






The methodological assessment report on

THE IMPACT AND DEPENDENCE OF BUSINESS ON BIODIVERSITY AND NATURE'S CONTRIBUTIONS TO PEOPLE

ipbes

THE IPBES METHODOLOGICAL ASSESSMENT REPORT ON THE IMPACT AND DEPENDENCE OF BUSINESS ON BIODIVERSITY AND NATURE'S CONTRIBUTIONS TO PEOPLE (BUSINESS AND BIODIVERSITY ASSESSMENT)

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IPBES is an independent intergovernmental body comprising more than 150 member Governments. Established by Governments in 2012, IPBES provides policymakers with objective scientific assessments about the state of knowledge regarding nature and the contributions it provides to people, as well as options for actions to protect and sustainably use these vital natural assets.

The Business and Biodiversity Assessment was initiated by the IPBES Plenary in decision IPBES-9/1 and is based on the scoping report set out in annex I to the same decision. The assessment was produced in accordance with the procedures for the preparation of Platform deliverables set out in annex I to decision IPBES-3/3.

The Business and Biodiversity Assessment was considered by the Plenary at its twelfth session (IPBES 12, Manchester, United Kingdom of Great Britain and Northern Ireland, 2026). The Plenary approved its summary for policymakers and accepted its chapters. All material can be found here: https://www.ipbes.net/business-impact

FOREWORD

We stand at a pivotal moment for business and nature! Businesses and financial institutions – alongside governments and civil society – have both the opportunity and the responsibility to lead the transition toward a more just and sustainable global economy. For too long, economic growth has come at the expense of biodiversity, eroding the very foundations of human wellbeing, financial stability and long-term prosperity. This trajectory presents not only an environmental crisis, but a profound systemic risk to economies and societies worldwide. Yet, current conditions continue to reinforce business-as-usual approaches, falling short of the transformative change urgently needed to halt and reverse biodiversity loss.

The Report on the Methodological Assessment of the Impact and Dependence of Business on Biodiversity and Nature's Contributions to People (Business and Biodiversity Assessment) marks a critical turning point. As the first assessment of its kind, this landmark report will help businesses and other actors recognize the central value of biodiversity in the long-term sustainability of businesses and society. It is a vital contribution to global efforts to achieve the goals of the Kunming-Montreal Global Biodiversity Framework (KMGBF), the Sustainable Development Goals, and the Paris Agreement on Climate Change. While offering specific insights into the implementation of the KMGBF Target 15 – which calls on businesses to measure, report and reduce their impacts on biodiversity – the report ultimately serves society as a whole. The assessment acknowledges the critical role businesses have played in reducing poverty, improving health and human wellbeing worldwide. These contributions have, however, come at a huge cost to biodiversity, which has declined at unprecedented levels in the last fifty years.

Developed by nearly 80 authors and 43 contributing authors from 35 countries, this assessment demonstrates





that all companies, regardless of sector, scale or context, are connected to biodiversity, whether directly or indirectly through complex value chains. Drawing on more than 5,000 references, it synthesizes a vast body of knowledge, methods and data to guide decision-making across portfolios, corporations, value chains and operations. It provides a strong foundation for aligning what is good for business with what is good for nature. Crucially, it also highlights the importance of engaging not only with scientific knowledge, but with Indigenous and local knowledge to improve how impacts and dependencies are understood and managed.

The assessment highlights that aligning profitability with biodiversity will require fundamental shifts. It identifies more than 100 concrete actions for governments, financial actors, businesses, Indigenous Peoples and local communities, and civil society. These actions recognize diverse national and sectoral contexts, while calling for immediate efforts to recognize dependencies, reduce impacts and reshape the systems that govern economic activity.

Achieving global goals for biodiversity and people demands coordinated action across policy, legal and regulatory frameworks; economic and financial systems; social values and cultural norms; technology and data; and capacity and knowledge. We already possess the methods, knowledge and data needed to act. What is required now is collective will and coordinated effort to create the conditions that incentivize and enable businesses to become active agents of positive change.

As Chair and Executive Secretary of IPBES, we extend our sincere gratitude to all the experts who have contributed to this landmark assessment. Their work is a compelling call for collaboration and accelerated action. We wish to express our particular appreciation to the co-chairs, Matt Jones (United Kingdom), Stephen Polasky (United States of America) and Ximena Rueda (Colombia) for their outstanding leadership. We also acknowledge the dedication of the coordinating lead authors, lead authors, review editors, fellows, contributing authors and external reviewers. Their collective efforts have ensured the timely delivery of a rigorous and forward-looking assessment which we are confident will be a valuable resource for a wide range of actors who are driving positive action for biodiversity in both the private and public sectors.

We also acknowledge the Alexander von Humboldt Biological Resources Research Institute in Colombia and UNEP-WCMC in the United Kingdom, which jointly hosted the Technical Support Unit for the assessment, including the invaluable contributions of Orlando Vargas Rayo, Olena Tarasova-Krasiieva and Alina Vera Paz, whose commitment underpinned the successful completion of this report. We also extend our sincere appreciation to the members of the Multidisciplinary Expert Panel and the Bureau, the IPBES secretariat, and all governments and institutions that have provided financial and in-kind support for this work.

This assessment provides a powerful foundation for action. It demonstrates that businesses and financial actors, together with governments and society, can drive systemic change needed to reduce negative impacts on biodiversity, enhance positive contributions, manage nature-related risks, and advance sustainable production and consumption. It also underscores that global progress must translate into meaningful change at the local level.

We are confident that the Business and Biodiversity Assessment will help catalyze the transformative changes needed to secure a resilient, just and sustainable future for both people and nature.

David Obura
Chair of IPBES

Luthando Dziba
Executive Secretary of IPBES

STATEMENTS FROM KEY PARTNERS



Nature remains one of the most undervalued foundations of our global economy, despite underpinning food systems, supply chains, and long-term prosperity. At a time when some may question the role of science, IPBES continues to lead the way and provide independent, authoritative evidence – because science-based decision-making is not optional, it is essential.

The first-ever Business and Biodiversity Assessment reinforces this role. It will give decision-makers clear evidence of how businesses depend on nature, how they impact it, and what this means for risk, resilience, and long-term value. By identifying risks early, we can help prevent escalating costs - higher food prices, rising insurance premiums, and economic instability - affecting families and communities worldwide.

Time is not on our side, but this Assessment offers a clear pathway on how we can align economic decision-making with environmental reality, delivering lasting benefits for people and for the planet.

Inger Andersen
Executive Director
United Nations Environment Programme (UNEP)



Businesses across the agrifood systems both depend on and significantly impact biodiversity.

To build a resilient future, we need to transform these systems to ensure the Four Betters: better production, better nutrition, a better environment, and a better life, leaving no one behind.

By effectively assessing and managing their relationship with nature, businesses can strengthen their resilience, drive innovation, and establish themselves as leaders in the global economy.

Every business along the value chain has a role in advancing sustainable practices that support biodiversity.

Key actions include scaling up investments in innovative, biodiversity-friendly technologies across production, processing, distribution and consumption, as well as implementing robust systems to monitor and report the impacts of their business operations. As a UN Collaborative Partner of IPBES, FAO supports agrifood businesses in enhancing their biodiversity performance, meeting recognized standards, and conducting risk-based due diligence.

This new IPBES assessment offers a timely analysis of such measures, providing crucial data for decision-makers dedicated to building agrifood systems that are more efficient, more inclusive, more resilient and more sustainable.

QU Dongyu
Director-General,
Food and Agriculture Organization of the United Nations (FAO)



The IPBES Business and Biodiversity Report is a crucial contribution to the implementation of the Kunming-Montreal Global Biodiversity Framework, particularly its Target 15, which is about businesses assessing and disclosing biodiversity-related risks and impacts. This is key not only to a better understanding of the centrality of biodiversity to value chains, but also to taking action to change business models, reduce negative and increase positive biodiversity impacts.

All businesses depend on nature. Some are very obviously exposed to risks stemming from resource depletion or environmental degradation; others may need to dig deeper to understand the breadth of their dependencies and impacts on biodiversity. Hidden risks can range from breaching regulatory frameworks to damaging the company's brand.

In any case, biodiversity is never a marginal issue. It lies at the crux of what makes companies thrive or flounder: value chain resilience.

In too many boardrooms and offices around the world, there is a still a dearth of awareness of biodiversity protection as a business investment. And too often, public policy still incentivises behaviour that drives biodiversity loss.

Transformative change is both necessary and possible. With the right business mindset supported by the right incentives, thriving in harmony with nature is within reach.

Congratulations to IPBES on showing the way.

Astrid Schomaker
Executive Secretary
Convention on Biological Diversity (CBD)



Businesses are inseparable from the ecosystems they operate in: they both depend on them and profoundly impact them. As significant drivers of today's planetary crises, businesses have contributed to climate change, biodiversity loss and cultural erosion. At the same time, they have a critical role to play in advancing more sustainable solutions, a role already reflected in a growing number of initiatives.

UNESCO's World Network of Biosphere Reserves is a strong example. These sites serve as living laboratories where biodiversity conservation, resilient livelihoods, cultural diversity and human wellbeing can reinforce one another. Through this network, UNESCO contributes in a concrete way to the implementation of the Kunming–Montreal Global Biodiversity Framework, by promoting solutions rooted in places, communities and long-term balance between people and nature.

UNESCO is particularly proud to have contributed to this assessment by supporting the inclusion of Indigenous and local knowledge. Indigenous Peoples and local communities are often among the first to experience the impacts of unsustainable and extractive business practices, and frequently bear disproportionate social, cultural and ecological costs. At the same time, their knowledge, values and governance systems offer important insights into economic models that prioritize balance, reciprocity and long-term stewardship of nature. Recognizing and respecting these knowledge systems is a necessary condition for building sustainable, inclusive and effective responses to the biodiversity crisis worldwide.

In this context, UNESCO warmly welcomes this new IPBES assessment as an important contribution to advancing our shared understanding and collective action for biodiversity.

Khaled El-Enany
Director-General,
United Nations Educational,
Scientific and Cultural Organization (UNESCO)



Biodiversity underpins every economy and every society. It generates jobs and income, regulates the climate, and sustains food, water, and health systems. Yet its very dependability hides the scale of our reliance on its continued stability. Too often, biodiversity is an invisible and expendable asset on a balance sheet. That is changing. Awareness is now accelerating of the risks to development if biodiversity fails – and of the economic opportunities and future prosperity that emerge where it thrives.

This IPBES Business and Biodiversity Assessment makes a vital contribution to exposing and explaining how business, economies, and development ambitions depend on biodiversity. Through our Nature Pledge, the United Nations Development Programme (UNDP) works alongside countries and our many partners to align economic progress with the protection and restoration of Nature. Our initiatives such as the Biodiversity Finance Initiative (BIOFIN) and our work supporting the Taskforce on Nature-related Financial Disclosures reveal growing investor and policymaker demand for actionable information. UNDP therefore strongly welcomes the assessment's focus on advancing categorization, methodologies, standardization, and other dimensions essential to scaling the value and integration of biodiversity into decision-making.

Nature-positive business transformation – aligned with global biodiversity commitments and strengthened through collaboration with governments, local communities, and Indigenous Peoples – is a fast-track to resilient, inclusive, and sustainable development. This approach is now far from optional. It is essential to our collective future.

Alexander De Croo
Administrator,
United Nations Development Programme
(UNDP)

Actions to build an enabling environment that aligns what is good for businesses with what is good for biodiversity require governments, financial actors, business and financial institutions and other actors. As co-chairs of the IPBES Business and Biodiversity Assessment we would like to acknowledge and express our enormous gratitude to the many people, representing many of these actor groups, whose expertise and support have made this assessment possible.

The assessment addresses one of the defining challenges of our time: how business, finance, governments and society can better understand, manage and transform the relationships between businesses actions and biodiversity. It has brought together evidence from across disciplines, sectors and knowledge systems to examine how businesses depend on, impact and can contribute to the recovery of biodiversity and its contributions to people. Producing this major report would not have been possible without the hard work of 79 experts from across the globe, who provided their voluntary time and efforts to deliver this product with the conviction to contribute to a better future for all.

We are first and foremost grateful to the coordinating lead authors, fellows and review editors, who gave their time, knowledge and energy to this assessment. Furthermore, we are grateful to the contributing authors whose contributions were essential to enrich the contents of this assessment. Their commitment to scientific rigour, policy relevance and constructive collaboration has been central to the development of the report. We deeply appreciate the generosity with which experts from different disciplines, regions and professional backgrounds worked together to assess a complex and rapidly evolving field.

We would like to express our sincere appreciation to the Technical Support Unit and the institutions that supported the assessment process. The assessment would not have been possible without their professionalism and tireless work. We are particularly grateful to the Alexander von Humboldt Biological Resources Research Institute in Colombia and UNEP-WCMC in the United Kingdom, which jointly hosted the Technical Support Unit for the assessment. Their support, commitment and hospitality were instrumental in sustaining the coordination, collaboration and careful work required to deliver an assessment of this scale and complexity.

We are indebted to the IPBES secretariat, especially the Executive Secretary and the wider secretariat team, for their continued guidance, support and commitment throughout the assessment. We also thank the IPBES Bureau, the Multidisciplinary Expert Panel and the Management Committee for their strategic advice, oversight and support. Their guidance

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helped ensure that the assessment remained firmly grounded in the IPBES mandate and responsive to the needs of governments and other users of the assessment.

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Finally, we would like to thank the families, friends and colleagues of everyone involved in this assessment. Producing an IPBES assessment requires a substantial commitment of time, energy and care. We are deeply grateful for the support, patience and encouragement that made this work possible.

The Business and Biodiversity Assessment is the result of a collective effort. We hope that it will help all actors become agents of positive change to create an enabling environment in which businesses contribute to a just and sustainable future for all.

Ximena Rueda Fajardo, Matt Jones and Stephen Polasky
Co-Chairs

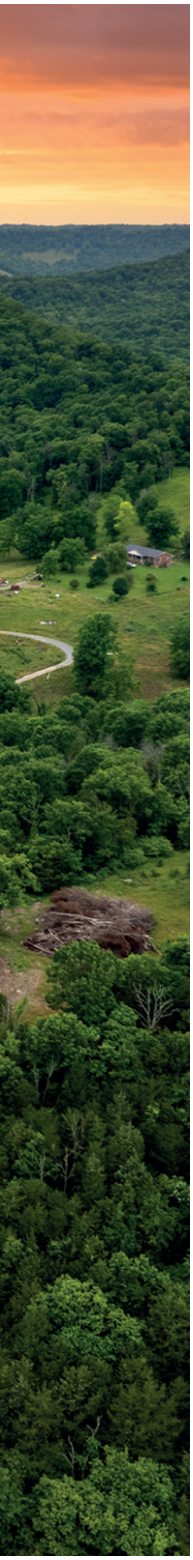
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SUMMARY FOR POLICYMAKERS

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PREFACE

The Methodological Assessment of the Impact and Dependence of Business on Biodiversity and Nature's Contributions to People (Business and Biodiversity Assessment)[2] comes at a time when urgent action is needed to halt and reverse biodiversity loss and when there is increasing recognition of the central role of businesses in creating transformative change for a just and sustainable future. Evidence shows that biodiversity and nature's contributions to people are declining across much of the globe.[3] The Kunming-Montreal Global Biodiversity Framework sets out a commitment to a whole-of-government and whole-of-society approach to put biodiversity on a path to recovery for the benefit of people and the planet. Businesses[4] have been key to driving the innovation and economic growth that have brought about rising standards of living, improved health outcomes, increased food security and reduced poverty, but these benefits have been unevenly distributed within and among countries.[5] At the same time, unsustainable economic activity and a focus on growth as measured by gross domestic product have been drivers of the decline of biodiversity and nature's contributions to people and stand in the way of transformative change.[6] Although it is a historically neglected phenomenon, awareness of biodiversity decline is now growing, as is the awareness of the increasing risks that further declines pose for society, the economy and businesses.

