 2019	a) 2015 b) 2019 c) 2019 d) 2018 e) 2021 f) 2021 g) 2021
Biodiversity offsets	Bennett <i>et al.</i> 2017 – survey of 99 regulatory biodiversity offsetting programmes in 33 countries. Facts and Factors 2022 - Global mitigation banking market is likely to grow at a CAGR value of 13.10% by 2028.	Investment in programmes intended to compensate for unavoidable impacts of development projects	2016	2016	2016, projected to 2022
Biodiversity credits	Bloomberg NEF 2023 World Economic Forum (WEF) 2022	Investment in programmes intended to increase biodiversity levels (net gain)	N/A	N/A	2022
Impact investing	State of Private Investment in Conservation (SOPIC) 2016 GIIN survey 2020 Impact yield 2020 ImpactAssets 50 (IA50) Impactyield.org	Private or public equity and debt investments intended to generate positive, measurable ESG impact alongside a financial return. The upper bound estimate assumes 16% of AUM is annual invested in Nbs	2019	2020	2022
Conservation NGOs	Annual reports of: Conservation International RSBP The Nature Conservancy WCS WWF	Expenditure reported by the largest conservation NGOs	2020	2021	2022
Payments for Ecosystem Services	OECD survey of 153 PES programmes in 37 countries and the global status and trends of Payments for Ecosystem Services (Salzman <i>et al.</i> 2018) Bennett and Ruef (2016) include PES for water quality trading and offsets and watershed services.	Voluntary finance flows between service users and service providers conditional on agreed rules of resource management for generating offsite services (Wunder 2015)	2015	2018	2018
Philanthropy	OECD CRS 2021 Bezos Earth fund 2020 OECD 2020b Fundingtheocean.org 2020 Our Shared Seas 2021	Finance flows reported by philanthropic foundations	2017	2020	2021
Private finance leveraged by multilateral organisations	OECD 2018 GEF 2017 GCF 2020 OECD 2020b	Private finance leveraged by development finance institutions, development banks, other development agencies and two multilateral climate and biodiversity funds. The OECD CRS and OECD Sustainable Ocean Economy collect private flows mobilized through a variety of blended finance mechanisms using instrument-specific methodologies, covering all leveraging mechanisms used by DFIs and multilateral development banks (guarantees, syndicated loans, project finance schemes, shares in collective investment vehicles, direct investment in companies, credit lines and simple co-financing).	2017/2018	2017/2018 and 2020 for marine	2021
Farmer's investments into conservation agriculture	Kassam <i>et al.</i> 2019 Elwin <i>et al.</i> 2023	Farmers' management decisions, such as to invest into conservation agriculture, have positive impacts on nature.	N/A	N/A	2019

The key assumptions made to estimate private finance flows to NbS are summarised in Table A1.5.

Table A1.5. Private NbS finance flows assumptions

Description	Assumption	Source
Private financial flows		
Impact investments: average capital invested in relation to the AUM	16.8%	Deutz <i>et al.</i> (2020) report
Impact investments: share of annual investment actually spent on biodiversity conservation (for those funds indicated in the Paulson Institute report)	5%	Deutz <i>et al.</i> (2020) report
Amount re-invested into biodiversity from sustainable supply chains (lower bound)	1.0%	Deutz <i>et al.</i> (2020) report
Amount re-invested into biodiversity from sustainable supply chains (upper bound)	1.5%	Deutz <i>et al.</i> (2020) report
Upper bound share of sustainable ocean economy flows relative to ocean economy flows for private finance	34%	Share of sustainable ocean economy flows relative to ocean economy flows for ODA
Lower bound share of sustainable ocean economy flows relative to ocean economy flows for private finance	10%	Expert consultation
Impact investments: share of annual investment of marine funds actually spent on biodiversity conservation	6%	In line with GIIN data

A1.5. Future nature-based solutions investment needs

To estimate future investment needs, SFN 2023 relies on modelling using Model of Agricultural Production and its Impact on the Environment (MAgPIE), a global land use allocation model designed to explore land competition dynamics in the context of carbon policy as well as off-model analysis.³²

³² MAgPIE v4.1 was used to model majority of the future NbS financial flows for Rio-aligned scenario. However, the latest version, MAgPIE v4.3, was used to model peatland restoration (Humpeñöder *et al.* 2020). v4.5 was used to model FPS scenario.

Step 1: Define model assumptions

Two scenarios with different assumptions were developed.

Policy scenario assumptions

Assumptions were defined for policy scenarios, including a carbon price trajectory aligned with a 1.5°C climate outcome, and land policy that meets post-2020 global biodiversity framework targets. Detailed modelling assumptions and sources are listed in Table A1.6 and A1.7.

Table A1.6. Rio-aligned and Forecast Policy Trajectory scenario descriptions

	Rio-aligned	Forecast Policy Trajectory
Narrative	Key Rio Conventions targets are met, limiting climate change to 1.5°C, halting biodiversity loss and achieving land degradation neutrality.	Key Rio Convention targets are not fully achieved. Policy action is based on national and international commitments, market trends and probability of policy implementation.
Source	Scenario created by SFN 2022 using the MAgPIE land use model and additional analysis drawing on academic literature on NbS technical potential.	UN PRI Inevitable Policy Response – Forecast Policy Scenario + Nature. This scenario was also developed using MAgPIE combined with additional analysis.
Key assumptions / outcomes	<ul style="list-style-type: none"> All countries meet GBF protected areas 30x30 target 2nd generation bioenergy demand increases to 18 EJ/year by 2050. 13% of global land area under restoration by 2050 	<ul style="list-style-type: none"> Countries fall short of GBF protected area target - only 20% of land is protected by 2030. 2nd generation bioenergy demand increases to 90 EJ/year by 2050. 6% of global land area under restoration by 2050

Table A1.7. Scenario modelling assumptions

Variable	Description	Source (Rio-aligned)	Rio-aligned Scenario	FPS+nature scenario ¹	Baseline scenario
1. Greenhouse gas (GHG) price trajectory	Defines global price trajectories for CO ₂ , N ₂ O, CH ₄ .	International Institute for Applied Systems Analysis (IIASA) Database and Postdam Institute for Climate Impact Research (PIK) integrated assessment modelling exercise	Shared Socioeconomic Pathways (SSP) 2 Representative Concentration Pathway (RCP) 2.6 consistent trajectory with carbon prices phasing-in globally in 2020	Implicit carbon prices proxy for a range of policies/regulations targeting a reduction in land use emissions, average at \$54/tCO ₂ in 2030 and \$105/tCO ₂ in 2050	No carbon price
2.Reduction factor for CO ₂ price	Lowers economic incentive for CO ₂ emissions reduction from avoided deforestation and afforestation compared to carbon price level	-	0.5	-	-
3.Bioenergy trajectory	Defines demand for second generation bioenergy crops (only used for fuel production, not for food)	IIASA Database and PIK integrated assessment modelling exercise	2 nd generation bioenergy demand increases to 18 EJ/year by 2050. SSP2 RCP2.6 consistent trajectory.	Bioenergy production aligned with national renewable energy regulations and strategies and Net Zero targets, 17EJ in 2030, 90EJ in 2050 (all 2 nd generation bioenergy by 2050)	SSP2 National Policies Implemented (NPI) consistent trajectory
4.Population	Sets trajectories based on SSPs	SSP database	SSP2 – ‘Middle of the road’ consistent pathways	SSP2 – ‘Middle of the road’ consistent pathways	SSP2 – ‘Middle of the road’ consistent pathways
5.GDP	Sets trajectories based on SSPs	SSP database	SSP2 – ‘Middle of the road’ consistent pathways	SSP2 – ‘Middle of the road’ consistent pathways	SSP2 – ‘Middle of the road’ consistent pathways
6.Protected areas	Defines trajectory of area under protection as per WDPA categories plus all proposed areas and key biodiversity hotspots	UNCBD - Global Biodiversity Framework (GBF) target	All countries meet GBF protected areas 30x30 target	Protected areas expand to 20% of global terrestrial land by 2030 and 24% by 2050	no change from current levels
7.Ruminant meat fadeout	Defines decline in proportion of calories from ruminant meat in total meat demand relative to baseline scenario where it is treated as constant	Bodirsky <i>et al.</i> n.d. Whitton <i>et al.</i> 2021	25% reduction in ruminant meat share of diet by 2050.	Per capita global ruminant meat consumption falls by 20% by 2050 Ruminant meat production stabilises at 37 megatons of dry matter per year in 2050 (decrease by 4% compared to 2020)	Ruminant meat share remains constant.