All businesses depend on and impact biodiversity and can act now on the basis of existing knowledge **(Figure SPM.1)**. Improving the knowledge base would allow businesses to better measure and respond to their dependencies and impacts. Biodiversity has multiple dimensions, from genes to species to ecosystems. Methods for analysing the impacts and dependencies of businesses on biodiversity exist, although tying specific business actions to biodiversity outcomes can be difficult. Different methods are appropriate for decision-making at different business levels, including the operations, value chain, corporate and portfolio levels. Information about impacts and dependencies can guide businesses and enable reporting, transparency, decision-making and actions to address risks and opportunities, which in turn can lead to improved outcomes for biodiversity and businesses. For businesses to play a central role in halting and reversing biodiversity loss, the conditions in which they operate need to be fundamentally changed to provide incentives for the conservation and sustainable use of biodiversity. The prevailing conditions affect businesses differently depending, for example, on their size, resources and influence. An enabling environment providing businesses with incentives for the conservation and sustainable use of biodiversity would need to include the following important dimensions: policy, legal and regulatory frameworks; economic and financial systems; social values, norms and culture; technology and data; and capacity and knowledge. Creating an effective enabling environment can help to closely align what is profitable for businesses with what is good for biodiversity and society. An enabling environment requires coordinated, collaborative action through a whole-of-government and whole-of-society approach.

This assessment reviews and critically evaluates approaches to the measurement of impacts and dependencies of businesses on biodiversity and discusses how such information can be used to improve outcomes for biodiversity and nature's contributions to people. The assessment also addresses the roles of multiple actors in creating an enabling environment. The primary audience includes Governments, businesses, and organizations in the financial system. In addition, the assessment is intended to benefit civil society and Indigenous Peoples and local communities.[7] Businesses play a major role in delivering transformative change to implement global policy goals and frameworks, such as the goals and targets under the 2030 Agenda for Sustainable Development, the Convention on Biological Diversity, the Kunming-Montreal Global Biodiversity Framework, the United Nations Framework Convention on Climate Change and the Paris Agreement.

2. In this assessment, "business and biodiversity" refers to the interconnected relationships of businesses – both individually and collectively – with biodiversity and nature's contributions to people, on which they depend and have an impact.
3. IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Brondízio, E.S., Settele, J., Díaz, S., and Ngo, H.T. (eds). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.3831673.
4. In this assessment, "businesses" refers to entities involved in the production, exchange and distribution of goods or services sold for currency, including for-profit businesses (companies and enterprises), state-owned enterprises, social enterprises and enterprises of Indigenous Peoples and local communities.
5. IPBES (2024). *Thematic Assessment Report on the Interlinkages among Biodiversity, Water, Food and Health of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Harrison, P.A., McElwee, P.D., and van Huysen, T.L. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.13850054.
6. IPBES (2024). *Thematic Assessment Report on the Underlying Causes of Biodiversity Loss and the Determinants of Transformative Change and Options for Achieving the 2050 Vision for Biodiversity of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* O'Brien, K., Garibaldi, L., and Agrawal, A. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.11382215.
7. The term "Indigenous Peoples and local communities" is used in this assessment in accordance with the methodological guidance for recognizing and working with Indigenous and local knowledge in IPBES (version of 5 May 2022), available at https://www.ipbes.net/modules-assessment-guide.

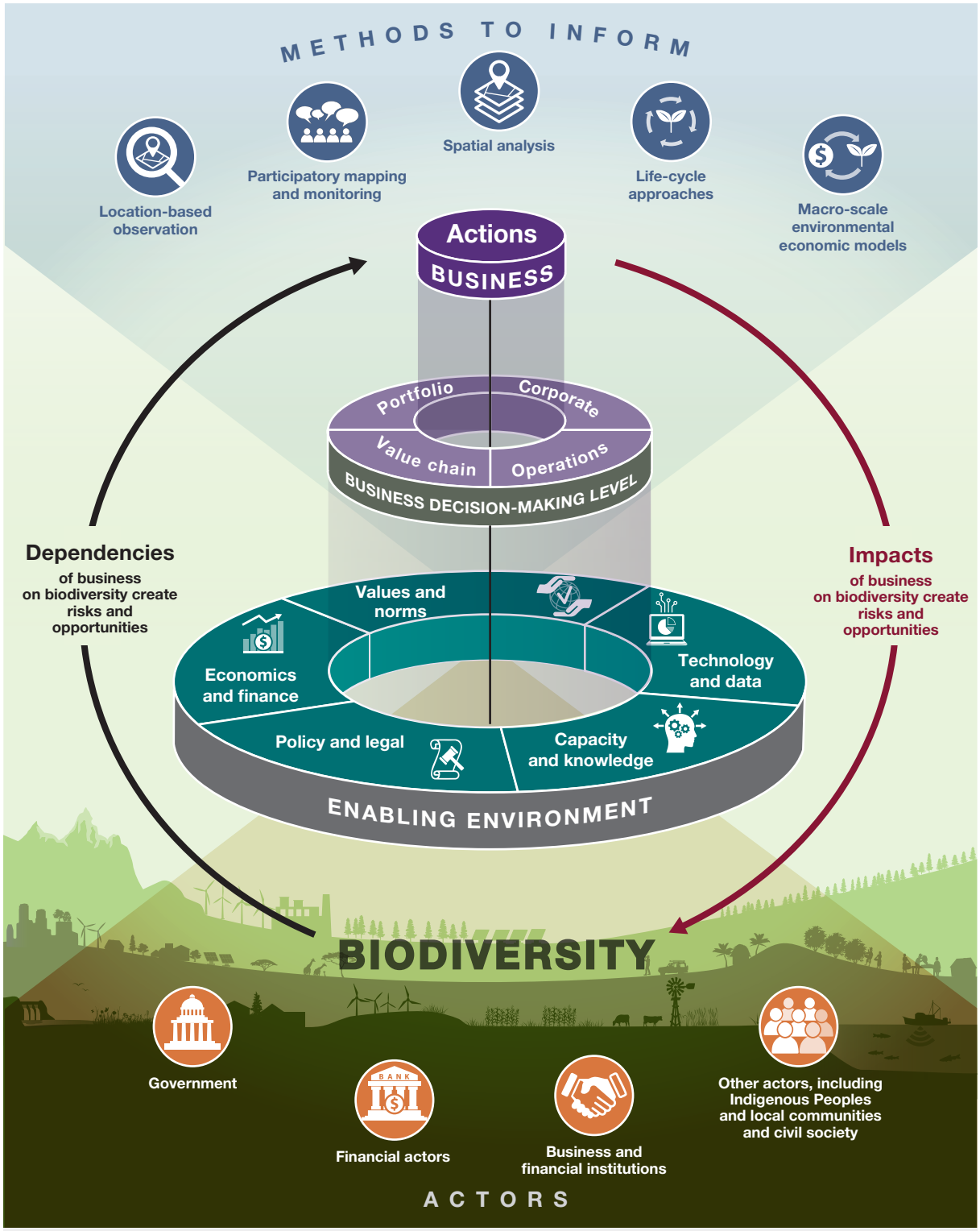


Figure SPM 1 **Overview of the business and biodiversity assessment. Businesses both depend on and impact biodiversity, creating risks and opportunities.**

Methods exist to measure business impacts and dependencies. These can be used to inform actions at all decision-making levels (i.e., portfolio, corporate, value chain and operations). Businesses, including financial institutions, working with Governments and financial and other actors, including civil society and Indigenous Peoples and local communities, can create an enabling environment. This can be achieved through changes in policy, legal and regulatory frameworks ("policy and legal"), economic and financial systems ("economics and finance"), social values, norms and culture ("values and norms"), technology and data, and capacity and knowledge {KM10}.





KEY MESSAGES

KEY MESSAGES

KM1 All businesses depend on and impact biodiversity and can be agents of positive change {A1, A2, A4, A5, A6, A8, B7}.

Biodiversity and nature's contributions to people underpin the economy; all businesses therefore depend, directly or indirectly, on biodiversity. From 1820 to 2022, the global economy grew from $1.18 trillion to $130.11 trillion (measured in 2011 constant dollars). Businesses played a central role in that growth. However, the failure to account for nature and integrate its values into economic and financial systems has led to environmental degradation, unprecedented rates of biodiversity loss and associated changes in nature's contributions to people, including ecosystem services, with 14 out of 18 categories of contributions measured showing declines.[8] The benefits to people and the decline in biodiversity have been unequally distributed among and within countries. The decline in biodiversity and nature's contributions to people has become a critical systemic risk to the economy, financial stability and human well-being, with implications for human rights. These systemic risks arising from biodiversity decline underscore the urgent need for transformative change. However, individual businesses often do not act to address their impacts and dependencies on biodiversity, or the resulting risks and opportunities, in part due to their lack of awareness. As businesses differ in size, sector, structure and relationship with biodiversity, informed action requires specific, context- and sector-dependent knowledge about impacts and dependencies. Because businesses are highly influential and can move quickly when motivated, informed and enabled to do so, they can be agents of positive change.

KM2 The current external conditions in which businesses operate are not always compatible with achieving a just and sustainable future and perpetuate systemic risks {A1, A2, A3, A5, B7, B13, C8}.

While some businesses take actions that are beneficial for biodiversity, inadequate or perverse incentives perpetuate business as usual and create barriers to businesses and others taking action that could halt and reverse biodiversity loss and addressing its interconnection with climate change and pollution. The conditions under which different businesses operate vary and do not affect all sectors or businesses equally. Currently, the existing rewards and penalties are not adequate to drive sufficient action by businesses for the conservation and sustainable use of biodiversity and the fair and equitable sharing of benefits from the utilization of genetic resources and associated traditional knowledge. Businesses often fail to internalize the negative impacts of their actions on biodiversity. Many policies either encourage business activities that are harmful to biodiversity or prevent behaviour that is beneficial to it. For example, large subsidies are directed towards business activities that drive biodiversity loss, often with the support of lobbying by businesses and trade associations with vested interests. In 2023, global public and private financial flows with direct negative impacts on nature were estimated at $7.3 trillion, including environmentally harmful public subsidies and private investment in high-impact sectors. Of that total, private finance accounted for around two thirds ($4.9 trillion), while public spending on environmentally harmful subsidies made up the remaining $2.4 trillion. By contrast, only around $220 billion in public and private financial flows in 2023 were directed towards activities that contribute to the conservation and sustainable use of biodiversity. These figures highlight both the opportunity and the need to align financial flows to support biodiversity outcomes. Where compliance by businesses and enforcement efforts are lacking, the effective implementation of laws and regulations is undermined. Furthermore, because business disclosures are often voluntary and not widespread, businesses are usually not held accountable. Businesses often lack the data and knowledge to quantify their impacts and dependencies on biodiversity, and much of the relevant scientific literature is not written for a business audience. Lack of transparency across value chains, including with regard to the risks and opportunities related to the sustainability of resource extraction, use and reuse and waste management, is a further barrier to action. In addition, ecological processes such as ecosystem regeneration do not align with the time pressures on business decision-making and timescales for investment returns and reporting, which place heavy emphasis on quarterly earnings and annual reporting.

KM3 Collaboration, collective and individual actions are essential to creating an enabling environment in which businesses contribute to a just and sustainable future {B1, B2, B3, B4, B5, B6, B7, B8, B12}.

In an enabling environment, the conditions and incentives under which businesses operate allow them to align their interests with what is beneficial for biodiversity and society. Creating an enabling environment involves changes in policy, legal and regulatory frameworks; economic and financial systems; social values, norms and culture; technology

8. Global trends have shown declines over the past 50 years in virtually all regulating contributions (habitat; pollination and seed dispersal; air quality regulation; climate regulation; ocean acidification regulation; water quantity and flow regulation; water quality regulation; soil formation and protection; hazard regulation; pest regulation) and non-material contributions (learning and inspiration; experiences; identity; options), while some material contributions have shown increases (energy; food and feed; materials) (IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services*).

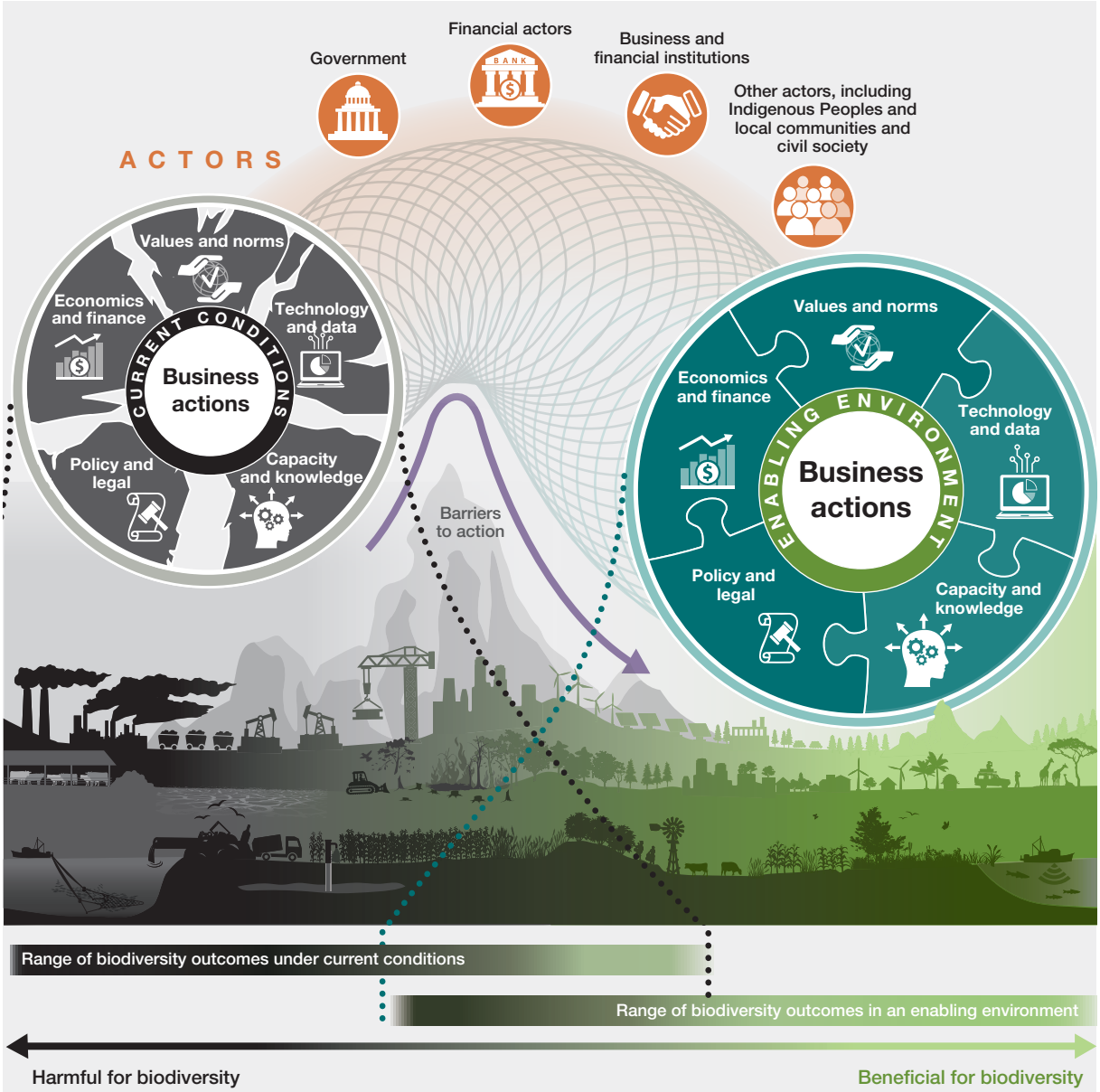


Figure SPM 2 **Creating an enabling environment would align what is beneficial for businesses with what is beneficial for biodiversity and nature's contributions to people.**

Business activities impacting biodiversity outcomes are influenced by policy, legal and regulatory frameworks; economic and financial systems; social values, norms and culture; technology and data; and capacity and knowledge. Current conditions often inhibit positive actions and even encourage negative actions by businesses, with harmful outcomes for biodiversity. Working collectively and individually, actors can overcome barriers to positive action.

and data; and capacity and knowledge (**Figure SPM.2** and **Table SPM.1**). These changes can be achieved by accelerating collaboration and collective action at all levels by and among Governments, financial actors,[9] other actors,[10] and businesses and financial institutions. Although collaboration is very important, individual actions can still contribute to creating an enabling environment.

9. In this assessment, financial institutions are those that provide financial goods and services to businesses and individuals in the form of loans, insurance and investments, and include, for example, banks, insurance companies, asset owners and managers, public development banks and investment funds. Financial actors include central banks, financial regulators and supervisors, and international financial institutions and standard-setting bodies which are financial institutions within the broader financial system. The financial system encompasses both financial institutions and financial actors, as well as the legal frameworks, regulations and business practices that govern financial transactions.

10. In this assessment, "other actors" include civil society, Indigenous Peoples and local communities, consumers, non-governmental organizations, international organizations and academia.

Table SPM 1 **Actions required to create an enabling environment.**

Actions organized by Governments **(A)**, financial actors **(B)**, businesses and financial institutions **(C)**, and other actors **(D)** in the five dimensions of the enabling environment. Different actors may have different starting points and priorities, and applicable actions may vary depending on evolving sectoral and national contexts, priorities and capacity, in accordance with national legislation.

(A) Governments

1. Policy and legal	2. Economics and finance	3. Values and norms	4. Technology and data	5. Capacity and knowledge
A.1.1 Set and enforce policy, legal and regulatory frameworks that incentivize or mandate actions by businesses and financial institutions for biodiversity conservation and sustainable use {B2}	A.2.1 Align fiscal policies and financial flows with biodiversity and sustainability goals {B3}	A.3.1 Foster inclusive and equitable decision-making frameworks that respect free, prior and informed consent {B4}	A.4.1 Generate and provide robust biodiversity data using advanced technologies and other data-collection methods {B5}	A.5.1 Encourage national institutions and government agencies to coordinate intercultural education programmes to strengthen understanding between stakeholders {B3}
A.1.2 Ensure that policies are equitable, inclusive and aligned with international obligations and national capabilities {B2}	A.2.2 Through government agencies and central banks, coordinate with other financial actors to align incentives with positive biodiversity outcomes {B3}	A.3.2 Promote ethical and sustainable business practices through the regulation of sustainability reporting, standards and incentives for sustainability adoption {B4}	A.4.2 Develop and maintain decision-support systems (e.g., forecasting toolkits and national information systems) to help businesses assess their impacts and dependencies on biodiversity {B5}	A.5.2 Lead capacity-building efforts through education, training and public awareness campaigns focused on measuring business impacts and dependencies on biodiversity {B6}
A.1.3 Integrate biodiversity criteria into land/marine spatial planning, permit issuance, public procurement and corporate governance {B2}	A.2.3 Design and implement economic and financial instruments that incentivize conservation and sustainable use of biodiversity {B3}	A.3.3 Support awareness and education initiatives that encourage cultural shifts towards sustainability, including sustainable consumption choices {B4}	A.4.3 Facilitate biodiversity monitoring systems and provide regulatory incentives to encourage data-sharing frameworks that strengthen evidence-based decision-making {B5}	A.5.3 Support mutual learning and collaboration among actors, including businesses, financial institutions and civil society {B6}
A.1.4 Develop and enforce environmental impact assessments, strategic environmental assessments and biodiversity strategies {B2}	A.2.4 Eliminate, phase out or reform harmful subsidies {B3}	A.3.4 Promote the use of methods and metrics that allow the representation of nature's contributions to people, including ecosystem services {C1, C2}	A.4.4 Collaborate with businesses, financial institutions and civil society to develop business-relevant, trusted and streamlined data infrastructure and governance systems for biodiversity information {B5}	A.5.4 Foster research to address gaps in knowledge and its application at the intersection of business and biodiversity {B6}
A.1.5 Engage in international and regional policy coordination to integrate biodiversity considerations into trade policies and value chains {B2}	A.2.5 Support and enhance capacity in research, monitoring, education and nature-based solutions and/or ecosystem-based approaches {B3}		A.4.5 Link biodiversity data to national economic accounts, through frameworks such as the United Nations System of Environmental-Economic Accounting, to integrate biodiversity considerations into policy and planning {B5}	A.5.5 Develop sector-specific and landscape-/seascape-level training programmes to engage multiple sectors in biodiversity management {B6}
A.1.6 Incentivize or mandate corporate disclosure and reporting on biodiversity-related risks, dependencies and impacts {B2}	A.2.6 Establish and support financial instruments such as green and blue bonds, conservation funds and public-private partnerships {B3}		A.4.6 Promote the generation of practical and actionable information through standardized, transparent and interoperable approaches, including the need for common data standards and interoperability of data sets {B5}	A.5.6 Weave Indigenous Peoples' and local communities' knowledge into capacity-building frameworks, with due respect for their free, prior and informed consent, in accordance with national legislation {B6}
A.1.7 Ensure regulatory coherence across government agencies, ministries and levels of governance, as well as across timelines, to mainstream biodiversity {B2}	A.2.7 Collaborate with financial institutions and actors and with civil society to promote innovative and blended finance for biodiversity {B3}			
A.1.8 Implement controls on advertising to prevent greenwashing and combat misinformation {B2}				

Table SPM 1

(A) Governments

1. Policy and legal	2. Economics and finance	3. Values and norms	4. Technology and data	5. Capacity and knowledge
A.1.9 Ensure fair and equitable benefit-sharing, particularly with Indigenous Peoples and local communities, in accordance with national legislation, e.g., for the use of genetic resources and traditional knowledge associated with genetic resources, and by facilitating appropriate access to genetic resources {B2}				

(B) Financial actors

1. Policy and legal	2. Economics and finance	3. Values and norms	4. Technology and data	5. Capacity and knowledge
B.1.1 Support consistent risk assessment frameworks for biodiversity-related financial decision-making {B2} B.1.2 Use regulatory and voluntary mechanisms to ensure that financial institutions account for biodiversity-related risks, dependencies and impacts {B3} B.1.3 Use biodiversity-related measures of impact and dependency to guide the allocation of loans, investments and insurance products {B3} B.1.4 Align fiscal policies and financial flows with biodiversity and sustainability goals {B3}	B.2.1 Drive systemic change in financial systems to minimize harm, address drivers of loss and align returns with positive outcomes for biodiversity and society {B3} B.2.2 Mobilize public and private capital towards biodiversity conservation, restoration and sustainable use projects {B3} B.2.3 Develop and use innovative financial instruments (e.g., green bonds, high-integrity biodiversity credits, conservation funds and sustainability-linked loans) to fund activities aligned with achieving global biodiversity goals {B3} B.2.4 For development banks and international financial institutions: provide technical assistance, conditional or concessional funding and promote blended finance approaches {B3}	B.3.1 Integrate societal and cultural values that promote the conservation and sustainable use of biodiversity into investment, lending and risk management decisions {B3} B.3.2 Promote responsible lending and investment practices aligned with social norms favouring biodiversity conservation {B3} B.3.3 Collaborate with civil society to increase transparency and accountability in financial activities and avoid financing harmful activities {B4} B.3.4 Engage in voluntary codes or standards that reflect societal expectations regarding ethical business conduct {B4}	B.4.1 Generate, use and leverage data and technology to support biodiversity-related impact assessments, risk analyses and financing strategies {B5} B.4.2 Develop and apply economic models, scenarios and decision-support tools that integrate biodiversity dependencies and impacts {B5} B.4.3 Participate in cross-sector data-sharing initiatives to align financial decision-making with biodiversity outcomes {B5} B.4.4 Use comparable biodiversity accounting methods to evaluate and disclose financial materiality and non-financial value creation, reflecting different ecological and regional contexts {B5} B.4.5 Support and invest in data infrastructure and digital tools that promote transparency and comparability in biodiversity-related reporting {B5}	B.5.1 Offer training programmes on biodiversity-related risk assessment and sustainable financing models {B6} B.5.2 Provide technical assistance, risk mitigation tools and fiscal instruments that build capacity for biodiversity-focused business strategies {B6} B.5.3 Foster collaboration between financial and non-financial actors to align capacity-building with biodiversity goals {B6} B.5.4 For development banks: lead by example by integrating biodiversity considerations into financial planning and investments {B6} B.5.5 For international financial institutions: support capacity-building through technical expertise, knowledge-sharing and regulatory guidance {B6}

Table SPM 1

(C) Businesses and financial institutions

1. Policy and legal	2. Economics and finance	3. Values and norms	4. Technology and data	5. Capacity and knowledge
C.1.1 Engage responsibly in lobbying and advocacy to support ambitious biodiversity policies, avoiding and discouraging lobbying for unsustainable practices that drive biodiversity loss, such as harmful subsidies or incentives {B2} C.1.2 Publicly disclose lobbying activities to maintain transparency and trust {B2} C.1.3 Use established frameworks to report on biodiversity impacts, dependencies, risks and opportunities, including biodiversity accounting methods {B2} C.1.4 Develop and engage in voluntary codes or standards and biodiversity-related corporate governance practices {B2} C.1.5 Comply with biodiversity-related policies, laws and regulations {B2} C.1.6 Integrate biodiversity-related risks, opportunities, costs and benefits into business decision-making and financial planning {B9}	C.2.1 Participate in and benefit from economic instruments and financial incentives that promote biodiversity conservation {B3} C.2.2 Collaborate with Governments and financial institutions in innovative financing mechanisms such as green bonds or high-integrity biodiversity credits to fund activities aligned with achieving global biodiversity goals {B3} C.2.3 Advocate for inclusive policies and the dismantling of financial barriers, which is essential for promoting economic equity {B3} C.2.4 Embrace new economic models that align with the values of Indigenous Peoples and local communities {B3}	C.3.1 Advocate for and collaborate on coordinated biodiversity disclosure for consumer products {B4} C.3.2 Engage in partnerships with Indigenous Peoples and local communities, affected communities and young people to promote environmental stewardship and long-term sustainability {B4} C.3.3 Engage in responsible marketing and communication that supports sustainable consumption patterns {B4} C.3.4 Engage in voluntary codes or standards that reflect societal expectations regarding ethical business conduct {B4} C.3.5 Align business operations and strategies with social values, norms and culture, emphasizing sustainability, equity and inclusivity {B4} C.3.6 Ensure respect for Indigenous Peoples and local communities and for their respective rights in accordance with national legislation and the principle of free, prior and informed consent, and establish mechanisms for the participation of Indigenous Peoples and local communities in decision-making {B4} C.3.7 Where relevant, align business practices and processes with the concept of benefit-sharing and with benefit-sharing mechanisms {B9}	C.4.1 Adopt corporate data disclosure and transparency standards that capture dependencies and impacts on nature {B2} C.4.2 Generate, use and share biodiversity data to inform decision-making and risk management {B5} C.4.3 Drive innovation and leverage new technologies (e.g., bio-based products, monitoring tools and artificial intelligence-driven analyses) {B5} C.4.4 Collaborate with Governments, financial institutions and civil society to develop data governance systems and infrastructure to enable responsible data-sharing {B5} C.4.5 Engage with Indigenous Peoples and local communities in data collection and use processes, with due respect for free, prior and informed consent, in accordance with national legislation {B5, B9}	C.5.1 Build capacity by investing in education, research, training and knowledge exchange on biodiversity, including through industry associations {B6} C.5.2 Participate in and support training and capacity-building initiatives led by Governments, financial institutions and civil society {B6} C.5.3 Educate consumers on biodiversity-focused strategies informed by knowledge on biodiversity impacts to support sustainable choices {B6} C.5.4 Involve Indigenous Peoples and local communities in training and decision-making processes to enhance intercultural competencies {B6} C.5.5 Partner with academia and civil society to co-develop and implement training programmes and promote awareness with regard to biodiversity {B6}

Table SPM 1

(D) Other actors, including Indigenous Peoples and local communities, consumers, non-governmental organizations, international organizations and academia

1. Policy and legal	2. Economics and finance	3. Values and norms	4. Technology and data	5. Capacity and knowledge
D.1.1 Influence policy, legal and regulatory environments through advocacy, responsible and transparent lobbying, and participation in decision-making and electoral processes {B2}	D.2.1 Advocate for, monitor and hold businesses to account for the fair and equitable sharing of benefits from the utilization of genetic resources {B3, B4}	D.3.1 Foster shifts in societal values and consumer choices and demand through education, awareness and advocacy campaigns promoting sustainable lifestyles and consumption {B4}	D.4.1 Lead and participate in biodiversity monitoring, participatory mapping, and reporting to enhance transparency and local empowerment {B5}	D.5.1 Lead education and awareness campaigns for the public and consumers on biodiversity impacts and sustainable choices {B6}
D.1.2 Promote equitable and inclusive policy design that respects rights, livelihoods and international obligations {B2}	D.2.2 Engage in partnerships and public-private initiatives to co-design and implement biodiversity-related financial instruments {B3}	D.3.2 Promote transparency, accountability and responsible advocacy {B4}	D.4.2 Leverage technology for biodiversity monitoring, environmental impact assessment and legal advocacy {B5}	D.5.2 Act as a bridge between Governments, businesses and financial institutions to facilitate knowledge exchange and shared understanding {B6}
D.1.3 Engage in monitoring progress and holding Governments and businesses accountable for biodiversity-related policies and actions {B4}	D.2.3 Participate in community-based finance or decentralized structures supporting conservation and sustainable use {B3}	D.3.3 Engage in voluntary disclosure and reporting frameworks to demonstrate alignment with biodiversity goals {B2, B4}	D.4.3 Co-develop technological tools and open data repositories with different actors to improve access to biodiversity information {B5}	D.5.3 Collaborate across civil society to strengthen biodiversity literacy and cross-sectoral engagement {B6}
		D.3.4 Facilitate collaboration and partnerships among stakeholders to integrate social and environmental priorities {B4}	D.4.4 Use campaigns and collaborations to promote responsible data use, combat misinformation and raise awareness of biodiversity issues {B5}	D.5.4 Design and deliver mutually supportive capacity-building programmes tailored to Indigenous Peoples and local communities {B6}
		D.3.5 Provide insights to a range of actors to encourage responsible business and financial practices to incorporate traditional ecological knowledge and relational values of nature {B4}	D.4.5 Contribute Indigenous and local knowledge to biodiversity data systems, ensuring cultural and ecological relevance, and applying free, prior and informed consent, in accordance with national legislation {B4}	D.5.5 Promote intercultural competence training and highlight the value of Indigenous knowledge systems {B6}
		D.3.6 Advocate for the recognition of rights and free, prior and informed consent in business and policy processes {B4}	D.4.6 Develop community-owned databases that safeguard traditional knowledge and respect intellectual property rights {B5}	D.5.6 Empower communities to participate in decision-making processes related to business and biodiversity {B6}
		D.3.7 Advocate to overcome unequal power structures and ensure fair participation in business and decision-making activities {B4}	D.4.7 Advocate for equal access to technology and Internet infrastructure to support participation in biodiversity monitoring and decision-making {B5}	
			D.4.8 Collect data on the ground through bottom-up approaches, which include traditional methods {B5, C2}	

KM4 **All businesses have a responsibility to address their impacts and dependencies {A3, B7, B8, B9, B10, B11, B12, B13, C1}.**

There are many actions that businesses, including financial institutions, can take now to benefit businesses and biodiversity **(Table SPM.2)**. The level of responsibility of individual businesses to act is a societal decision[11] that can be informed by the scale of their impacts and dependencies on biodiversity and nature's contributions to people, including ecosystem services. Methods exist for measuring businesses' impacts and dependencies **(Table SPM.5)**. Impacts and dependencies can result in risks and opportunities for businesses. By understanding and managing their impacts and dependencies, businesses can reduce risks and deliver positive outcomes for both business and biodiversity. Understanding and managing impacts can lead to changes in business dependencies, and understanding dependencies can support actions to address impacts. Historically, business actions to manage negative impacts have mostly been driven by regulation **(Figure SPM.3)**.

Businesses, including financial institutions, can: (a) establish corporate governance and strategic frameworks to set directions and enable actions that improve biodiversity outcomes across their operations, value chains and portfolio; (b) implement actions in their operations to deliver positive outcomes for biodiversity at the site, landscape and seascape levels, including by applying the mitigation hierarchy to avoid, minimize, restore, and offset impacts; (c) implement actions for their value chain that address impacts and dependencies directly or by influencing others upstream (working with suppliers) and downstream (engaging distributors, retailers and consumers); and (d) in the case of financial institutions, shift finance in their portfolios away from harmful activities and

11. The term "societal decision", as used here, refers to a decision taken in relation to globally agreed goals and national contexts, including policy, laws and regulations.