Note: 1. This list is not exhaustive and derived from the FPS+nature scenario overview (UN Principles for Responsible Investment [PRI] 2023b). The FPS+nature scenario results from the combination of a set of levers which includes FPS energy-related policy levers, land related policy levers and includes additional assumptions on nature markets: (i) increasing biodiversity credit prices, (ii) soil nitrogen uptake efficiency increases to 65 per cent in 2050, (iii) food waste falls globally by 23 per cent between 2020 and 2050 (UNPRI 2023a).

Scope of nature-based solutions

16 NbS were selected based on their mitigation potential and data availability and quality (Figure A1.3). The different types of NbS included are described in Table A1.8. Investment needs for these NbS is estimated from the present to 2050 through land use modelling and additional off-model analysis based on academic literature.

Figure A1.3. NbS included in investment needs analysis

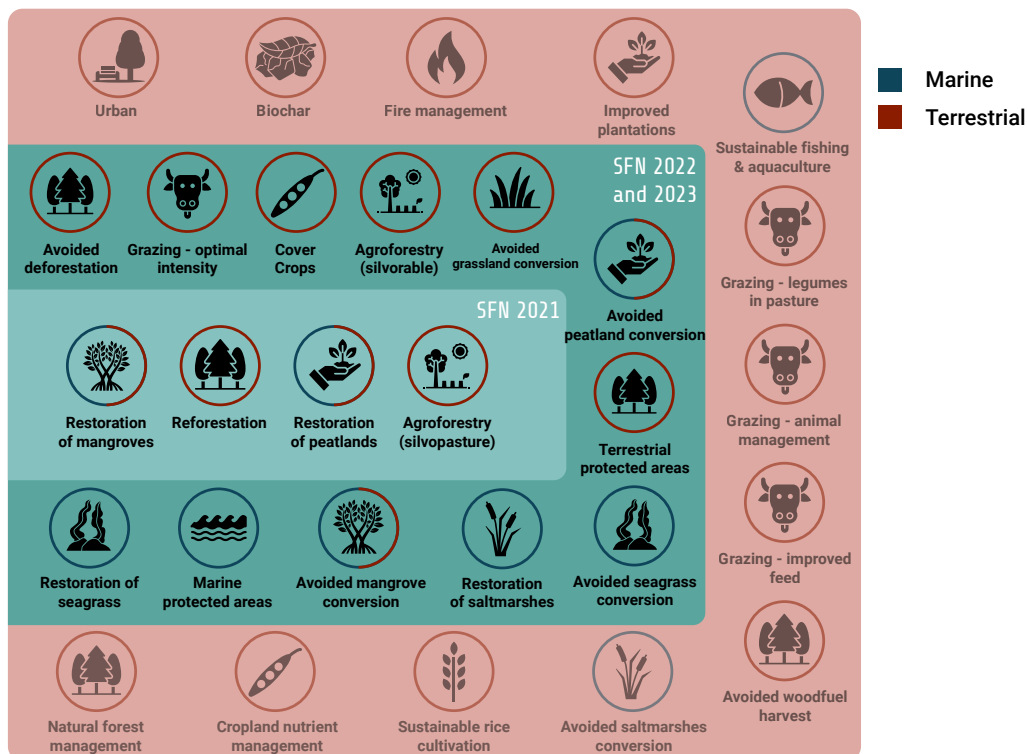


Table A1.8. NbS types and definitions

NbS category	Description
Reforestation	Conversion from non-forest (less than 25 per cent tree coverage) to forest (more than 25 per cent tree coverage) in previously forested areas
Agroforestry (silvopasture and silvoarable)	A land use system in which trees are grown with agriculture on the same land. SFN 2021 focused on silvopasture, which is the combination of trees and livestock; SFN 2022 included silvoarable agroforestry, which is the planting of trees in croplands. Following Wilkinson <i>et al.</i> (2020), two silvoarable types are considered: tree intercropping and multistrata agroforestry. SFN2023 continues the 2022 categorisation.
Restoration of mangroves	Restoration of damaged and degraded global mangrove forests.
Restoration of peatlands	Rewetting of damaged and degraded global peatlands.
Restoration of seagrass	Restoration of damaged and degraded global coastal seagrass meadows.
Restoration of saltmarshes	Restoration of damaged and degraded global coastal saltmarshes.
Grazing – optimal intensity	Grazing optimisation is the offtake rate that leads to maximum forage production (Henderson <i>et al.</i> 2015). This prescribes a decrease in stocking rates in areas that are overgrazed and an increase in stocking rates in areas that are under-grazed, with the net result of increased forage offtake and livestock production.
Cover crops	Cultivation of cover crops in fallow periods between main crops. Prevents losses of arable land while regenerating degraded land.
Avoided deforestation	Avoidance of conversion, destruction or degradation of forests, where forests are defined as areas with more than 25 per cent of tree coverage, in line with the global study by Tyukavina <i>et al.</i> (2012).
Avoided grassland conversion	Avoided conversion of temperate grasslands, tropical savannas and shrublands; the focus is placed on the conversion of grasslands to croplands.
Avoided mangrove conversion	Avoided conversion, destruction or degradation of global mangrove forests.
Avoided seagrass conversion	Avoided conversion, destruction or degradation of global seagrass.
Avoided peatland conversion	Avoided conversion, destruction or degradation of global peatlands.
Protected area	Area closures that can help reduce conversion and degradation of marine and terrestrial ecosystems, including deforestation and forest degradation.

Regional analysis

SFN 2023 and MAgPIE's modelling results are presented by region based on aggregation countries and areas based on the following list.