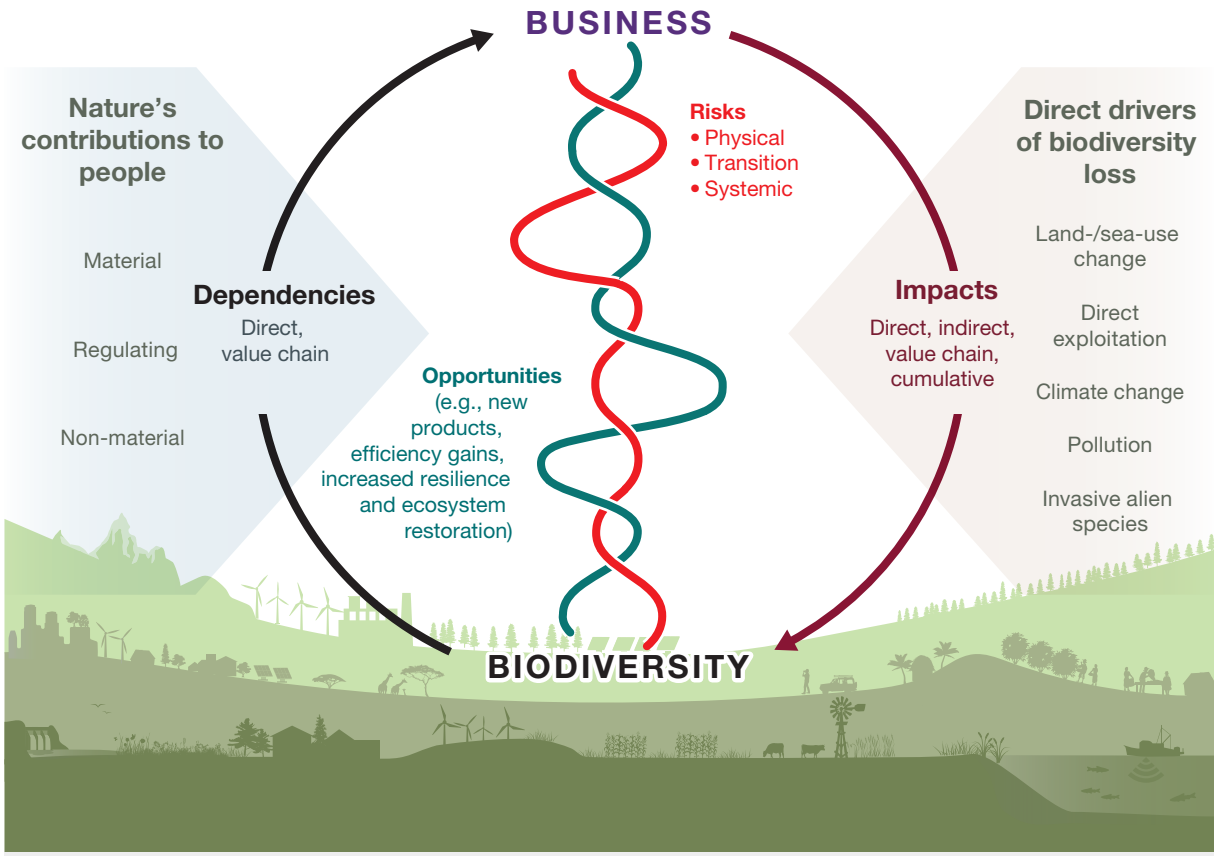


Figure SPM 3 **Impacts and dependencies of business on biodiversity and nature's contributions to people.**

Businesses have impacts that can be direct, indirect, through the value chain, or cumulative, and their activities contribute to the five direct drivers of biodiversity loss. Their dependencies can be direct or through the value chain and can arise from nature's material, non-material and regulating contributions to people. Risks can be physical, transitional or systemic. Opportunities for business include new products, efficiency gains and increased resilience. Risks and opportunities may interact, and risk management may create opportunities.

towards positive impacts. Through actions at these levels, businesses can contribute to an enabling environment and influence other actors to improve biodiversity outcomes. To avoid greenwashing, it is essential that businesses develop transparent and credible strategies based on an understanding of their impacts and dependencies and clearly demonstrate verifiable biodiversity outcomes **(Table SPM.2)**.

KM5 Methods, knowledge and data for measuring impacts and dependencies already exist and can further inform decisions and actions, directly and in the value chain {A5, B8, C1, C3}.

The science base for understanding and measuring business impacts and dependencies is already being used to guide business actions. Some businesses already apply

Table SPM 2 **Actions that businesses can take now to address their impacts and dependencies.**

Close links exist between actions implemented across the four decision-making levels. For example, targets set at the corporate level drive actions and outcomes at the operations and value chain levels. Across all decision-making levels, actions can be taken individually or collectively, including through collaboration and partnerships.

Business decision-making level	Examples of actions businesses can take
Corporate {A3, B2, B9}	• Comply with biodiversity-related policies, laws and regulations • Set ambitious commitments and targets and integrate biodiversity into corporate strategy • Integrate biodiversity-related risks, opportunities, costs and benefits into business decision-making and financial planning • Create policies, develop management systems and clarify requirements for engagement, measurement, monitoring, reporting, disclosures and assurance • Establish mechanisms for the participation of Indigenous Peoples and local communities in decision-making • Establish policies and standards to comply with access and benefit-sharing and consent mechanisms, including free, prior and informed consent, in accordance with national legislation • Weave Indigenous and local knowledge into operations, resource management and sustainability strategies • Build staff capacity and board-level environmental leadership • Establish auditing, monitoring and performance assessment • Transition the business, build capacity and ensure adequate resourcing to implement policies and achieve targets • Introduce innovative processes, products and services • Explore and adopt alternative business models **Additional actions specifically for financial institutions {B12}:** • Set requirements for clients to address impacts and dependencies • Commit resources to the use of instruments such as blended finance, green or sustainability-linked bonds, and impact investing
Operations {B11}	• Conduct environmental and social impact assessments and develop management plans • Develop baselines and monitoring that recognize the multiple values of nature • Apply the mitigation hierarchy to achieve no net loss of biodiversity (or better) • Measure and monitor biodiversity impacts and outcomes of actions • Identify and meaningfully engage with stakeholders • Seek free, prior and informed consent, particularly from Indigenous Peoples and local communities, in accordance with national legislation • Go beyond impact mitigation to engage in landscape conservation, restoration and sustainable management
Value Chain {B10}	• Map value chain actors and ensure traceability to prioritize and inform action • Use supplier management systems to set expectations, monitor performance and address non-compliance • Build relationships and partnerships to improve capacity and drive performance through training, knowledge exchange and innovation • Integrate communities into value creation activities, such as sourcing, production and distribution • Engage, educate and incentivize downstream customers, clients and consumers
Portfolio {B12}	• Assess biodiversity impacts and dependencies • Engage with businesses within the portfolio to foster actions that improve performance in terms of biodiversity impacts and dependencies • Manage biodiversity risks and impacts, for example through stewardship, divestment and/or exclusion

existing methods, knowledge and data; as the science base improves, all businesses will be able to take action. The understanding of how to apply methods for impact assessment is more advanced than for assessments of dependencies. The availability of measurement approaches and underlying data varies by business sector, ecological realm and jurisdiction. The application and uptake of methods is low and uneven across and within business sectors and varies across regions and countries, reflecting differences in data availability and technical capacity.

Different knowledge communities offer credible methodologies that can be applied across diverse business contexts, each contributing distinct approaches to addressing impacts and dependencies. Many aspects of biodiversity and nature's contributions to people may be relevant to measuring business impacts and dependencies, including aspects at the genetic, species and ecosystem levels and the diverse benefits associated with nature's contributions to people. Which aspects should be measured depends on the context, location and action to be taken or the decision to be informed. As a result, a combination of methods or metrics, which may include scientific, Indigenous and local knowledge, will often be necessary to fully capture the impacts and dependencies of business on biodiversity and nature's contributions to people.

KM6 Different methods to measure and manage impacts and dependencies are needed for different sectors, decision-making levels and business purposes {A8, B8, C1, C2, C4, C7}.

No single method is suitable for all business decisions **(Table SPM.3)**. Different methods and metrics are needed for distinct sectors, decision-making levels and purposes of measurement.

Decisions at the operations level require site-specific information and data, which may be gathered using bottom-up approaches,[12] including location-based observations, participatory mapping and monitoring, and spatial analysis built on the data from those sources. Such approaches can make use of data and metrics representing local values and the knowledge, rights and interests of other groups, including Indigenous Peoples and local communities. Bottom-up approaches can provide greater accuracy at local scales and can show how outcomes change in response to concrete actions or activities on the ground. Cumulative impacts, which arise from the aggregated effects of businesses and other actors at a location over time, are better assessed for an area such as a site, landscape or seascape than for a particular business.

Top-down methods[13] include life-cycle approaches and macro-scale environmental economic models appropriate for decisions at the portfolio, corporate and value chain levels. Depending on the purpose of measurement, they can be conducted with lower-resolution spatial data but wider geographical scale. Portfolio-level decisions can be guided by globally comparable methods where there is sufficient resolution within sectors (e.g., differentiating according to geography or product type). Corporate-level decisions can be informed by methods that use company-specific information. Value chain-level decisions can make use of life-cycle approaches that assess potential impacts of value chains, although they are less relevant for assessing dependencies. Top-down methods provide an assessment of potential impacts and dependencies and inform decisions through screening and comparing options. However, those methods may have limited ability to track progress resulting from specific business actions. Top-down approaches using coarse-resolution data often fail to reflect local ecological values and are less able to represent the diverse values of nature, including the values and interests of Indigenous Peoples and local communities.

As a result, important areas for the future development of top-down approaches include higher-resolution spatial and temporal data and better interweaving with diverse values of nature for understanding dependencies, impacts, risks and opportunities.

KM7 Appropriate methods to measure and manage business impacts and dependencies can be selected on the basis of coverage, accuracy and responsiveness {C1, C2, C4}.

Methods can be assessed as fit for purpose against three overarching characteristics: coverage, accuracy and responsiveness. Coverage refers to both the geographical scale as well as the extent of impacts and dependencies included. To be fit for purpose, a method or combination of methods needs to cover the impacts and dependencies of the activities of a business at the relevant geographical scale. Accuracy is the degree to which the results correctly describe what they are designed to measure. The accuracy necessary for a method to be considered fit for purpose varies by both decision-making level and purpose of measurement. Responsiveness refers to the ability of the method to detect changes that can be attributed to the actions and activities of the business. To be fit for purpose, a method needs to clearly link changes in biodiversity and nature's contributions to people to specific interventions.

Currently available methods do not always satisfy the criteria of coverage, accuracy and responsiveness for all business

12. Bottom-up methods start from site-level, species-level or asset-level observations and build biodiversity measures from the ground up. They are characterized by high precision and low coverage.

13. Top-down methods start from aggregate, system-level signals (e.g., for sectors or regions) and infer biodiversity outcomes or pressures from above. They are characterized by wide coverage and low precision.

applications. Where methods do not meet the necessary requirements, they may not be entirely fit for purpose. They can, however, still produce useful information on which businesses can act. Such limitations need to be understood by businesses. Different methods also require different levels of expertise, resources and costs, presenting particular challenges for small and medium-sized enterprises. While recognizing constraints, businesses can start using methods and improve their capabilities over time.

Table SPM 3 **Suitability of methods for assessing impacts and dependencies by decision-making level and purpose of measurement.**

The categories of methods are not mutually exclusive and represent a continuum rather than strictly delineated categories. At each decision-making level, methods can be applied for different purposes. The icons indicate the extent to which methods within each category are currently available and applicable, can be applied given sufficient accuracy, coverage and responsiveness ("Proceed with caution"), or are currently not feasible or applicable.

Business decision-making level	Purpose of measurement	Method categories: Location-based observation Involves using direct measurements at specific locations, including field observations and remote sensing	Participatory mapping and monitoring Involves collaboration with external stakeholders, rights holders or communities, including Indigenous Peoples and local communities	Spatial analysis Includes overlays of spatial data layers, and ecological and hydrological modelling	Life-cycle approaches Includes full life-cycle assessments and various forms of environmental footprinting	Macro-scale environmental economic models Includes qualitative and quantitative approaches
Operations Business operations carried out at sites under the direct control of the business entity		⇉	⇉	⇢	⇢	✕
		⇉	⇉	⇢	⇢	✕
		⇉	⇉	⇢	⇢	✕
		⇉	⇉	⇢	✕	✕
Value chain Activities beyond the direct control of an individual business entity, involving suppliers, manufacturers, distributors, retailers and customers		✕⇢	✕⇢	⇢	⇉	✕
		✕⇢	✕⇢	⇢	⇢	✕
		⇢	⇢	⇢	⇢	✕
		⇢	⇢	⇢	✕	✕
Corporate A business or group of business entities, typically within an industry, governed as a single organization		✕⇢	✕⇢	⇢	⇉	⇉
		✕⇢	✕⇢	⇢	⇢	⇢
		✕⇢	✕⇢	⇢	⇢	✕
		✕⇢	✕⇢	✕⇢	✕	✕

Table SPM 3

Business decision-making level	Purpose of measurement	Method categories: Location-based observation Involves using direct measurements at specific locations, including field observations and remote sensing	Participatory mapping and monitoring Involves collaboration with external stakeholders, rights holders or communities, including Indigenous Peoples and local communities	Spatial analysis Includes overlays of spatial data layers, and ecological and hydrological modelling	Life-cycle approaches Includes full life-cycle assessments and various forms of environmental footprinting	Macro-scale environmental economic models Includes qualitative and quantitative approaches
Portfolio A group of investments owned by a financial institution, or a group of business units owned by a conglomerate	Screening	✕→	✕→	···→	⇉	⇉
	Comparing options	✕→	✕→	···→	···→	✕→
	Tracking potential changes in impacts/dependencies	✕→	✕→	✕→	···→	✕
	Observing change in biodiversity	✕→	✕→	✕→	✕	✕

Purpose of measurement

- **Screening:** identifying priorities requiring further analysis or action
- **Comparing options:** evaluating potential impacts and dependencies of business activities relative to alternatives
- **Tracking potential changes in impacts/dependencies:** measuring change in pressures over time as part of an impact assessment, or the change in reliance of business activities on nature's contributions to people over time as part of a dependency assessment
- **Observing change in biodiversity:** showing positive or negative changes in biodiversity and nature's contributions to people that can be attributed or linked to business activities or action on biodiversity

Level of applicability

- ⇉ **Available and applicable**
- ···→ **Proceed with caution:** methods can be applied provided sufficient accuracy, coverage and responsiveness
- ✕→ **Not currently feasible**
- ✕ **Not applicable**

KM8 Businesses could better measure and manage their impacts and dependencies by appropriately engaging with science and Indigenous and local knowledge, methods and practices {A5, A7, B5, B6, B10, C3, C4, C7, C8}.

Data and knowledge on the impacts and dependencies of business on biodiversity and nature's contributions to people exist within the scientific community, among Indigenous Peoples and local communities, and within businesses, but are often siloed and not effectively considered by businesses in decision-making. Scientific literature is not written for businesses, and a lack of translation and attention to the needs of businesses has slowed uptake of scientific findings. Among businesses, there is often limited understanding of the role of Indigenous Peoples and local communities as stewards of biodiversity and holders of knowledge on its conservation, restoration and sustainable use. Better understanding could improve business decision-making. Indigenous Peoples and local communities often find themselves inadequately represented in research and decision-making processes, further undermining their contributions and weakening their voices, which may result in businesses failing to learn from them. This may have implications for the ability of businesses to comply with access and benefit-sharing mechanisms and approaches. While examples of interweaving Indigenous and local knowledge with scientific methods exist, businesses lack the experience of working with Indigenous Peoples and local communities needed to ensure that their knowledge is represented and their values are considered in decision-making. Due diligence by businesses involves

consent mechanisms, including the free, prior and informed consent of Indigenous Peoples and local communities, in accordance with national legislation. Structured collaboration resulting in the sharing and better use of data and information, scientific insights and Indigenous and local knowledge on business impacts and dependencies can translate into better management of business risks and the realization of opportunities.

KM9 The existing knowledge base needs to be strengthened by addressing important gaps in knowledge and its application {A5, A7, B5, B6, B13, C3, C4, C5, C6, C7, C8}.

Businesses can act now on the basis of existing knowledge; however, limitations remain in the currently available knowledge base and guidance. A paucity of quantitative, standardized and comparable estimates of the impacts of different businesses hinders the ability of all actors to fully understand and effectively manage business activities. This restricts the ability of financial institutions to choose investments that minimize negative or maximize positive impacts. Needs differ according to context, scale and sector, and consistent methodological approaches need to be developed and disseminated that produce accurate results, particularly for decision-making contexts in which the ability to compare or aggregate data across sites, value chains or businesses is important. Existing methods have yet to produce a comprehensive and comparable attribution of impacts across all sectors or businesses. The ability of assessments to inform action is hampered by their limited integration into business accounts and processes. Clear gaps in knowledge and its application exist in relation to: (a) business-relevant data; (b) completeness of evidence; (c) applicability of methods; (d) data accessibility and transparency; and (e) adoption of methods.

Addressing these gaps would contribute to significantly improving the ability of businesses to measure their impacts and dependencies, with implications for their understanding of risks and opportunities. Better understanding could help to accelerate actions that benefit both businesses and biodiversity. Priority actions to address gaps can include:

(a) Facilitating greater uptake by businesses of existing methods and knowledge and their integration into business accounting and management systems;

(b) Collecting and sharing comparable information, including through disclosure mechanisms, on the activities and locations of businesses, their operations and value chains;

(c) Providing scenarios that support the assessment of performance against agreed goals and targets;

(d) Providing actionable guidance for businesses to select methods appropriate to their context and needs;

(e) Co-creating actions based on methods and knowledge built with participatory approaches involving Indigenous Peoples and local communities.

Information that is easily understandable, standardized, transparent, interoperable, practical and actionable provides the foundation on which businesses and financial institutions can choose actions that are beneficial for biodiversity and society. Turning disclosure and awareness into informed action across the whole of society requires specific, context-dependent knowledge about business impacts and dependencies on biodiversity and nature's contributions to people. In the case of dependencies, mandatory or voluntary disclosure could support scientific advances in order to accurately measure nature's non-material and regulating contributions to people, which are currently underrepresented in tools and approaches. Examples include recreation, learning and inspiration, supporting identities, regulation of pollutants, climate regulation and pollination.

KM10 Creating an enabling environment can incentivize actions that are beneficial for businesses, biodiversity and society for a just and sustainable future {A8, B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13}.

Under current conditions, what is profitable for businesses often results in loss of biodiversity, and what is good for biodiversity and society is often not profitable. Businesses are motivated to focus on financial materiality in order to meet short-term objectives and achieve profitability. This undermines their ability to take actions that address long-term outcomes with system-level implications. To address this problem, efforts have been made to require businesses to consider not only what is financially material but also what is material for biodiversity and society. While this can encourage businesses and financial institutions to consider multiple dimensions when taking decisions, it perpetuates a system built on the idea of trade-offs between profitability and biodiversity. Creating an enabling environment that provides incentives for the conservation and sustainable use of biodiversity and nature's contributions to people could align what is profitable with what is good for biodiversity and society. It would result in businesses and financial institutions being positive agents of change in transforming to a just and sustainable economic system by addressing their impacts on biodiversity loss, climate change and pollution, which are interconnected.





BACK-GROUND

BACKGROUND MESSAGES

A. Understanding the relationship between business and biodiversity

A1 Businesses depend on biodiversity, but business actions continue to drive declines in biodiversity and nature's contributions to people *(well established)*.

Biodiversity provides goods and services that are essential to the economy and business activities. For example, biodiversity provides raw materials and energy and regulates environmental conditions, including by modulating water flows to reduce flooding during wet seasons and by providing water during dry seasons. Biodiversity also underpins genetic diversity, which can inform research and innovation and contributes to science, education and cultural and spiritual values *(well established)* {2.2.1}. Despite its importance, the loss of biodiversity and nature's contributions to people has accelerated since the industrial revolution due to rapid economic growth and changes in production and consumption patterns *(well established)* {1.1.2, 1.1.3}. Economic activity and global trade have increased at a faster pace than human population growth *(well established)* {1.1.2}. The transformative change assessment[14] identified three underlying causes of biodiversity loss: disconnection from nature, concentration of power and wealth, and prioritization of short-term individual and material gains (*well established*) {1.1.4}. Business activities are shaped by and contribute to these socioeconomic trends and their underlying causes, often in complex and unpredictable ways (*well established*) {3.2.1}. The growing economy continues to contribute to the direct drivers of biodiversity loss (i.e., land- and sea-use change, unsustainable direct exploitation of organisms, climate change, pollution, and invasive alien species, among others), placing increasing pressure on biodiversity and nature's contributions to people *(well established)* {1.1.4}. Measures of biodiversity and nature's contributions to people have shown declines for decades *(well established)* {1.1.1, 1.1.2, 1.1.3, 1.1.4}. Since 1992, human-produced capital (e.g., buildings and machinery) that improves economic productivity has increased by approximately 100 per cent per capita on average, with wide disparities among countries, while stocks of natural capital (i.e., ecosystems and natural resources) have been reduced by nearly 40 per cent *(well established)* {1.1.2}.

14. IPBES (2024). *Transformative Change Assessment* (see footnote 6).

A2 Biodiversity losses caused by economic activity put the future of businesses, the economy and global society at risk *(well established)*.

The loss of biodiversity and nature's contributions to people, including stocks of natural resources, resulting from unsustainable use threatens the ability of businesses, local economies and entire sectors to function *(well established)* {1.2.9}. The first global assessment of biodiversity and ecosystem services[15] shows that, while biodiversity and nature's contributions to people are providing more food, energy and materials than at any other point in human history, doing so often comes at the expense of rapid biodiversity decline, diminished ecosystem function and reductions in many of nature's contributions to people *(well established)* {1.1.2, 1.3}. Because biodiversity loss is driven in large part by economic activity and by systemic failures to internalize nature's values, the resulting degradation of ecosystems generates physical risks for the very businesses and economic systems that depend on them *(well established)* {1.1.2, 1.3, 1.2.9}. This situation creates pervasive systemic risk that affects the stability of the financial system and the global economy *(well established)* {1.2.9}. Risks associated with biodiversity loss and ecosystem collapse, along with extreme weather events, critical changes to Earth systems,[16] and natural resource shortages and pollution, are expected to be among the highest-ranked global risks over the next 10 years *(well established)* {1.4.2}. Climate- and biodiversity-related risks may interact to amplify social and economic impacts *(well established)* {1.4.2, 3.5.2}. Such risks affect some sectors directly (e.g., agriculture, tourism and insurance) and all sectors indirectly *(established but incomplete)* {2.5.1, 2.5.5}. Those risks may have disproportionate impacts on developing countries, whose economies are more reliant on biodiversity and have less technical and financial capacity to absorb shocks *(well established)* {1.2.9, 3.5.2}.

15. IPBES (2024). Global Assessment Report on Biodiversity and Ecosystem Services (see footnote 3).

16. As defined in World Economic Forum, *Global Risks Report 2025* (Geneva, 2025).

A3 Current conditions perpetuate business as usual and do not support the transformative change required to halt and reverse biodiversity loss *(well established)*.

Business governance, strategies and structures have evolved in response to economic, financial, political and social systems that have commonly ignored or undervalued biodiversity, creating tension between business actions and the conservation and sustainable use of biodiversity *(well established)* {1.1.2, 1.1.4}. For example, time pressures on decision-making and timescales for investment returns and reporting by businesses – with emphasis on quarterly earnings and annual reporting – are shorter than many ecological processes, such as ecosystem regeneration *(established but incomplete)* {5.3.2}. As a result, the loss of biodiversity is not adequately internalized in business decision-making, making it difficult for businesses to justify action under traditional interpretations of fiduciary duty, which typically prioritize short-term shareholder returns *(established but incomplete)* {5.1}.

Markets fail to adequately price or value biodiversity and many of nature's contributions to people, such as the filtration of pollutants, climate regulation and pollination *(well established)* {1.1.2}. Therefore, businesses bear little or no financial cost for negative impacts and may not generate revenue from positive impacts on biodiversity *(well established)* {1.1.2}. As a result, there are insufficient incentives for businesses to take action in order to conserve, restore or sustainably use biodiversity *(well established)* {1.1.2, 5.1, 5.3.2}.

Public policy can further accelerate biodiversity decline *(well established)* {5.3.2}. In 2023, global public and private financial flows with direct negative impacts on nature, including environmentally harmful public subsidies and private investment in high-impact sectors, were estimated at $7.3 trillion. Of that total, private finance accounted for around two thirds ($4.9 trillion), while public spending on environmentally harmful subsidies to economic sectors responsible for biodiversity loss and nature's decline totalled approximately $2.4 trillion. There are considerable differences between business sectors.[17] By contrast, only around $220 billion in public and private financial flows in 2023 were directed towards activities that contribute to the conservation and sustainable use of biodiversity *(well established)* {5.3.2}. Some subsidies are positive for biodiversity outcomes *(well established)* {1.1.2}. Far lower and fewer subsidies are provided to businesses for the conservation, restoration or sustainable use of biodiversity *(well established)* {5.3.2}. Public subsidies that support harmful activities and distort trade can have significant economic repercussions for all countries, especially for developing countries, and in some cases may have implications for the capacity of businesses to invest in sustainable activities and practices. Incorporating biodiversity considerations into trade policies is an important lever to create an enabling environment *(established but incomplete)* {1.1.2, 6.1.4}. Some business actions intended to conserve and sustainably use biodiversity and nature's contributions to people, such as modes of sustainable production and consumption (e.g., waste reduction or circular economy approaches), can be profitable under the current conditions. This explains why some businesses already take some actions that have a positive impact on biodiversity *(established but incomplete)* {5.3.1}; however, those actions alone are not enough to halt and reverse the loss of biodiversity at a global scale (*well established*) {5.1, 5.2.2}.

A4 All businesses across all sectors depend on biodiversity and nature's contributions to people *(well established)*.

Business dependencies can result from: (a) material inputs to processes and products, such as genetic resources, raw materials and energy; (b) regulation of the environmental conditions in which the businesses operate, such as modulation of water flows and control of erosion; and (c) non-material contributions, such as recreational, educational and spiritual, cultural and aesthetic values (*well established*) {2.2.1, 2.5.2, 2.5.4, 2.9}. Dependencies on material inputs can result in negative impacts on other actors and on the business itself when extraction exceeds levels of sustainable use *(well established)* {2.2.1}. In managing their dependencies, businesses have to navigate complex trade-offs and consider broader societal needs *(established but incomplete)* {2.8}. The magnitude of the dependence and the availability and stability of the supply of nature's contributions to people determines the associated type and level of risk to the business *(established but incomplete)* {2.2.4, 2.5.5}. Dependencies are not always obvious; for example, while grocery stores and restaurants have little direct dependence on biodiversity, they are part of the agricultural value chain that begins with primary agricultural producers *(well established)* {2.2.1}. Similarly, waste management can depend on microbial communities for efficient solid waste processing *(well established)* {2.2.1}. Dependencies on biodiversity may span long distances (e.g., consumption of traded goods far from the place of production) and long periods of time (e.g., timber harvests) *(well established)* {2.2.1}. Many Indigenous Peoples and local communities and their businesses are especially dependent on biodiversity for their livelihoods and well-being. Upstream smallholder producers, including women and girls, may have limited capacity to absorb or adapt to

17. Information on specific sectors with figures on financial flows can be found in section 5.3.2 of the assessment report, as well as in: United Nations Environment Programme, *State of Finance for Nature 2026: Nature in the Red – Powering the Trillion Dollar Nature Transition Economy* (Nairobi, 2026).

negative impacts compared to businesses downstream in the value chain *(established but incomplete)* {1.2.3, 1.2.9, 2.2.4, 2.5.5, 2.7, 3.2.4}.

A5 Understanding of business dependencies on biodiversity and nature's contributions to people across sectors and scales is incomplete and uneven *(well established)*.

Sectors with high and direct dependence on biodiversity, such as agriculture or extractive industries, tend to have financial incentives to consider and measure dependencies because they use or produce raw materials *(well established)* {2.5.1, 3.5}. There is relatively limited consideration of dependencies and associated risks in the value chain and for non-material and regulating contributions. Studies of business dependencies have focused mainly on biophysical data in directly dependent sectors such as agriculture, fisheries, pharmaceuticals and tourism and on readily apparent inputs such as pollination and water *(established but incomplete)* {2.5}. Fewer studies have translated dependencies into monetary valuation *(established but incomplete)* {2.3, 2.4}. Businesses may also be dependent on Indigenous and local knowledge and could learn from Indigenous Peoples and local communities and the ways in which their businesses conserve and sustainably use biodiversity *(established but incomplete)* {2.7}. In most regions of the world, there is less understanding of the magnitude of business dependencies than of business impacts *(well established)* {2.5, 3.4, 4.5.2}. More evidence is available for Europe, the Americas and Asia than for Africa and Oceania *(established but incomplete)* {2.8}. Better understanding of the magnitude of business impacts and dependencies and associated risks and opportunities could help to accelerate actions that benefit both businesses and biodiversity *(established but incomplete)* {2.6, 2.8, 5.3.2}.

A6 All businesses across all sectors have impacts on biodiversity and nature's contributions to people, including through their value chains *(well established)*.

The impacts of business on biodiversity can be negative or positive, direct or indirect (through the value chain), and can operate through a range of drivers that vary by location and sector, as well as within sectors *(well established)* {1.4.1, 3.2}. Business activities can affect all dimensions of biodiversity (e.g., genes, species and ecosystems) and nature's contributions to people (i.e., material, non-material and regulating contributions) *(well established)* {3.2, 3.4}. Impacts from multiple businesses can have cumulative effects that can lead to ecological tipping points being crossed, causing potentially irreversible biodiversity loss with far-reaching economic, social and ecological consequences *(well established)* {1.2.9}. The form, magnitude and reversibility of a business's impacts vary according to the type, scale (spatial and temporal), magnitude, frequency, location and sector of its activities *(well established)* {3.2}. A business's size does not always reflect the magnitude of its impacts *(well established)* {3.2}. To date, business impacts have been predominantly negative, and many positive outcomes claimed would be more accurately described as reductions in negative impacts *(well established)* {3.2, 3.5}. While existing methods do not yet provide a comprehensive and comparable attribution of impacts across all sectors, available estimates identify agriculture, forestry and fishing; electricity and energy; mining and quarrying; construction; and transportation and storage as sectors with relatively high quantified direct impacts *(established but incomplete)* {3.4}. Because the activities of primary sectors are driven by demand from other sectors, businesses and consumers further along the value chain also contribute to those impacts *(well established)* {3.2, 3.4}. Business impacts are frequently assessed using metrics of biodiversity, such as changes in forest cover or mean species abundance. These biodiversity metrics are not necessarily good proxies for the impact on nature's contributions to people, including ecosystem services *(well established)* {3.2.1, 3.4}. Fewer studies include the impacts of businesses on nature's contributions to people; as a result, the consequences of business activities for human well-being, including intergenerational impacts, are often ignored *(well established)* {3.3, 3.4}.

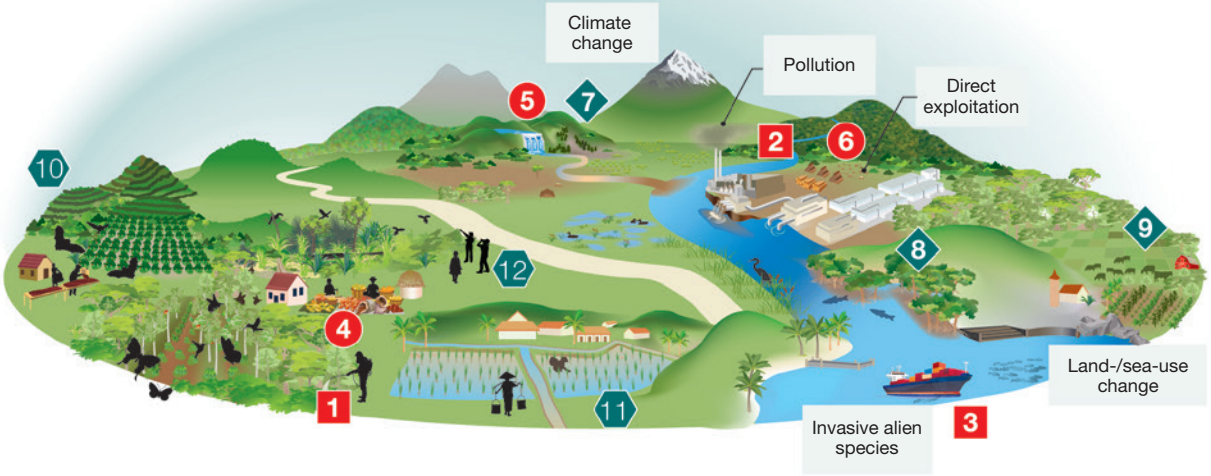
A7 Business impacts on biodiversity and nature's contributions to people have profound impacts on human health and well-being, particularly among Indigenous Peoples and local communities *(well established)*.