Oceania: Australia; Heard Island and McDonald Islands; New Zealand;

North America: Canada; Saint Pierre and Miquelon; United States of America;

Latin America: Aruba; Anguilla; Argentina; Antarctica; Antigua and Barbuda; Bonaire, Sint Eustatius and Saba; Bahamas; Saint Barthélemy; Belize; Bermuda; Bolivia; Brazil; Barbados; Bouvet

Island; Chile; Colombia; Costa Rica; Cuba; Curaçao; Cayman Islands; Dominica; Dominican Republic; Ecuador; Falkland Islands; Guadeloupe; Grenada; Guatemala; French Guiana; Guyana; Honduras; Haiti; Jamaica; Saint Kitts and Nevis; Saint Lucia; Saint Martin (French part); Mexico; Montserrat; Martinique; Nicaragua; Panama; Peru; Puerto Rico; Paraguay; South Georgia and the South Sandwich Islands; El Salvador; Suriname; Sint Maarten (Dutch part); Turks and Caicos Islands; Trinidad and Tobago; Uruguay; Saint Vincent and the Grenadines; Venezuela (Bolivarian Republic of); Virgin Islands (British); Virgin Islands (U.S.);

Europe: Åland Islands; Albania; Andorra; Austria; Belgium; Bulgaria; Bosnia and Herzegovina; Switzerland; Cyprus; Czechia; Germany; Denmark; Spain; Estonia; Finland; France; Faroe Islands; United Kingdom of Great Britain and Northern Ireland; Guernsey; Gibraltar; Greece; Greenland; Croatia; Hungary; Isle of Man; Ireland; Iceland; Italy; Jersey; Liechtenstein; Lithuania; Luxembourg; Latvia; Monaco; North Macedonia; Malta; Montenegro; Netherlands; Norway; Poland; Portugal; Romania; Svalbard and Jan Mayen; San Marino; Serbia; Slovakia; Slovenia; Sweden; Turkey; Holy See;

Africa: Angola; Burundi; Benin; Burkina Faso; Botswana; Central African Republic; Côte d'Ivoire; Cameroon; Democratic Republic of the Congo; Congo; Comoros; Cabo Verde; Djibouti; Eritrea; Ethiopia; Gabon; Ghana; Guinea; Gambia; Guinea-Bissau; Equatorial Guinea; Kenya; Liberia; Lesotho; Madagascar; Mali; Mozambique; Mauritania; Mauritius; Malawi; Mayotte; Namibia; Niger; Nigeria; Réunion; Rwanda; Senegal; Saint Helena, Ascension and Tristan da Cunha; Sierra Leone; Somalia; South Sudan; Sao Tome and Principe; Eswatini; Seychelles; Chad; Togo; Tanzania, the United Republic of; Uganda; South Africa; Zambia; Zimbabwe;

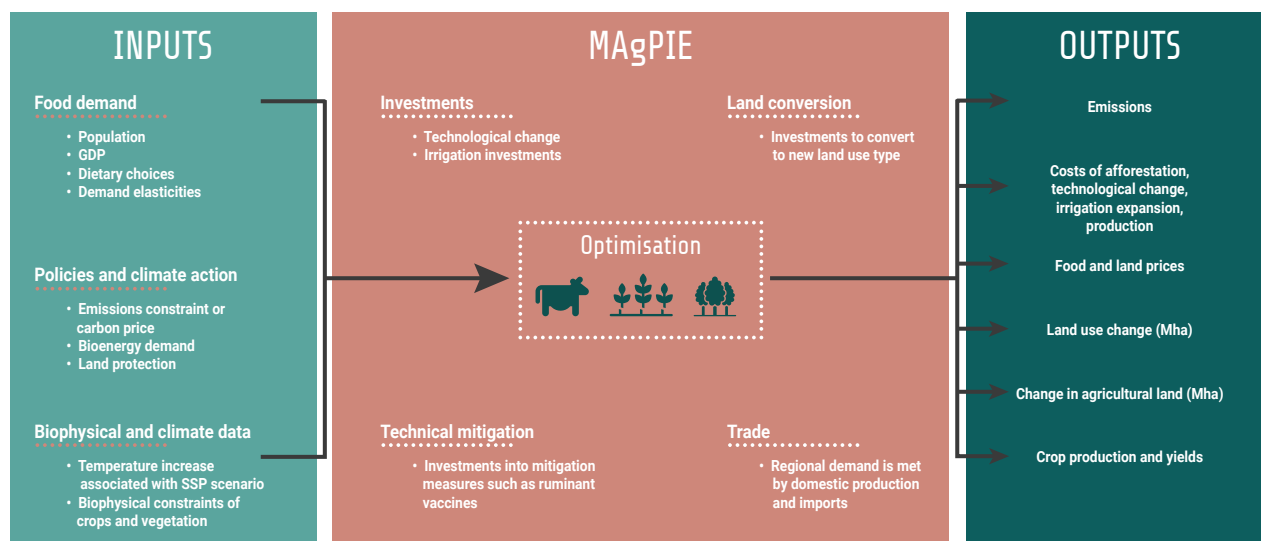
Asia: Afghanistan; American Samoa; French Southern Territories; Bangladesh; Brunei Darussalam; Bhutan; Cocos (Keeling) Islands; China; Cook Islands; Christmas Island; Fiji; Micronesia (Federated States of); Guam; Hong Kong; Indonesia; India; British Indian Ocean Territory; Japan; Cambodia; Kiribati; Republic of Korea; Lao People's Democratic Republic; Sri Lanka; Macao; Maldives; Marshall Islands; Myanmar; Northern Mariana Islands; Malaysia; New Caledonia; Norfolk Island; Niue; Nepal; Nauru; Pakistan; Pitcairn; Philippines; Palau; Papua New Guinea; Democratic People's Republic of Korea; French Polynesia; Singapore; Solomon Islands; Thailand; Tokelau; Timor-Leste; Tonga; Tuvalu; Taiwan; United States Minor Outlying Islands; Viet Nam; Vanuatu; Wallis and Futuna; Samoa;

Middle East and Reforming Economies: United Arab Emirates; Armenia; Azerbaijan; Bahrain; Belarus; Algeria; Egypt; Western Sahara, Georgia; Iran (Islamic Republic of); Iraq; Israel; Jordan; Kazakhstan; Kyrgyzstan; Kuwait; Lebanon; Libya; Morocco; Republic of Moldova; Mongolia; Oman; Palestine, State of; Qatar; Russian Federation; Saudi Arabia; Sudan; Syrian Arab Republic; Tajikistan; Turkmenistan; Tunisia; Ukraine; Uzbekistan; Yemen.

Step 2: Run the model to optimise land-use pattern

MAgPIE takes a set of policy input assumptions and estimates the least cost way in which the land use sector can meet demand for agricultural products while respecting planetary boundaries (e.g. food and water security) and ensuring human wellbeing. Key outputs from the model include cost of action and land use change

Figure A1.4. MAgPIE: structure of the optimisation process



MAgPIE’s modelling outputs were adjusted to 2023 USD prices and aggregated with off-model analysis to estimate annual investment needed between 2023 and 2050.