Business impacts on biodiversity can negatively influence the interrelationships between people and nature, with potentially long-lasting economic, social and cultural implications *(well established)* {3.2.4}. Women and girls, young people, rural communities and Indigenous Peoples and local communities are especially susceptible to negative impacts from businesses *(well established)* {3.2.4, 3.4.4, 3.5.4}. There is growing recognition that, when assessing their impacts on nature, businesses should include social and human rights considerations {1.4.2}. Industrial development threatens approximately 60 per cent of Indigenous lands globally, and nearly one quarter of Indigenous territories are under high pressure from resource exploitation *(established but incomplete)* {2.7}. The same issues affect local communities {3.2.1}. Demand for minerals vital to the energy transition has elevated these risks, with mining projects frequently being developed in Indigenous and local territories (*established but incomplete*) {2.7}. Some businesses led by Indigenous Peoples and local communities share communal objectives and draw on place-based knowledge, characteristics that make them more likely to have positive impacts *(established but*

incomplete) {1.2.3, 2.7.2}. Indigenous and local knowledge offers valuable lessons for businesses, including different ways of conceptualizing and understanding businesses, traditional practices, business principles and ways of operating. Community-based monitoring approaches that interweave Indigenous and local knowledge with scientific methods exist; however, uptake of these approaches by businesses is low (*well established*) {4.3.1}.

A8 Business impacts and dependencies create both risks and opportunities for businesses *(well established)*.

Biodiversity loss creates risks for businesses that may be physical (e.g., flood damage to facilities), transitional (e.g., new regulations) and systemic (e.g., macroeconomic and financial shocks). These biodiversity-related risks can interact, creating larger risks for businesses *(well established)* **(Figure SPM.4)** {1.4.2, 3.5.2, 3.5.4}. Biodiversity-related risks can have legal and financial consequences for businesses and financial institutions *(well established)* {1.2.9}. The extent to which specific businesses are exposed to risks arising from their dependencies remains understudied *(established but incomplete)* {2.5.5}. Biodiversity-related opportunities can be created by avoiding harm to biodiversity, mitigating negative impacts, delivering positive impacts and managing dependencies sustainably, including through restoration, nature-based solutions and/or ecosystem-based approaches *(well established)* {1.4.2, 2.2.4, 3.5.3}. For example, businesses may find opportunities to meet the demand for monitoring and reporting of biodiversity outcomes {3.5.3}. Such opportunities can be commercially viable and deliver positive outcomes for biodiversity and businesses and other stakeholders, such as the



	Risks ⊖	Opportunities ⊕
Impacts ■◆	1 Intensive forestry relies on pesticides with a negative impact on non-target pollinators, creating reputational risk with nearby communities 2 Furniture manufacture discharges chemicals into freshwater ecosystem, creating risk of non-compliance with permit 3 Transportation and shipping spreads invasive alien species, creating compliance risks	7 Sustainable forest management reduces soil erosion, creating an opportunity for payments for ecosystem services from nearby hydropower facility 8 Investments in the protection, restoration and sustainable use of mangroves can provide cost-effective alternatives to grey infrastructure 9 IIntroducing native trees in pastures devoted to cattle ranching increases milk production and animal well-being
Dependencies ●⬢	4 Indigenous-led fruit farm depends on wild pollinators, creating risk to crop yield if pollinator abundance falls 5 Hydropower depends on standing forest for soil stabilization and erosion control, creating risk if deforestation leads to an increase in sediment 6 Furniture manufacture value chain depends on supply of high-quality timber, creating risk if supply fails	10 Coffee farms depend on bats as predators of pests, creating an opportunity to increase yields with sustainable habitat management 11 Agriculture depends on freshwater abstraction, creating an opportunity to reduce costs through sound management 12 Ecotourism depends on endemic species, creating an opportunity to increase income through collaboration with nearby communities to manage habitat

Figure SPM 4 **Examples of the intersections between impacts, dependencies, risks and opportunities.**

opportunities arising from sustainable land management, the value of which is projected to quadruple to $737 billion by 2050 *(established but incomplete)* {1.2.10}. When businesses avoid, reduce or otherwise mitigate biodiversity-related risks, the risks can turn into opportunities *(well established)* {3.5.3}. Addressing systemic risks and taking advantage of the significant opportunities that arise with transformative change require coordinated actions that go beyond what individual businesses have incentives or resources to accomplish alone *(well established)* {1.2.6, 5.7.3, 6.1.3}. The lack of quantitative assessments of opportunities contributes to low uptake of positive actions *(established but incomplete)* {3.4.3, 5.3.2}. With information and proper incentives, businesses can address biodiversity-related impacts, dependencies, risks and opportunities and contribute to positive outcomes *(well established)* {1.4.2, 3.5.2, 3.5.3, 3.5.4, 5.6.2, 5.6.3, 5.6.4, 5.7.1}. Understanding of risks and opportunities has increased with the publication of influential global reports, such as the first Global Assessment of Biodiversity and Ecosystem Services (2019), which have contributed to the recognition of the loss of biodiversity and nature's contributions to people as a major risk to the global economy *(well established)* {1.1.2, 1.4.2, 2.4.5}.

B. Options for action by businesses, including financial institutions and other financial actors, and Governments and other actors

B1 Creating an enabling environment for transformative change requires collaborative action by Governments, financial actors, other actors and businesses themselves *(well established)*.

Current conditions are sufficient to drive some actions by some businesses, but they are not sufficient to achieve the transformative change necessary to halt and reverse biodiversity loss *(established but incomplete)* {5.1, 5.3.1, 6.1.3}. Businesses influence and are influenced by conditions created through policy, legal and regulatory frameworks, economic and financial systems, social values, norms and culture, technology and data, and capacity and knowledge *(well established)* {5.3, 5.7}. Changing these conditions, including through alternative models and measures of economic welfare, such as bioeconomy, circular economy, degrowth, post-growth, inclusive wealth and decoupling, can enable transformational action by businesses to address the underlying causes of biodiversity loss *(well established)* {5.3, 5.4, 5.6, 5.7, 6.1.2, 6.1.3}. Such an enabling environment can be created by accelerating, at all levels, individual and collaborative actions by Governments, financial institutions and other actors,[18] and by businesses themselves, through a whole-of-government and whole-of-society approach *(well established)* {5.6, 5.7, 6.1.3, 6.1.4}.

Along with changes in social values and norms, changes promoted by Governments through public policies and financial incentives could align what is considered financially material to businesses with what is considered material to biodiversity and society *(well established)* {5.3, 6.3}.

18. Including civil society, Indigenous Peoples and local communities, consumers, non-governmental organizations, international organizations and academia.

Changes in conditions to create an enabling environment will impact businesses differently depending on their scale (i.e., size of business or footprint), structure, sector, maturity and relationship with biodiversity. Informal business sectors and small, medium-sized and micro-enterprises may be resource-constrained, requiring additional support to accomplish biodiversity-related objectives *(established but incomplete)* {5.3.2}. Businesses in developing countries face additional and specific challenges, such as structural barriers, fiscal and financial constraints, the influence of vested interests, a lack of institutional frameworks, technologies and technology transfer, and the need for capacity-building, undermining their capacity to invest in the technological development and educational initiatives needed to support transformative change *(established but incomplete)* {5.3.2, 6.1.5}.

B2 Policies, laws and regulations set by Governments and financial actors can influence businesses to take actions that contribute to the conservation and sustainable use of biodiversity *(well established)*.

Governments and financial actors establish the policy, legal and regulatory environment in which businesses operate, including mandatory rules (i.e., laws and regulations) and voluntary incentives for businesses to take actions that contribute to the conservation and sustainable use of biodiversity *(well established)* {6.1, 6.2.1, 6.2.2}. Financial institutions can support the implementation of these mandatory rules and voluntary incentives *(well established)* {5.3.1, 6.3.1}. Policies, laws and regulations designed in an equitable and inclusive manner, taking into account existing international obligations and differing capabilities and levels of development, while avoiding unintended impacts on

livelihoods, are essential to supporting the conservation and sustainable use of biodiversity *(well established)* {6.3.1}. Lobbying, advocacy and engagement carried out by businesses, civil society, trade associations and Indigenous Peoples and local communities, along with electoral processes, can influence the policy, legal and regulatory environment *(well established)* {5.7.2, 6.3}.

Measures of business impacts and dependencies can be used to provide evidence for decision-making and can support policy design *(well established)* {6.3.1.1}. Types of policies that influence business actions include fiscal policies (e.g., subsidies and taxes), land-use and marine spatial planning and zoning, the issuance of permits for business activities on the basis of biodiversity criteria (including environmental impact assessments, strategic environmental assessments and national biodiversity strategies and action plans), public procurement policy, controls on advertising, the creation of standards to prevent greenwashing, the development of voluntary standards, and rules on corporate governance and disclosure *(well established)* {5.3.1, 6.3.1}. Since business activity extends beyond national borders through international value chains and global trade, regional and international policies and regulations may also be necessary *(well established)* {6.2.1}.

Governments can also promote beneficial outcomes for biodiversity and Indigenous Peoples and local communities through access and benefit-sharing arrangements (e.g., under the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization to the Convention on Biological Diversity) *(well established)* {6.3.1.5}. Patent-protected products based on biochemical substances from plants used for traditional medicine have historically generated significant revenue in the pharmaceutical and natural product industries but have not typically resulted in revenues for Indigenous Peoples and local communities, who are stewards of the knowledge associated with those genetic resources *(established but incomplete)* {6.3.1.5}.

Many current policies, such as subsidies for environmentally harmful activities, have negative impacts on biodiversity *(well established)* {5.3.2, 6.2, 6.3.1}. Businesses often lobby to keep them in place. Responsible engagement by businesses individually and collectively for ambitious biodiversity policies can help to drive systemic change, whereas lobbying against such changes to public policy can perpetuate business as usual. Public disclosure of lobbying activities is crucial for maintaining trust in the integrity of businesses *(established but incomplete)* {5.7.2, 5.7.3, 5.7.4}. Regulatory coherence across ministries and at all levels of governance is needed if harmful incentives are to be removed and biodiversity is to be addressed in sectoral policies *(well established)* {6.4.3}.

Public disclosure of business impacts and dependencies can drive greater transparency, build trust and help Governments and financial actors to enforce current laws and regulations *(established but incomplete)* {5.7.4, 6.3.1.4}. Governments and financial actors can develop consistent risk assessment frameworks and standardized reporting and promote or mandate the establishment of disclosure requirements for biodiversity-related impacts, dependencies, risks and opportunities *(well established)* {6.3.1}. The world views and approaches to materiality that underpin reporting and disclosure standards have implications for how businesses are held accountable. Integrating diverse social values can make standards more effective *(well established)* {4.6, 5.2.2, 6.3.1, 6.3.3}. Voluntary policies and business-led guidance and initiatives, such as financing principles and policies set by trade associations and commodity round tables, can supplement formal rules and help to create a level playing field across geographies, sectors and value chains *(well established)* {5.4, 5.7.2, 5.7.3, 6.3.1}.

B3 Effective economic and financial instruments can create incentives for businesses to consider the risks, opportunities, costs and benefits of their impacts and dependencies on biodiversity *(well established)*.

Financial and economic instruments can help to align returns for businesses with positive outcomes for biodiversity and society *(established but incomplete)* {5.3.1, 6.1, 6.2, 6.3.2}. Alignment requires eliminating, phasing out or reforming the financial incentives underlying biodiversity loss and scaling up positive incentives for the conservation, restoration and sustainable use of biodiversity *(well established)* {5.3.2, 6.3.2}. Governments, central banks, financial regulators and supervisors, public development banks and international financial institutions can encourage financial institutions to allocate financial services (i.e., loans, investments, insurance policies) in ways that incentivize conservation and sustainable practices while discouraging harmful activities *(well established)* {5.6.4, 6.3.2}.

Governments can promote action through economic instruments such as taxes, subsidies, payments for ecosystem services, environmental markets, and multilateral benefit-sharing mechanisms such as the Cali Fund for the Fair and Equitable Sharing of Benefits from the Use of Digital Sequence Information on Genetic Resources *(well established)* {6.3.1, 6.3.2}. Governments can reform fiscal policies by eliminating, phasing out or reforming harmful subsidies and fostering positive incentives *(well established)* {6.3.2}. Public funding can be allocated to research on and monitoring of biodiversity and nature's contributions to people, education and capacity-building, targeted actions for nature-based solutions and/or ecosystem-based approaches, and the conservation, restoration and sustainable use of biodiversity *(well established)* {6.3.2}.

Governments can promote, and financial institutions can implement, innovative instruments to finance biodiversity projects, such as green bonds, payments for ecosystem services, high-integrity biodiversity credit systems, conservation funds, and sustainability-linked loans, where appropriate *(well established)* {5.6.4, 6.3.2}. Central banks and supervisors can help to drive transparency with biodiversity-inclusive financial regulations and risk management *(established but incomplete)* {6.3.2}. Public development banks can promote investments in restoration projects through blended finance, while international financial institutions can provide technical assistance and conditional funding *(established but incomplete)* {6.3.2}. Individually and collaboratively, financial institutions have a pivotal role in mobilizing finance and reforming global and national financial systems to enable businesses to take transformative actions *(established but incomplete)* {5.6.4, 6.3.2}.

Existing financial structures often disadvantage Indigenous Peoples and local communities, creating economic and social disparities *(established but incomplete)* {6.3.2.3}. Businesses can advocate for inclusive policies and the dismantling of financial barriers, which is essential for promoting economic equity *(established but incomplete)* {6.3.2.3}. Furthermore, businesses can embrace new economic models that align with the values of Indigenous Peoples and local communities *(established but incomplete)* {6.3.2.3}.

B4 Social values and norms that shape consumer preferences and determine acceptable business behaviour can help to drive transformative change *(well established)*.

Social values, norms and culture help to determine acceptable business behaviours and play an important role in fostering transformative change *(established but incomplete)* {5.3, 6.1}. All actors play a vital role by fostering inclusivity and equity, thereby ensuring that Indigenous Peoples and local communities are involved in decision-making processes that respect free, prior and informed consent *(established but incomplete)* {5.2.2, 6.1, 6.2, 6.3.3}. Governments can promote ethical practices by regulating sustainability reporting, establishing standards, supporting compliance with access and benefit-sharing arrangements and providing incentives for businesses to adopt sustainable practices *(established but incomplete)* {5.3.1, 6.3.1, 6.3.3}.

Civil society can promote shifts in social values and consumer behaviour through education and awareness-raising, advocacy, accountability and collaboration *(established but incomplete)* {6.2}. Advocacy campaigns can raise awareness, foster sustainable consumption habits and encourage businesses to align operations with biodiversity goals *(established but incomplete)* {6.3.3.2}. By facilitating partnerships, civil society ensures that environmental and societal needs are considered *(established but incomplete)* {6.3.3.1}. Civil society and non-governmental organizations can increase transparency and accountability *(established but incomplete)* {6.3.1}. Civil society also plays a key role in developing effective monitoring strategies and verification systems *(established but incomplete)* {6.3.4.1}. For example, campaigns can support widespread responsible business, lending and investment practices by pressuring financial institutions to improve their engagement strategies and avoid financing harmful activities *(established but incomplete)* {6.3.1, 6.3.3}. Businesses can use social signalling to influence consumer choices and social norms *(established but incomplete)* {5.4.4}. All actors have a role to play in promoting sufficiency and shifting away from unsustainable consumption patterns towards sustainable lifestyles and business models *(established but incomplete)* {5.6.1}.

In many countries, mechanisms for Indigenous Peoples and local communities to overcome unequal power structures, engage in policy advocacy and participate fairly in business activities are currently insufficient to ensure that businesses follow the communities' procedures of collective governance *(established but incomplete)* {5.3.2, 6.2, 6.3.3}. Businesses that depend on or impact biodiversity within the territories of Indigenous Peoples and local communities can adopt policies that guarantee that their decision-making processes are inclusive *(established but incomplete)* {5.6.1, 5.6.2, 6.3.3.1, 6.4.7}. Such mechanisms would allow the concerns of Indigenous Peoples and local communities in relation to potential business impacts and dependencies to be incorporated into business targets and strategies *(established but incomplete)* {2.7.2, 5.6.1, 6.3.3.1}.

All stakeholders, including businesses, can benefit from aligning their operations with social values, norms and culture by respecting cultural traditions and emphasizing stewardship of biodiversity *(established but incomplete)* {5.3.1, 6.3.3}. Engaging with Indigenous Peoples and local communities allows businesses to interweave Indigenous and local knowledge into their operations, fostering mutual respect and supporting positive outcomes *(established but incomplete)* {6.3.3}. Partnerships with Indigenous Peoples and local communities can emphasize the relational values of nature and highlight the long-term impacts of current management decisions *(established but incomplete)* {5.7.3, 6.3.3.1}.

B5 The generation, use and sharing of data and the leveraging of technology can create new opportunities for businesses to act *(well established)*.

Governments can conduct biodiversity monitoring and collect and provide access to robust biodiversity data, including by leveraging multiple available technologies

such as Earth observation and artificial intelligence, while accounting for the methodological limitations of those technologies *(established but incomplete)* {1.5.4, 5.3.2, 6.3.4.1}. Within the legal frameworks in which they operate, Governments can also facilitate biodiversity monitoring and intelligence systems, such as the biodiversity forecasting toolkit implemented in New South Wales, Australia, or the biodiversity information system implemented in Malaysia (*well established*) {5.6.2, 6.3.4.3}. The leveraging of technology and sharing of data by Governments can support the implementation of multilateral agreements, such as the Convention on Biological Diversity *(well established)* {6.3.1}.

Governments, businesses, financial institutions and other actors, such as academia and non-governmental organizations, can collaborate to develop trusted and streamlined data governance and infrastructure that enable data-sharing across value chains and with financial institutions. In this context, businesses can play a catalytic role by making biodiversity data and tools publicly accessible as shared resources, including through pre-competitive collaboration on technology and data *(established but incomplete)* {5.7.2, 5.7.3, 6.1}. Businesses and financial institutions can generate, use and share data and leverage technology to support impact assessments, and they can generate and use models that integrate biodiversity and nature's contributions to people into economic and financial approaches *(established but incomplete)* {5.6.4, 5.7, 6.3.4.4}. Standard-setting bodies can use data and technology to promote transparency and consistency across sectors and countries by guiding businesses to disclose biodiversity impacts, for example by developing comparable accounting methods and disclosure frameworks that reflect different ecological and regional contexts and go beyond profit and financial materiality *(established but incomplete)* {5.4, 5.7.3, 6.3.4.2}. Civil society can drive transparency through biodiversity monitoring and reporting. Campaigns and collaborations can raise awareness and combat misinformation while promoting responsible biodiversity practices through accessible data resources *(established but incomplete)* {6.3.4.1}. Many of these approaches are already being implemented through existing tools, initiatives and experiences *(well established)* {1.4.1, 5.6, 5.7, 6.3}.

Indigenous Peoples' and local communities' deep-rooted knowledge of local ecosystems and the development of modern data collection and analysis tools can enable a dynamic system for monitoring biodiversity *(established but incomplete)* {6.2, 6.3.4.1}. Access to technology can also help Indigenous Peoples and local communities to monitor environmental changes, conduct environmental impact assessments of business activities on their territories, participate in the analysis of risks and opportunities and support greater accountability by asserting their rights and claims *(established but incomplete)* {6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4}. Civil society plays an important role in generating data, knowledge and capacity, for example through citizen-based approaches, recognized in some countries as citizen science *(well established)* {1.5.5 6.2.2.4}.

B6 Enhanced capacity and knowledge across actors can support the measurement of impacts and dependencies by businesses and guide business actions *(well established)*.

Governments and businesses can play a pivotal role in facilitating capacity-building (i.e., education, training programmes and public awareness campaigns) tailored to specific audiences and geographical contexts. They can also stimulate access to measurement tools and facilitate open-source and location-specific data on biodiversity *(well established)* {6.3.5.1}.

Civil society and academic institutions can enhance capacity by fostering education and can provide diverse perspectives to bridge the gap between businesses, Governments and various groups, such as young people and Indigenous Peoples and local communities, to ensure mutual understanding and engagement *(established but incomplete)* {6.3.5.1, 6.3.5.2}. Public awareness campaigns aimed at consumers can provide information to support sustainable patterns of consumption *(established but incomplete)* {6.3.3}.

Financial actors and financial institutions can complement capacity-building efforts through technical assistance programmes, risk mitigation tools and fiscal instruments *(established but incomplete)* {6.3.5.1}. In addition, public development banks could lead by example, supporting strategies and planning initiatives that mainstream biodiversity considerations into financial policies and investments, effectively building the capacity of financial institutions and businesses to act sustainably *(well established)* {6.3.5.1}.

Education and capacity-building programmes for businesses, communities and civil society can be tailored to the needs, realities and knowledge systems of Indigenous Peoples and local communities *(well established)* {6.3.5.3}. Establishing such programmes can raise awareness of Indigenous and local knowledge and empower individuals and communities to engage in decision-making processes related to business activities *(well established)* {6.3.5.3}. Indigenous Peoples and local communities are vital actors with regard to intercultural competencies; businesses can therefore benefit from involving these communities in their training programmes *(well established)* {6.3.5.2}.

B7 All businesses have a responsibility to act and can take further action within an enabling environment *(well established)*.

Transformative change requires action by all businesses *(well established)* {1.1.2, 5.1, 6.1.2, 6.1.4}. The responsibility of individual businesses to act can be determined by reference to globally agreed goals, national contexts (including policies, laws and regulations) and the impacts and dependencies of business on biodiversity. Globally agreed goals, such as Target 15 of the Kunming-Montreal Global Biodiversity Framework, include specific requirements for large and transnational businesses and financial institutions to act. Those requirements reflect the fact that responsibility is not evenly shared among businesses *(established but incomplete)* {5.2.2}. The current level of business action is insufficient for transformative change, in part because the enabling environment is missing *(well established)* {5.1, 6.1.5}. An effective enabling environment would set clear expectations about who must act, where action is required and at which locations, and which biodiversity outcomes need to be achieved {1.5, 6.3}. While these conditions are not yet fully in place, some businesses are taking incremental action, motivated by a range of factors *(well established)* {5.1, 5.5, 5.6}.

Businesses' motivations to act include intrinsic factors, such as moral norms, in their internal culture and leadership, and instrumental factors, such as attracting and retaining their workforce and the internal imperative to respond to their biodiversity-related risks and opportunities *(established but incomplete)* {5.3.1}. Whether such motivations exist depends on the socioecological context in which businesses operate *(well established)* {2.2.3, 2.2.4, 5.3}. Minor changes in context, such as changes in the cost of raw materials, the regulatory regime, the state of biodiversity or in the availability of or access to information, can change the motivations for business actions *(established but incomplete)* {5.3.1}. Transformative change under an appropriate enabling environment would align profitable business actions with what is good for biodiversity and society *(well established)* {1.5, 6.1.2, 6.1.3}. Creating this enabling environment would result in businesses and financial institutions being positive agents of change in transforming to a just and sustainable economic system *(well established)* {1.5, 5.3.2, 6.1.4}.

B8 Businesses can take actions to address their impacts and dependencies, contribute to an enabling environment and influence others *(well established)*.

Actions are needed by all businesses, including private financial institutions. Priorities differ according to a business's size, sector, structure, relationship with biodiversity, location where outcomes can be achieved most effectively, and degree of control and influence over stakeholders *(established but incomplete)* {5.2, 5.6, 5.7}. Signalling to inspire others requires businesses to provide robust, transparent and credible reporting of actions and outcomes *(well established)* {5.7.4}.

Actions can be pursued across the four decision-making levels at which biodiversity impacts and dependencies are measured: corporate, operations, value chain and portfolio (*well established*) {5.5, 5.6, 5.7}. Close links exist between actions implemented across decision-making levels; for example, targets set at the corporate level drive actions and outcomes at the operations and value chain levels *(well established)* {5.6, 5.7}. Across all decision-making levels, actions can be taken individually or collectively, including through partnerships (e.g., public-private partnerships) *(established but incomplete)* {5.7.2, 5.7.3} **(Figure SPM.5)**.

B9 Corporate-level action sets directions, aligns governance and resources with ambitions and enables implementation and outcomes across operations and value chains *(well established)*.

Businesses can establish ambitious, outcome-oriented biodiversity commitments and targets and integrate them into corporate strategy *(well established)* {5.6.1}. Biodiversity targets are more effective when their development and implementation take into consideration a business's impacts and dependencies on biodiversity and nature's contributions to people, and when they are aligned with national and global biodiversity objectives (including the three objectives of the Convention on Biological Diversity, as well as the 2050 Vision for Biodiversity) *(established but incomplete)* {2.8, 5.6.1}. Businesses can also create and revise internal policies and standards, including on procurement, incentives, investment, access and benefit-sharing, product and service design and use, marketing, stakeholder engagement and grievance mechanisms, and management systems for biodiversity measurement, monitoring, reporting and disclosure. Policies can support corporate accountability more effectively when they are paired with accounting frameworks that integrate biodiversity, alongside standardized disclosure mechanisms for businesses to report their impacts, dependencies, risks and opportunities *(established but incomplete)* {4.6.1, 5.6.1, 5.7}. Effective delivery requires shifts in corporate governance and resourcing – which have typically prioritized financial returns and profit maximization for shareholders – towards purpose-oriented models that broaden accountability to other stakeholders. Those shifts depend on aligning shareholder and societal interests, providing appropriate incentives for directors and managers, and adequate resource allocation *(established but incomplete)* {5.6.1}. The adoption of innovations and new technologies that address business impacts and dependencies – in products, processes and services – can improve outcomes for biodiversity across operations and value chains. Examples include circular

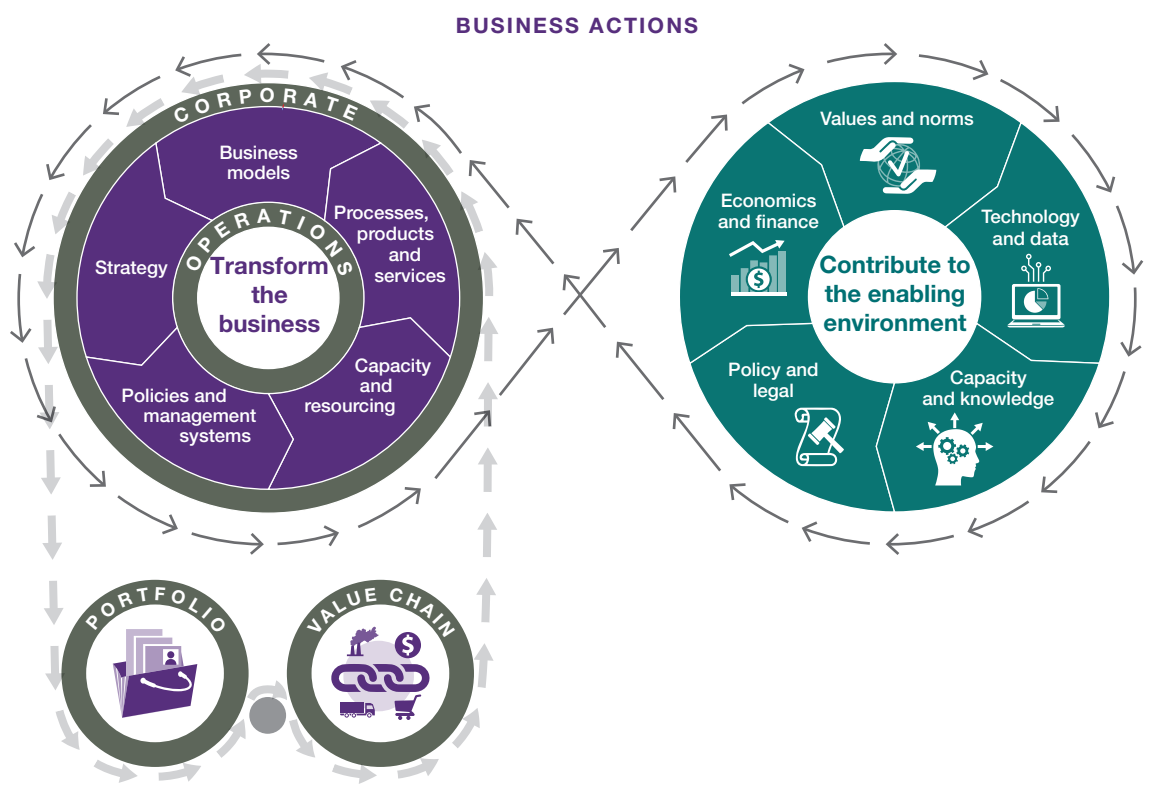


Figure SPM 5 **Actions by businesses to address their impacts and dependencies and contribute to creating an enabling environment.**

At the corporate level, businesses can set strategy, design policies and management systems, allocate capacity and resources, introduce innovative processes, products and services, and explore alternative business models. These measures can facilitate actions at the operations, value chain and portfolio levels and can contribute to creating an enabling environment. Business actions and the enabling environment continue to influence each other.

economy approaches focused on product durability and extension of product lifespans *(well established)* {5.6.1}. In addition, businesses can adopt policies to facilitate investment in biodiversity beyond their operations and value chains, including through high-integrity biodiversity credits. Finally, businesses can explore alternative business models that align with global biodiversity goals and targets and contribute towards a just and sustainable future. This can be done, for example, by shifting ownership to non-investor stakeholders, changing governance rights and decision-making power, or adopting legal forms that establish accountability for stakeholders *(established but incomplete)* {5.6.1}.

Corporate-level actions can benefit from being informed by data generated through the measurement of biodiversity and nature's contributions to people *(established but incomplete)* {4.6.1, 5.6.1}. While such information can guide and improve outcomes, many corporate-level actions can also be implemented immediately, despite incomplete data, especially when designed and implemented through meaningful engagement with internal and external stakeholders *(established but incomplete)* {5.5, 5.6.1}. Such engagement supports knowledge acquisition, democratic environmental governance and improved corporate legitimacy. Engagement can build staff capacity and board-level environmental leadership, gather diverse perspectives on biodiversity values and actions, and provide input on strategy, target-setting and the assessment of impacts and dependencies. It can also establish requirements and commitments with regard to auditing, monitoring and performance assessment *(established but incomplete)* {2.8, 4.6.1, 5.5, 5.6.1}.

B10 Improving transparency, traceability and collaborative action in the value chain can help businesses to address impacts and dependencies *(well established)*.

For many businesses, especially those that rely on raw materials, significant impacts and dependencies on biodiversity and nature's contributions to people accrue

across value chains *(well established)* {2.2.3, 3.2.2}. Businesses can adopt approaches that emphasize integration across value chains and can collaborate with suppliers and customers *(established but incomplete)* {5.6.3}. Businesses can start by mapping value chains (considering actors and inputs) and improving traceability by linking products and materials to specific suppliers, locations and impacts. Doing so can help them to identify risks and prioritize actions, although mapping beyond direct suppliers often remains challenging *(established but incomplete)* {5.6.3}. Examples at the corporate and value chain levels exist, such as companies in the chocolate industry that have made advances in recording biodiversity dependencies to improve business decisions through full traceability of materials and improved supplier control mechanisms *(established but incomplete)* {5.6.3}.

Once value chains are mapped, businesses can communicate expectations to suppliers, monitor performance and exercise due diligence, including addressing non-compliance *(established but incomplete)* {5.6.3}. Approaches that incentivize environmental performance and build long-term relationships and supplier capacity through training, knowledge exchange and innovation are often effective at improving outcomes and can be particularly critical for small businesses with limited resources *(established but incomplete)* {5.6.3, 5.7.3}. Effective value chain management requires businesses to go beyond procurement requirements, data collection and due diligence and engage in close, sustained collaboration and capacity-building with suppliers. This may include Indigenous Peoples and local communities, smallholder producers, and small and medium-sized enterprises, which often face limited institutional capacity and resources. Integrating communities into value-creation activities such as sourcing, production and distribution has been identified as a success factor in sustainable value chain management *(established but incomplete)* {5.6.3}. Consumer-facing strategies such as product labelling, education, incentives and post-purchase engagement can shape behaviour and improve transparency, but their effectiveness is constrained by consumer scepticism, certification costs and business models that rely on unsustainable consumption *(established but incomplete)* {5.6.3, 5.7}.

B11 Businesses can act at the operations level to address impacts and dependencies of their activities *(well established)*.

Businesses can use robust environmental and social impact assessments and management plans at ecologically meaningful scales to inform decisions on where to locate and how to manage operations. Those assessments can be supported by credible monitoring of both business actions and biodiversity outcomes within an adaptive management cycle *(well established)* {4.4, 5.6.2}. To deliver lasting outcomes on the ground, businesses can apply the mitigation hierarchy: first avoiding harm to biodiversity, then minimizing harm, restoring biodiversity, and offsetting residual impacts to achieve "no net loss" – and preferably a net gain – in biodiversity and nature's contributions to people. Later-stage measures such as restoration and offsetting are typically more costly and uncertain, and less effective at returning biodiversity to baseline conditions, reinforcing the need to prioritize early-stage avoidance and minimization *(well established)* {5.6.2}. Although the mitigation hierarchy is recognized as leading practice, adoption remains incomplete, in part because many business activities and impacts fall outside regulatory requirements *(well established)* {5.6.2}. Very few operations have achieved "no net loss" or shown that they have the capacity to do so *(well established)* {5.6.2}. Monitoring requires sector-specific metrics linked to targets; yet reporting often lacks data for independent verification *(well established)* {5.6.2}. Analyses should also consider displacement (or "leakage") of impacts, where actions at one operation shift pressures on biodiversity elsewhere *(well established)* {5.6.2}. In addition, opportunities at the operations level exist for businesses to go beyond impact mitigation to engage in landscape conservation, restoration and sustainable management *(established but incomplete)* {5.5, 5.7.1, 5.7.2}.