The Rio-aligned scenario is compared with a business as usual (BAU) scenario which assumes

no increase in finance flows to NbS over time. The difference in costs between the modelled scenario and the BAU scenario represents the additional investment needed to achieve climate, biodiversity and land targets, such that for each time period, t:

$$\text{Investment Needs}_t = \text{Costs}_{t, \text{Rio-aligned or forecasted policy Scenario}} - \text{Costs}_{t, \text{BAU Scenario}}$$

In MAgPIE, land is a limited resource which is allocated to either agricultural production (food, feed and other materials) or carbon sequestration. This allocation process minimises costs incurred by the land use system to meet demand for agricultural products. Demand for agricultural products is a function of both population and income. The former relationship is straightforward – more food and fibre will be needed to feed and clothe a growing population. The latter reflects that, as people become richer, their budget constraint loosens, allowing individuals to demand more than “strictly” needed. As both population and GDP are set to increase, demand will grow, and the agricultural sector will have to produce more using the same amount of land. This will intensify competition among land uses, leading to investment in innovation, higher production efficiency and higher food prices.

The introduction of climate policies puts additional pressure on the land use sector, increasing the costs associated with meeting agricultural

demand. First, expanding protected areas to include biodiversity hotspots as well as setting aside land to meet Nationally Determined Contributions (NDC) commitments reduces the hectares of land available for agricultural production. Additionally, the introduction of a price on greenhouse gases has two direct effects on the land use system: on one hand, it increases production costs for emission-intensive activities, such as production of beef and animal feed; on the other hand, it increases the benefits associated with non-productive activities, such as regrowth of natural vegetation for carbon sequestration. To meet demand under increasingly stringent land constraints and with cleaner/ less-costly production systems, the land use system faces substantial transition costs both in the form of investments to increase efficiency as well as operational costs associated with more intensive production systems.

Step 3: Use model outputs to conduct investment needs analysis

The model accounts for all costs in the land use sector. The analysis differentiates between direct and indirect costs of climate action. Direct costs include costs related to GHG emissions and mitigation actions. Indirect costs include investment and recurring costs in the agricultural sector, which are likely to increase with policy ambition. The difference across scenarios is driven by the additional pressure on land use systems by climate action. To reach climate, biodiversity and land degradation targets, the land use sector

allocates larger areas to forestry and regrowth of natural vegetation, reducing the amount of land available for agricultural production. To feed an increasingly populous and rich world, agricultural producers need to become more efficient by investing in innovation and the production process. For example, to increase their crop yields firms will have to invest capital to acquire innovative machinery or develop new production systems and spend more on skilled labour.

Table A1.9. Costs estimated in MAgPIE

Category	List of costs	Description
Indirect costs	1. Costs of input factors	For producing food and materials includes labour, energy, physical inputs, non-land capital cost
Indirect costs	2. Investment in technical change and adoption	Includes Research and Development, adoption and irrigation expansion
Indirect costs	3. Costs of processing, transport and trade	Includes all downstream costs to consumer
Indirect costs	4. Cost of land conversion	Including land clearing and preparation for agriculture or restoration
Indirect cost	5. Cost of forest management	Cost associated with forest management
Direct costs	6. Costs of climate policy	Split into a. Emissions costs associated with a Paris-aligned carbon pricing trajectory b. Rewards for negative emissions

To estimate investment needs, the analysis focuses on differences in indirect costs of policy action. Focussing on this category of cost allows estimation of investment in NbS needed to meet climate, biodiversity and land degradation targets.

Total investment needs between 2023 and 2050 are calculated as the difference in cumulative discounted cashflows of indirect costs of climate, biodiversity and land degradation neutrality action between policy and baseline scenario:

$$\text{Total investment needs}_{2023-2050} = \sum_{t=2023}^{2050} \Delta \text{Costs}_t = \sum_{t=2023}^{2050} \text{Costs}_{t, \text{Rio/Policy-Aligned Scenario}} - \text{Costs}_{t, \text{BAU Scenario}}$$

Step 4: Conduct off-model analysis for additional NbS categories

This section provides an overview of the analysis of investment needs for NbS that are not covered in the model. As MAgPIE focuses on forests and innovation in the agricultural sector, modelled results are integrated with off-model analysis to complement the estimation of future NbS finance flow needs:

- Identify feasible area for mangrove, seagrass, saltmarsh, grassland, wetland and peatland restoration and protection.
- Estimate direct costs of sustainable land management of agroforestry, cover crops, grazing optimal intensity.
- Gather annual capital investment and operating costs to deploy NbS across regions.
- Combine cost in 2023 prices and feasible area data (constrained by relevant MAgPIE variables where possible) to calculate the sum of capital investment and the cumulative operations expenditure between the initial investment period and 2050.

The focus on these NbS types is due to their mitigation potential, data availability and compatibility with modelled results. Estimates collected from Griscom *et al.* (2020), Roe *et al.* (2021) and McKinsey (2022) ensure that solutions with high climate mitigation potential are included. A second stage of the analysis includes data collection on both costs and potential future uptake for each solution.

Solutions that could not be integrated with modelled results are excluded. Only those marine NbS with established 'blue carbon' revenue generating potential and scientifically verifiable levels of carbon abatement are included.³³ This analysis excludes emerging and nascent solutions, e.g. kelp forests and seaweed farming. It also excludes oyster and coral reefs.³⁴

See Table A1.10 for a description of the off-model methodology and assumptions used to calculate investment needs for each NbS and Table A1.11 for a list of data sources employed.

³³ Blue Carbon: The Potential of Coastal and Oceanic Climate Action (McKinsey 2022)

³⁴ Coral reef restoration is not included due to ambiguity around its carbon sink properties.

Table A1.10. Investment needs analysis and approach outside MAgPIE

NbS	Approach
Avoided peatland conversion and restoration of peatlands	Area of land use change is taken from Humpenöder <i>et al.</i> (2020). An upper bound aligned with the 1.5°C target uses estimates of land available for rewetting that are not constrained by socioeconomic factors based on Griscom <i>et al.</i> (2017) and Wilkinson <i>et al.</i> (2020).
Agroforestry and optimal managed grazing	Based on land use patterns from Wilkinson <i>et al.</i> (2020), assuming linear growth from 2020 to 2050.
Cover crops	In the lower bound scenario, the report uses an average of estimates from Griscom <i>et al.</i> (2017), Roe <i>et al.</i> (2021) and Wilkinson <i>et al.</i> (2020). This is extended to an upper bound by using Griscom's figure for technical potential. Costs are taken from World Economic Forum's Nature Net Zero (WEF 2021).
Avoided grassland conversion	Based on the historical rate of conversion of natural grasslands to cropland from 1980 to 1990. Costs are taken from Vivid Economics analysis.
Avoided mangrove conversion and restoration of mangroves	Based primarily on Mckinsey (2022), Worthington and Spalding (2018) and Griscom <i>et al.</i> (2020).
Avoided conversion and restoration of seagrass and saltmarsh	<p>Restoration</p> <p>Following Macreadie <i>et al.</i> (2021), the upper bound for land suitable for mangrove restoration is set at 0.812Mha. This is less than ten percent of the total land available (9-11Mha). Mckinsey (2022) estimates that the feasible land for restoration, given biophysical and socioeconomic constraints, is 0.6Mha. Roe <i>et al.</i> (2021) estimates that only 0.2Mha is 'practically' available at a cost-effective level. This is set as the lower bound.</p> <p>In contrast, global estimates of land available for seagrass meadow and salt-marsh restoration are unconstrained, due in part to a lower volume of research and incomplete global mapping. The upper bound in each case is set at 11.8 and 5.5Mha, respectively. We set lower bounds at a similar ratio to that for mangroves to capture the uncertainty in feasibility once biophysical and socio-economic constraints are introduced, that is at 0.65 and 0.3Mha respectively.</p> <p>Costs for marine restoration are taken from Bayraktarov <i>et al.</i> (2016).</p> <p>Avoided conversion of seagrass and saltmarshes</p> <p>Area of projected land use change is based on historical rates, following Griscom <i>et al.</i> (2017). Costs are from Vivid Economics analysis.</p>

Table A1.11. Off modelling analysis data sources

NbS type	Source
Agroforestry - Silvoarable (tree intercropping)	Wilkinson <i>et al.</i> 2020
Agroforestry - Silvoarable (multistrata agroforestry)	
Agroforestry - Silvopasture	
Agroforestry - Silvoarable	Griscom <i>et al.</i> 2020
Agroforestry - Silvoarable and silvopasture	Roe <i>et al.</i> 2021
Cover crops	Wilkinson <i>et al.</i> 2020 Griscom <i>et al.</i> 2020 WEF 2021
Optimal managed grazing	Wilkinson <i>et al.</i> 2020 Griscom <i>et al.</i> 2020 Wilkinson <i>et al.</i> 2020 Laporte <i>et al.</i> 2021
Peatland restoration	Humpenöder <i>et al.</i> 2021 Wilkinson <i>et al.</i> 2020 Griscom <i>et al.</i> 2020 Roe <i>et al.</i> 2021 Defra, Glenk 2018, Moxey and Moran 2014
Avoided peatland degradation	Humpenöder <i>et al.</i> 2021 Griscom <i>et al.</i> 2020 Roe <i>et al.</i> 2021 NOAA 2020, DEFRA Financial Intervention Model
Avoided grassland conversion	Griscom <i>et al.</i> 2017 Climate Trust 2014, Baker <i>et al.</i> 2020, ICF International 2013
Mangrove restoration	Worthington and Spalding 2018 Saintilan <i>et al.</i> 2020 Griscom <i>et al.</i> 2017 Mckinsey 2022 Roe <i>et al.</i> 2021 Bayraktarov 2020 Earth Security 2020 Taillardat 2021 Bayraktarov <i>et al.</i> 2015, WEF 2021, Kapos <i>et al.</i> 2019, Gilman <i>et al.</i> 2007
Seagrass meadows restoration	Griscom <i>et al.</i> 2017 Mckinsey 2022 Bayraktarov <i>et al.</i> 2020 Bayraktarov <i>et al.</i> 2015, Fonseca and Koehl 2006, Fonseca <i>et al.</i> 1998, Tan <i>et al.</i> 2020
Saltmarsh restoration	Griscom <i>et al.</i> 2017 Mckinsey 2022 Bayraktarov 2016
Avoided mangrove conversion	Griscom <i>et al.</i> 2017 McKinsey 2022 Roe <i>et al.</i> 2021 WEF 2021, Caldeira 2012, Aerts <i>et al.</i> 2018
Avoided seagrass meadows conversion	McKinsey 2022 Stowers <i>et al.</i> 2003
Avoided saltmarsh conversion	Griscom <i>et al.</i> 2017

A2. Physical benefits

Investing in NbS is estimated to have significant benefits through GHG removals and the protection of biodiversity.

A2.1. Greenhouse gases removals

For forestry NbS, emissions benefits were taken from MAgPIE using the Dasgupta 'Immediate Action' scenario (Dasgupta 2021). To estimate the emissions benefit associated with additional investment in NbS, this analysis uses peer-reviewed sequestration rates – weighted according to region – and applies them to modelled land use change between 2023 and 2050, assuming linear growth in most cases. GHG removals from protected areas are not included as there are possibilities of overlap with capture from other NbS (especially protection and restoration NbS), and there is also high uncertainty due to the variable ecosystems covered by protected areas. For avoided deforestation, emissions were calculated relative to business-as-usual scenarios.

Table A2.1. GHG abatement potential by NbS

NbS type	Source	Abatement potential (tCO ₂ e/ha/year)	Abatement potential per year (GtCO ₂ e/year)	
			By 2030	By 2050
Agroforestry - Silvoarable (tree intercropping)	Wilkinson <i>et al.</i> 2020	1.7	0.65	
Agroforestry - Silvoarable (multistrata agroforestry)		4.5		
Agroforestry - Silvopasture		2.7	1.1	
Agroforestry - Silvoarable	Griscom <i>et al.</i> 2017	0.37		1.0
	WEF 2021		0.3	
Agroforestry - Silvoarable and silvopasture	Girardin <i>et al.</i> 2021			1.9
	Roe <i>et al.</i> 2021			1.1 – 3.2
Cover crops	Wilkinson <i>et al.</i> 2020	0.25-0.78		
Cover crops	Griscom <i>et al.</i> 2017	0.32		0.41
	Girardin <i>et al.</i> 2021			0.37
	WEF 2021		0.45	
Optimal managed grazing	Wilkinson <i>et al.</i> 2020	0.6	0.7	
	Griscom <i>et al.</i> 2017			0.3
	Girardin <i>et al.</i> 2021			0.22
Peatland restoration	Humpenöder <i>et al.</i> 2021		1.0	
	Wilkinson <i>et al.</i> 2020			
	Girardin <i>et al.</i> 2021			0.39
	Griscom <i>et al.</i> 2017			0.82
	Roe <i>et al.</i> 2021			0.6
	WEF 2021		1.0	
Avoided peatland conversion	Humpenöder <i>et al.</i> 2021		0.9	
	Girardin <i>et al.</i> 2021			0.68
	Griscom <i>et al.</i> 2017			0.75
	Roe <i>et al.</i> 2021			0.2
	WEF 2021		0.9	
Avoided grassland conversion	Griscom <i>et al.</i> 2017			0.12
	Girardin <i>et al.</i> 2021			0.04
Mangrove restoration	Worthington <i>et al.</i> 2018			
	Griscom <i>et al.</i> 2017			0.6
	Mckinsey 2022	23.5		0.6
	Roe <i>et al.</i> 2021			0.006
	Hoegh-Guldberg and Bruno 2010			0.16-0.25
Seagrass meadows restoration	Griscom <i>et al.</i> 2017			0.21
	Mckinsey 2022	12.5		0.21
	Hoegh-Guldberg and Bruno 2010			0.03-0.05
Salt-marshes restoration	Griscom <i>et al.</i> 2017			0.036
	Mckinsey 2022			0.03-0.04
	Hoegh-Guldberg and Bruno 2010			0.01-0.03

Avoided mangrove conversion	Griscom <i>et al.</i> 2017			0.13
	McKinsey 2022	42.9		0.13
	Roe <i>et al.</i> 2021			0.065
	Hoegh-Guldberg and Bruno 2010			0.02-0.04
Avoided seagrass meadows conversion	Griscom <i>et al.</i> 2017			0.13
	McKinsey 2022	17.4		0.16
	Hoegh-Guldberg and Bruno 2010			0.19-0.65
Avoided saltmarshes conversion	Griscom <i>et al.</i> 2017	143		0.42
	McKinsey 2022			0.04-0.06
	Hoegh-Guldberg and Bruno 2010			0.04-0.07

A2.2. Biodiversity

The Biodiversity Intactness Index (BII) summarises the change in ecological communities in response to human pressures. The BII is an estimated percentage of the original number of species that remain and their abundance in any given area, despite human impacts. For this report, the BII is reported from MAGPIE under the Dasgupta 'Immediate Action' scenario, which prioritises biodiversity, compared to a BAU scenario (Dasgupta 2021).

References for Technical Annex

- Aerts, J.C.J.H. (2018). A review of cost estimates for flood adaptation. *Water* 10(11), 1646. <https://www.mdpi.com/2073-4441/10/11/1646>.
- Baker, J.S., Proville, J., Latane, A., Cajka, J., Aramayo-Lipa, L. and Parkhurst, R. (2020). Additionality and avoiding grassland conversion in the Prairie pothole region of the United States. *Rangeland Ecology & Management* 73(2), 201-215.
- Bayraktarov, E., Saunders, M.I., Abdullah, S., Mills, M., Beher, J., Possingham, H.P. et al. (2015). The cost and feasibility of marine coastal restoration. *Ecological Society of America* 26(4), 1055-1074.
- Bennett, G., Gallant, M. and Ten Kate, K. (2017). *State of Biodiversity Mitigation 2017: Markets and Compensation for Global Infrastructure Development*. http://www.forest-trends.org/wpcontent/uploads/2018/01/doc_5707.pdf.
- Bezos Earth Fund (2023). Conserving and restoring nature. <https://www.bezosearthfund.org/our-programs/conserving-restoring-nature>. Accessed 15 June 2023.
- BloombergNEF (2023). \$1 trillion to protect biodiversity is cheaper than the cost of inaction, 5 April. <https://about.bnef.com/blog/1-trillion-to-protect-biodiversity-is-cheaper-than-the-cost-of-inaction/>. Accessed on 30 October 2023.
- Bodirsky, B.L., Dietrich, J.P., Martinelli, E., Stenstad, A., Pradhan, P., Rolinski, S. et al. (no date). *From Starved to Stuffed: Long-Term Dynamics of Diets and Anthropometrics*.
- Caldeira, K. (2012). Avoiding mangrove destruction by avoiding Carbon Dioxide emissions. *Biological Sciences* 109(36), 14287-14288.
- Capital for Climate (2023). Nature-based solutions investment. Exemplar funds and vehicles. <https://nbs.capitalforclimate.com/fundsandvehicles>. Accessed 13 June 2023.
- Carbon Pulse (2023). Forecasters see rapidly growing biodiversity market as nature crisis forces response, 10 January. <https://carbon-pulse.com/186974>. Accessed 01 June 2023.
- Climate Policy Initiative (2021). *Global Landscape of Climate Finance 2021*. <https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Full-report-Global-Landscape-of-Climate-Finance-2021.pdf>.
- Conservation International and Affiliates (2022). *Conservation International and Affiliates Annual report*. <https://www.conservation.org/about/annual-report>. Accessed 01 June 2023.
- Dasgupta, P. (2021). *The Economics of Biodiversity: The Dasgupta Review*. London.
- De Jong, B. (2019). *World Seafood Map 2019: Value Growth in the Global Seafood Trade Continues*. April. https://research.rabobank.com/far/en/documents/175201_1966414_rabobank_value-growth-global-seafood-trade_beyhan_may2019.pdf.
- Deutz, A., Heal, G. M., Niu, R., Swanson, E., Townshend, T., Zhu, L. et al. (2020). *Financing Nature: Closing the global biodiversity financing gap*. The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Centre for Sustainability. https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf. doi: 10.3389/fcosc.2020.615419.
- Earth Security (2020). *Financing the Earth's Assets: The Case for Mangroves*. 7 December. <https://www.earthsecurity.org/reports/financing-the-earths-assets-the-case-for-mangroves>.

- Ecosystem Marketplace (2022). *State of the Voluntary Carbon Markets 2021*. <https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022>.
- Elwin P., Amadi E., Mitchell E. and Hunter P. (2023). *Financial Markets Roadmap for Transforming the Global Food System*, Planet Tracker. March 2023. <https://planet-tracker.org/wp-content/uploads/2023/03/Financial-Markets-Roadmap-for-transforming-the-Global-Food-System.pdf>.
- Environmental Markets Lab (2018). Subsidy Explorer. <http://www.subsidyexplorer.org/>. Accessed 01 June 2023.
- Facts and Factors (2022). Global mitigation banking market is likely to grow at a CAGR value of 13.10% by 2028, 9 August. <https://www.fnfresearch.com/news/global-mitigation-banking-market>. Accessed 21 September 2023.
- Fonseca, M.S. and Koehl, M.A.R. (2006). Flow in seagrass canopies: The influence of patch width. *Estuarine, Coastal and Shelf Science* 67 (1-2), 1-9. <https://www.sciencedirect.com/science/article/pii/S0272771405003252>.
- Fonseca, M.S., Kenworthy, W.J. and Thayer, G.W. (1998). *Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters*. United States of America, National Oceanic and Atmospheric Administration.
- Food and Agriculture Organisation (2018a). *The State of the World's Forest 2018- Forest pathways to sustainable development*. Rome. <https://www.fao.org/3/i9535en/i9535en.pdf>.
- Food and Agriculture Organisation (2018b). *The State of World Fisheries and Aquaculture 2018 - Meeting the Sustainable Development Goals*. Rome. <http://www.fao.org/documents/card/en/c/I9540EN/>.
- Food and Agriculture Organisation (2020). FRA 2020 remote sensing survey. <https://www.fao.org/forest-resources-assessment/remote-sensing/fra-2020-remote-sensing-survey/en/>. Accessed 19 September 2023.
- Food and Agriculture Organisation (2021). *Nature-Based Solutions in Agriculture Sustainable Management and Conservation of Land, Water, and Biodiversity*. Rome. <https://www.fao.org/3/cb3140en/cb3140en.pdf>.
- Funding the Ocean (2020). Funding the ocean. <https://fundingtheocean.org/>. Accessed 01 June 2023.
- Garardin, C.A.J., Jenkins, S., Seddon, N., Allen, M., Lewis, S.L., Wheeler, C.E. et al. (2021). Nature-based solutions can help cool the planet – if we act now. *Nature* 593, 191-194.
- Gilman, E., Ellison, J., Sauni, I. and Tuamu, S. (2007). Trends in surface elevations of American Samoa mangroves. *Wetlands Ecology and Management*, 15, 391-404.
- Glenk, K. and Martin-Ortega, J. (2012). The economics of peatland restoration. *Journal of Environmental Economics and Policy* 7(4), 345-362. <https://www.tandfonline.com/doi/full/10.1080/21606544.2018.1434562>.
- Global Impact Investing Network (2020). *Annual Impact Investor Survey 2020*. <https://thegiin.org/assets/GIIN%20Annual%20Impact%20Investor%20Survey%202020.pdf>.
- Griscom, B.W., Adams, J., Ellis, P.W., Houghton, R.A., Lomax, G., Miteva, D.A. et al. (2017). Natural climate solutions. *Proceedings of the National Academy of Sciences* 114, 11645-11650. <https://www.pnas.org/doi/abs/10.1073/pnas.1710465114>.
- Hamrick, K. (2017). *State of Private Investment in Conservation 2016: A Landscape Assessment of an Emerging Market*. Ecosystems Marketplace, A Forest Trends Initiative. <https://www.forest-trends.org/publications/state-of-private-investment-in-conservation-2016/>.

- Henderson, B.B., Gerber, P.J., Hilinski, T.E., Falcucci, A., Ojima, D.S., Salvatore, M. et al. (2015). Greenhouse Gas mitigation potential of the world's grazing lands: Modeling soil carbon and nitrogen fluxes of mitigation practices. *Agriculture, Ecosystems & Environment* 207, 91-100. 1 September. <https://www.sciencedirect.com/science/article/abs/pii/S0167880915001139>.
- Hoegh-Guldberg, O. and Bruno J.F. (2010). The impact of climate change on the world's marine ecosystems. *Science* 328(5985), 1523-1528. <https://www.science.org/doi/abs/10.1126/science.1189930>.
- Humpenöder, F., Karstens, K., Lotze-Campen, H., Leifeld, J., Menichetti, L., Barthelmes, A. et al. (2020). Peatland protection and restoration are key for climate change mitigation. *Environmental Research Letters* 15, 10. <https://iopscience.iop.org/article/10.1088/1748-9326/abae2a/pdf>.
- ICF International (2013). *Greenhouse Gas Mitigation Options and Costs for Agricultural Land and Animal Production within the United States*. https://www.usda.gov/sites/default/files/documents/GHG_Mitigation_Options.pdf.
- Impact Assets (2023). IA50 Database. <https://impactassets.org/ia-50/>. Accessed 13 June 2023.
- Impact Yield (2023). Impact Investing Database. <https://impactyield.com/impact-investing-search>. Accessed 13 June 2023.
- International Energy Agency (2023). Fossil Fuel Consumption Subsidies. <https://www.iea.org/reports/fossil-fuels-consumption-subsidies-2022>. Accessed 22 June 2023.
- International Monetary Fund (2021). Government Finance Statistics. Functional Expenditures (COFOG). <https://data.imf.org/regular.aspx?key=61037799>. Accessed 25 May 2023.
- Kapos, V., Wicander, S., Salvaterra, T., Dawkins, K. and Hicks, C. (2019). *The Role of the Natural Environment in Adaptation: Background Paper for the Global Commission on Adaptation*. https://gca.org/wp-content/uploads/2020/12/RoleofNaturalEnvironmentinAdaptation_V2.pdf?_gl=1*1lhxkl6*_ga*MjA3NzQyNjY2OC4xNjk4NzY0OTA3*_up*MQ.
- Kassam, A., Friedrich T. and Derpsch, R. (2019). Global spread of Conservation Agriculture. *International Journal of Environmental Studies* 76(1), 29-51. <https://www.tandfonline.com/doi/epdf/10.1080/00207233.2018.1494927?needAccess=true>.
- Koplow, D. and Steenblik, R. (2022). *Protecting Nature by Reforming Environmentally Harmful Subsidies: The Role of Business*. <https://www.earthtrack.net/document/protecting-nature-reforming-environmentally-harmful-subsidies-role-business>.
- Laporte, T., Jutel, V. and Leenknecht, V. (2021). La mise en défens ou comment gérer les pressions de pâturage. https://cen-nouvelle-aquitaine.org/wp-content/uploads/2021/06/FicheTechnique_CATZH64_N%c2%b05_generalites_V4.pdf. Accessed on 31 October 2023.
- Macreadie, P.I., Costa, M.D.P., Atwood, T.B., Friess, D.A., Kelleway, J.J., Kennedy, H. et al. (2021). Blue carbon as a natural climate solution. *Nature Reviews Earth & Environment* 2, 826-839.
- Mckinsey (2022). *Blue Carbon: The Potential of Coastal and Oceanic Climate Action*. <https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/blue%20carbon%20the%20potential%20of%20coastal%20and%20oceanic%20climate%20action/blue-carbon-the-potential-of-coastal-and-oceanic-climate-action-vf.pdf?shouldIndex=false>.
- Moxey, A. and Moran, D. (2014). UK peatland restoration: Some economic arithmetic. *Science of the Total Environment* 484, 114-120. <https://www.sciencedirect.com/science/article/pii/S0048969714003635>.
- Naphade, A. (2020). Sustainable palm oil market analysis with key players, applications, trends and forecasts to 2026. <http://news.marketsizeforecasters.com/sustainable-palm-oil-market-analysis-with-key-players-applications-trends-and-forecasts-to-2026>. Accessed 22 June 2023.

- Organisation for Economic Co-operation and Development (2019). Fisheries Support Estimates Database. <https://impactyield.com/impact-investing-search>. Accessed 13 June 2023.
- Organisation for Economic Co-operation and Development (2020a). *A Comprehensive Overview of Global Biodiversity Finance*. <https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf>.
- Organisation for Economic Cooperation and Development (2020b). *Reframing Financing and Investment for a Sustainable Ocean Economy*. https://www.oecd-ilibrary.org/environment/reframing-financing-and-investment-for-a-sustainable-ocean-economy_c59ce972-en.
- Organisation for Economic Co-operation and Development (2021). *Tracking Economic Instruments and Finance for Biodiversity 2021*. <https://www.oecd.org/environment/resources/biodiversity/tracking-economic-instruments-and-finance-for-biodiversity-2021.pdf>.
- Organisation for Economic Co-operation and Development (2022). *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*. <https://www.oecd.org/publications/agricultural-policy-monitoring-and-evaluation-22217371.htm>.
- Organisation for Economic Co-operation and Development (2023a). Creditor Reporting System (CRS). Official Development Assistance. <https://stats.oecd.org/index.aspx?DataSetCode=CRS1>. Accessed 25 May 2023.
- Organisation for Economic Co-operation and Development (2023b). Government Expenditure by Function (COFOG). https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE11. Accessed 25 May 2023.
- Our Shared Seas (2021). *A Decade of Ocean funding: Landscape Trends 2010-2020*. <https://oursharedseas.com/funding/>.
- Partnership for Forests (2023). Funds for Nature Investor Database. <https://partnershipsforforests.com/fundsfornature/>. Accessed 25 May 2023.
- Rainforest Alliance (2022a). *Cocoa Certification Data Report 2021*. <https://www.rainforest-alliance.org/wp-content/uploads/2022/05/Cocoa-Certification-Data-Report-2021.pdf>.
- Rainforest Alliance (2022b). *Coffee Certification Data Report 2021*. <https://www.rainforest-alliance.org/wp-content/uploads/2022/05/Coffee-Certification-Data-Report-2021.pdf>.
- Roe, S., Streck, C., Beach, R., Busch, J., Chapman, M., Daioglou, V. et al. (2021). Land-based measures to mitigate climate change: Potential and feasibility by country. *Global Change Biology* 27, 6025–6058. <https://doi.org/10.1111/gcb.15873>.
- Roundtable for Responsible Soy (2022). *Management Report 2021*. https://issuu.com/rtrs/docs/rtrs_management_report_2021.
- Royal Society for the Protection of Birds (2023). *Annual Report 2022-2023: Together, We're Creating a World where Wildlife and People can Thrive*.
- Saintilan, N., Khan, N.S., Ashe, E., Kelleway, J.J., Rogers, K., Woodroffe, C.D. et al. (2020). Thresholds of mangrove survival under rapid sea level rise. *Science* 364(6495), 1118-1121. <https://www.science.org/doi/full/10.1126/science.aba2656>.
- Salzman, J., Bennett, G., Carroll, N., Goldstein, A. and Jenkins, M. (2018). The global status and trends of Payments for Ecosystem Services. *Nature Sustainability* 1, 136-144.
- Schuhbauer, A., Chuenpagdee, R., Cheung, W.W.L., Greer, K. and Sumaila, U.R. (2017). How subsidies affect the economic viability of small-scale fisheries. *Marine Policy* 82, 114-121.

Skerritt, D. and Sumaila, R. (2021). Broadening the global debate on harmful fisheries subsidies through the use of subsidy intensity metrics. *Marine Policy* 128, 104507. 10.1016/j.marpol.2021.104507.

Solidaridad Network (2019). *Responsible Soy – 10 Years on*. <https://www.solidaridadnetwork.org/news/responsible-soy-10-years-on>.

Statista (2022). Global organic food market value in 2021 and 2026. <https://www.statista.com/statistics/869052/global-organic-food-and-beverage-market-value/>. Accessed 01 July 2023.

Stowers, J.F., Fehrmann, E. and Squires, A. (2003). *Seagrass Scarring in Tampa Bay: Impact Analysis*. <https://studylib.net/doc/13358208/seagrass-restoration-success-failure-and-the-costs-of->

Sumaila, R., Skerritt, D., Schuhbauer, A., Ebrahim, N., Li, Y., Kim, H.S. et al. (2019). Updated estimates and analysis of global fisheries subsidies. *Marine Policy* 109. <https://www.sciencedirect.com/science/article/pii/S0308597X19303677>.

Taillardat, P., Fong, L., Sasmito, S.D., Ren, J., Tarigan, S., Lupascu, M. et al. (2021). *From Peatlands to the Coast: Organic Carbon Cycling and Associated Greenhouse Gas Emissions across the Aquatic Continuum in Southeast Asia*.

The Biodiversity Finance Initiative (2016). *BIOFIN Workbook – Mobilizing Resources for Biodiversity and Sustainable Development*. https://www.biofin.org/sites/default/files/content/publications/undp-biofin-web_0.pdf.

The Biodiversity Finance Initiative (2020). *Moving Mountains - Unlocking Private Capital for Biodiversity and Ecosystems*. <https://www.biofin.org/sites/default/files/content/publications/BIOFIN%20-%20Moving%20Mountains%20-%20Unlocking%20private%20capital%20for%20biodiversity%20and%20ecosystems%20%28Web%20Version%29.pdf>.

The Climate Trust (2014). *Evaluation of Avoided Grassland Conversion and Cropland Conversion to Grassland as Potential Carbon Offset Project Types*. <https://climatetrust.org/wp-content/uploads/2014/07/Evaluation-of-Avoided-Grassland-Conversion-and-Cropland-Conversion-to-Grassland-as-Potential-Carbon-Offset-Project-Types-.pdf>.

The Nature Conservancy (2023). *2022 Annual Report, Progress for the planet*. https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_AR_2022.pdf.

Tyukavina, A., Potapov, P. and Hansen, M.C. (2012). *Assessment of Recently Unchanged Forested Areas in the United States Using Landsat-WELD and LIDAR Data*.

United Nations Environment Programme (2021). *Nature-Based Solutions for Climate Change Mitigation*. 4 November. <https://www.unep.org/resources/report/nature-based-solutions-climate-change-mitigation>.

United Nations Environment Programme, United Nations Development Programme and Food and Agriculture Organisation (2021). *A Multi-Billion-Dollar Opportunity: Repurposing Agricultural Support to Transform Food Systems*. <https://www.unep.org/resources/repurposing-agricultural-support-transform-food-systems>.

United Nations Principles for Responsible Investment (2023a). IPR Forecast Policy Scenario + nature. <https://www.unpri.org/inevitable-policy-response/ipr-forecast-policy-scenario-nature/10966.article>. Accessed 31 October 2023.

United Nations Principles for Responsible Investment (2023b). IPR: Forecast Policy Scenario + nature (FPS + nature) - Preparing financial markets for climate- & nature-related policy & regulatory risks. <https://www.unpri.org/download?ac=17705>. Accessed 31 October 2023.

United Nations Water (2015). *A 10 Year Story – The Water for Life Decade 2005-2015 and Beyond*. <https://www.un.org/waterforlifedecade/pdf/WaterforLifeENG.pdf>.

United States of America, National Oceanic and Atmospheric Administration (2020). *Nature-Based Solutions: Installation and maintenance Costs*. <https://coast.noaa.gov/data/digitalcoast/pdf/nature-based-solutions-installation-maintenance.pdf>.

Voora, V., Larrea, C., Bermudez, S. and Balino, S. (2019). *Global Market Report: Palm Oil*. <https://www.iisd.org/system/files/publications/ssi-global-market-report-palm-oil.pdf>.

Whitton, C., Bogueva, D., Marinova, D. and Phillips, C.C. (2021). Are we approaching peak meat consumption? Analysis of meat consumption from 2000 to 2019 in 35 countries and its relationship to Gross Domestic Product. *Animals* 11(12), 3466.

Wildlife Conservation Society (2023). *2022 Impact Report*. https://cdn.wcs.org/2022/10/03/79thlo8qoi_WCS_Impact_Report_2022_fnl_linked_WEB.pdf?_gl=1*1o3wycp*_ga*MTY1NzQ3MTgzNS4xNjg0NzY5Njkz*_ga_BTX9HXMYSX*MTY4NDc2OTY5My4xLjAuMTY4NDc2OTY5My42MC4wLjA.

Wilkinson, K. (ed.) (2020). *The Drawdown Review. Climate Solutions for a New Decade*. Project Drawdown. <https://drawdown.org/drawdownframework/drawdown-review-2020>.

World Economic Forum (2021). *Nature and Net Zero*. https://www3.weforum.org/docs/WEF_Consultation_Nature_and_Net_Zero_2021.pdf.

World Economic Forum (2022). *Biodiversity Credits: Unlocking Financial Markets for Nature-Positive Outcomes*. https://www3.weforum.org/docs/WEF_Biodiversity_Credit_Market_2022.pdf.

World Wildlife Fund (2015). *Profitability and Sustainability in Responsible Forestry. Economic Impacts of FSC Certification on Forest Operators*. https://d2ouvy59p0dg6k.cloudfront.net/downloads/profitability_and_sustainability_in_responsible_forestry_main_report_final.pdf.

World Wildlife Fund (2022). *Annual Report and Financial Statements 2021-22*. <https://www.wwf.org.uk/sites/default/files/2022-12/WWF-UK-Annual-Report-and-Financial-Statements-2021-22.pdf>.

Worthington, T. and Spalding, M. (2018). *Mangrove Restoration Potential: A Global Map Highlighting a Critical Opportunity*. <https://api.repository.cam.ac.uk/server/api/core/bitstreams/a48758ae-9956-4c5f-96ba-d20d5c1e183e/content>.

Wunder, S. (2015). Revisiting the concept of payments for environmental services. *Ecological Economics* 117, 234-243. <https://www.sciencedirect.com/science/article/pii/S0921800914002961>.