Meaningful engagement of stakeholders and Indigenous Peoples and local communities before, throughout and after the closure of business activities is essential to building trust, aligning actions with local and national priorities and recognizing applicable rights *(well established)* {5.6.2.4}. For example, when establishing or significantly changing their activities, businesses should recognize and respect the free, prior and informed consent of Indigenous Peoples and local communities, along with their respective rights in accordance with national legislation.

Indigenous and local knowledge can inform baselines and monitoring, recognize the multiple values of nature and improve the design of mitigation measures and business practices, with long-term socioeconomic and environmental benefits. However, such integration remains rare in practice *(established but incomplete)* {2.7.2, 3.3.1, 4.6.2, 5.6.2}.

B12 Financial institutions can shift finance away from harmful activities and towards business activities with positive impacts on biodiversity *(well established)*.

In addition to actions that apply to all businesses, financial institutions can play a pivotal role in fostering business transitions to align with biodiversity goals. The actions and their influence on biodiversity outcomes vary across financial institutions (i.e., lenders, investors and insurers), but all have a role in redirecting financial flows to support biodiversity outcomes. Through "financing green" and "greening

finance" approaches, financial institutions can, respectively, shift capital flows towards business activities with positive impacts and away from businesses with negative impacts on biodiversity and nature's contributions to people *(established but incomplete)* {5.6.4}.

Financial institutions can establish and communicate the criteria for their decisions to lend to, invest in and insure businesses *(well established)* {5.6.1, 5.6.4}. Decisions taken on the basis of these criteria benefit from information provided by the specific and robust measurement and disclosure of impacts, dependencies, risks and opportunities *(well established)* {4.4.1, 4.4.2, 5.6.4}.

Financial institutions can influence actions across their entire portfolio through capital allocation and stewardship strategies by engaging with clients to align practices with biodiversity targets, exercising voting rights and excluding or divesting from harmful activities *(well established)* {4.1.2, 4.4.1, 5.6.4}. Recognizing the need to support business activities, financial institutions can also engage with businesses to foster actions that improve performance or support the transition of their activities. This is particularly true for places and activities in which both upfront investments and risks are substantial, such as in small- and medium-sized enterprises working towards the conservation and sustainable use of biodiversity *(well established)* {6.4.3}.

In addition to shifting financial flows away from negative activities, financial institutions can deploy instruments and strategies, such as blended finance, impact investing and green or sustainability-linked bonds, to provide capital to businesses engaged in conserving, restoring or sustainably using biodiversity. Financial institutions can also make contributions to initiatives such as the Global Biodiversity Framework Fund *(established but incomplete)* {5.6.4.5, 5.6.4.6, 5.6.4.7}.

B13 Barriers to businesses and others taking action persist, with considerable variation across national and sectoral contexts *(well established)*.

Barriers to action exist for all groups of actors **(Table SPM.4)**. These barriers do not affect all actors equally and may disproportionately affect small and medium-sized enterprises and financial institutions in developing countries *(well established)* {5.3.2, 5.4, 5.6}. Action is limited by systemic barriers such as profit-driven business models, as well as economic systems that measure progress in gross domestic product, weak policy incentives, limited access to financial resources, and data or knowledge gaps, including a lack of quantitative and comparable measurements of business impacts (*well established*) {3.6.3, 5.3.2}. Business-led initiatives have emerged to address some of these barriers, but they tend to focus on large companies and may emphasize disclosure over the need to deliver tangible biodiversity outcomes. Unclear and uncertain expectations from consumers, investors and Governments hinder consistent and credible business contributions to global biodiversity goals and targets *(well established)* {5.3.2}.

Table SPM 4 **Examples of barriers to action across components of the enabling environment.**

Component of enabling environment	Barriers to action
Policy and legal	• Weak or inconsistent biodiversity policies or political will (e.g., lack of ambition or specificity to guide business action) • Lack of regulations mandating the disclosure of biodiversity-related impacts, risks and opportunities • Regulatory fragmentation across jurisdictions • Contradictory regulatory injunctions • Lack of regulations to address nature-related risks in the financial sector • Weak enforcement of rules • Undue influence of negative corporate lobbying • Corruption and illegal activity • Pressure to deliver quick results • Absence of a level playing field
Economics and finance	• Short-term profit orientation and limited financial incentives to take actions with long-term outcomes • Fiduciary duty limitations – executive mandates that do not include environmental and social considerations • Perverse incentives that do not internalize impacts on biodiversity • Weak or absent penalties for causing biodiversity decline (i.e., no obligation to restore, recover or reverse damage caused) • Limited financial resources for investments to improve outcomes for biodiversity, especially for small- and medium-sized enterprises • Weak capacity to assess the stock and flow of natural capital and to assess the various values (including economic) of ecosystem services • Failure to take negative externalities into account

Table SPM 4

Component of enabling environment	Barriers to action
Values and norms	• Conflicting priorities of groups in civil society • Weak societal pressure on businesses to provide positive actions for biodiversity or reduce harm to biodiversity • Unclear expectations of business among consumers, investors and Governments • Entrenched organizational culture and fragmented accountability for biodiversity within businesses • Limited custodianship and recognition of the rights of Indigenous Peoples and local communities • Power imbalances that limit or compromise the potential for cooperation among multiple actors
Technology and data	• Lack of access to technology, data, models and scenarios, knowledge regarding their use and incentives and regulation to increase their uptake • Poor data quality • Inconsistent metrics and proliferation of guidance that creates confusion • Weak data-tracking systems within businesses • Lack of access to scientific information • Absence of methods for businesses to disaggregate global biodiversity goals at a resolution sufficient to support effective decision-making and to enable businesses to act
Capacity and knowledge	• Limited awareness of impacts and dependencies of businesses on biodiversity (e.g., investor knowledge gaps) • Limited capacity, knowledge and skills for taking effective action • Low uptake of tools by businesses • Lack of visibility and transparency in the operations of businesses and across value chains • Limited information about links between business actions and biodiversity outcomes

Traceability {1.1.2, 1.3, 1.5.2, 2.5.5, 4.5.3, 5.2.2, 5.3.1, 5.3.2, 5.4, 5.6, 6.3, 6.4}

C. Measuring businesses' impacts and dependencies on biodiversity and nature's contributions to people

C1 Many different methods and metrics are available. This diversity is needed to measure the impacts and dependencies of businesses on biodiversity and nature's contributions to people *(well established)*.

Different aspects of biodiversity and nature's contributions to people require different metrics and methods of measurement: no single metric or method can be used to measure all impacts and dependencies across all sectors and locations *(well established)* {2.3, 2.4, 3.3, 4.1, 4.2, 4.4}. Methods vary in their ability to capture impacts and dependencies by location, within sectors and along the value chain, and to account for cumulative impacts **(Table SPM.5)** *(well established)* {2.3, 2.4, 3.3}. Methods can be grouped into categories of macro-scale environmental economic models, life-cycle approaches, spatial analysis, participatory mapping and monitoring, and location-based observations (*well established*) {2.3, 3.3, 4.2}. These approaches use different types of metrics for impacts and dependencies, including metrics for assessing the condition and significance of a location in terms of biodiversity (for both species and ecosystems) and metrics for assessing the potential and actual flow of nature's contributions to people and human well-being, reflecting different values of nature *(well established)* {3.3, 4.2}. Monetary and quantitative and qualitative non-monetary valuation methods, including sociocultural valuation, can be applied in order to understand the consequences of impacts and dependencies for aspects of human well-being *(well established)* {2.3.4, 2.3.5, 3.3, 4.6.1}. Methods are frequently used in combination to improve the accuracy or extend the coverage of measurements *(well established)* {2.4.1, 3.3, 4.2.3}. The choice of methods and metrics used has implications for representing the diverse values of nature *(well established)* {2.3, 2.4, 3.3, 4.3.2, 4.6}.

Methods need to be selected carefully, ensuring their fitness for the individual business purpose for which they are being applied *(established but incomplete)* {4.2, 4.4}. Fitness for purpose depends on coverage, accuracy and responsiveness *(well established)* {2.3, 2.4, 3.3, 4.4}.

The coverage of a method refers both to its geographical coverage and to the extent to which it includes impacts and dependencies on biodiversity and nature's contributions to people *(established but incomplete)* {4.2.1}. To be considered fit for purpose, a method needs to cover all relevant pressure types and impacts and dependencies of a

Table SPM 5 **Examples of applications of methods for assessing business dependencies and impacts.**

Sociocultural and monetary valuation methods, integrated approaches and accounting frameworks can also support assessment of dependencies and impacts {Table 2.2, Table 3.1, 4.6}.

Method categories	Dependency assessment examples {Table 2.2}		Impact assessment examples {Table 3.1}	
Location-based observations	Primary data from smallholder farms in South America was used to assess how natural pollination affects coffee fruit set.		Satellite imagery was used to quantify the direct and indirect impacts of industrial mines on deforestation across the global tropics.	
	Small-scale farmers and fishers used visual surveys to gauge the richness, evenness and relative dominance of species.		Field sampling was used to measure the abundance and diversity of birds, plants, insects and spiders across crop fields of varying sizes in North America.	
Participatory monitoring and mapping	Local fishing communities in West Africa, as key stakeholders representing Indigenous Peoples and local communities, collaborated with researchers to map and assess fisheries, revealing how artisanal fishing businesses depend on healthy coastal and mangrove habitats.		Participatory mapping identified potential impacts of offshore wind farms on local fisheries and marine biodiversity in South America.	
	In South-East Asia, Indigenous Peoples and local communities and a mariculture enterprise co-mapped marine nature's essential contributions to people in order to demonstrate their shared reliance on healthy reefs and mangroves, guiding more inclusive and sustainable resource management.		Community monitors and scientists collaborated to assess water pollution and its impacts downstream of a coal mine in Southern Africa.	
Spatial analysis	The acreage of medicinal plant resources in North-East Asia was identified and classified to illustrate industry dependence on specific plant habitats and ecosystem productivity.		Different potential power line routes were overlaid with environmental and social data layers to measure the routes' impacts on ecologically sensitive and socially complex areas in Southern Africa.	
	Machine-learning models project shifting areas for grape cultivation in Central and Western Europe, highlighting the wine sector's reliance on biodiversity-driven climatic and soil conditions.		Global modelling of biodiversity and nature's contributions to people was combined with asset locations to quantify the direct impacts of corporate assets from over 2,000 businesses.	
Life-cycle approaches	Dependency of rice production systems on water provisioning, as well as dependencies on carbon sequestration, water quality and air quality regulation in South Asia, North-East Asia and North America.		Life-cycle assessment and environmentally extended multi-regional input-output models were combined to estimate biodiversity impacts across a global set of 3,000 businesses.	
			Life-cycle assessment was integrated with spatial modelling to assess the impacts of alternative feedstock sources for bioplastics from South and North America on biodiversity and nature's contributions to people.	
Macro-scale environmental economic models	Agricultural dependency on pollination was estimated to outweigh the abatement costs of several measures to protect pollinators in Central and Western Europe.		Nested multi-regional input-output models were used to quantify the impacts of beef production on threatened animal species in Oceania through local and global supply chains.	

Purpose of measurement

Screening: identifying priorities requiring further analysis or action.

Tracking potential changes in impacts/dependencies: measuring change in pressures over time as part of an impact assessment, or the change in reliance of business activities on nature's contributions to people over time as part of a dependency assessment.

Comparing options: evaluating potential impacts and dependencies of business activities relative to alternatives.

Observing change in nature: showing positive or negative changes in biodiversity and nature's contributions to people that can be attributed or linked to business activity or action on biodiversity

business on biodiversity and nature's contributions to people at relevant geographical and temporal scales *(established but incomplete)* {4.2.1}.

Accuracy is the degree to which results correctly describe what they are designed to measure *(established but incomplete)* {4.2.1}. The accuracy necessary for a method to be considered fit for purpose varies by application *(established but incomplete)* {4.2.1}. Many business decisions do not require highly accurate results, provided that the results are directionally correct *(well established)* {4.4}. For example, if a method provides adequate information on the relative biodiversity impacts of two raw materials, it can enable a decision on the choice of one material over the other. Methods based on modelling approaches (e.g., multi-regional input-output modelling, life-cycle approaches and spatial modelling) can sometimes provide a false sense of accuracy not supported by the level of detail of the underlying data or models; these shortcomings can be addressed by the use of data generated through bottom-up methods (e.g., location-based observations and participatory mapping and monitoring) (*well established*) {4.4}. Understanding the limitations of the results of different methods would assist decision makers in avoiding ill-informed or incorrect decisions *(well established)* {4.4}. Guidelines and capacity-building could help businesses to correctly interpret results from different methods, thereby ensuring that they adequately inform action *(established but incomplete)* {4.5}.

Responsiveness is defined as the ability of a method to link business actions to changes in biodiversity or nature's contributions to people *(well established)* {4.2}. Responsiveness is particularly important for tracking change in pressures as part of an impact assessment, or reliance on biodiversity as part of a dependency assessment, and for detecting changes over time in response to business activities or actions *(well established)* {4.4}. Attribution of observed changes in biodiversity or nature's contributions to people to business activities should use baselines and counterfactuals, and account for time lags, indirect effects and variation in background conditions *(well established)* {4.2, 4.4, 5.2.1}.

C2 Methods exist to support all business decisions, and appropriate methods can be selected according to purpose and decision-making level *(well established)*.

Determining the appropriate measurement approaches for different decision contexts requires consideration of the four main purposes of measuring biodiversity **(Table SPM.6)** alongside the four business decision-making

Table SPM 6 **Purposes of measurement and examples of applications.**

Purpose of measurement		Examples of applications
Screening	Identifying priorities requiring further analysis or action	• Investment portfolios • Products or business lines • Types of material or supply chain • Operational locations
Comparing options	Evaluating potential impacts and dependencies of business activities or decisions relative to alternatives	• Portfolio manager choosing individual securities for an investment fund • Businesses choosing types of raw material for products or a specific supplier • Businesses assessing the relative impact of proposed new acquisitions • Businesses choosing sites for operations
Tracking change in potential impacts and dependencies	Measuring the change in pressures over time as part of an impact assessment, or the change in reliance of business activities on nature's contributions to people over time as part of a dependency assessment	• Asset manager tracking changes in the overall biodiversity footprint of an investment portfolio over time • Credit analyst assessing changes in businesses' risk profiles • Businesses assessing changes in their biodiversity footprint • Businesses tracking changes in the extent of potential dependencies on biodiversity and nature's contributions to people
Observing changes in biodiversity	Noting positive or negative changes in biodiversity and nature's contributions to people that can be linked to business activities or action on biodiversity	• Businesses measuring changes in ecosystems at a site • Businesses measuring changes in nature's contributions to people linked to operations • Governments measuring the extent and quality of ecosystems in an agricultural landscape • Non-governmental organizations measuring changes in species populations

levels **(Figure SPM.6)**. Location-based observations (including relevant maps and remote sensing) can inform biodiversity assessments at the operations level for all business purposes, often with existing data, but may require significant data gathering to inform decisions requiring greater geographical coverage (e.g., decisions that affect value chains, corporate strategies and portfolios) *(well established)* {4.4}. As a result, decisions at those levels often rely on aggregate metrics and proxies *(well established)* {4.4}. Bottom-up methods, such as location-based observations and participatory mapping and monitoring, that make use of primary data collection to populate a wide set of metrics and integrate local specificities can effectively represent the diverse values of nature (*well established*) {4.4}. Aggregate metrics,[19] which are outputs of top-down model-based methods, are not appropriate for measuring changes in biodiversity outcomes at specific sites, for decisions affecting specific sites or for selecting specific investments *(well established)* {4.4}.

19. Such as "mean species abundance" or "potentially disappeared fraction of species".

C3 Business uptake of impact and dependency measurements and disclosure is currently limited *(well established)*.

While many methods of measuring impacts and dependencies are available, a lack of necessary internal capacity or financial resources may limit the ability of businesses to apply them, with implications for equity and participation across countries and actors *(established but incomplete)* {4.5.3, 5.3.2}. Business uptake may be limited by the perceived complexity of biodiversity and nature's contributions to people, which cannot easily be measured by a single approach or metric, but requires a combination of multiple methods and metrics *(established but incomplete)* {4.5.3}.

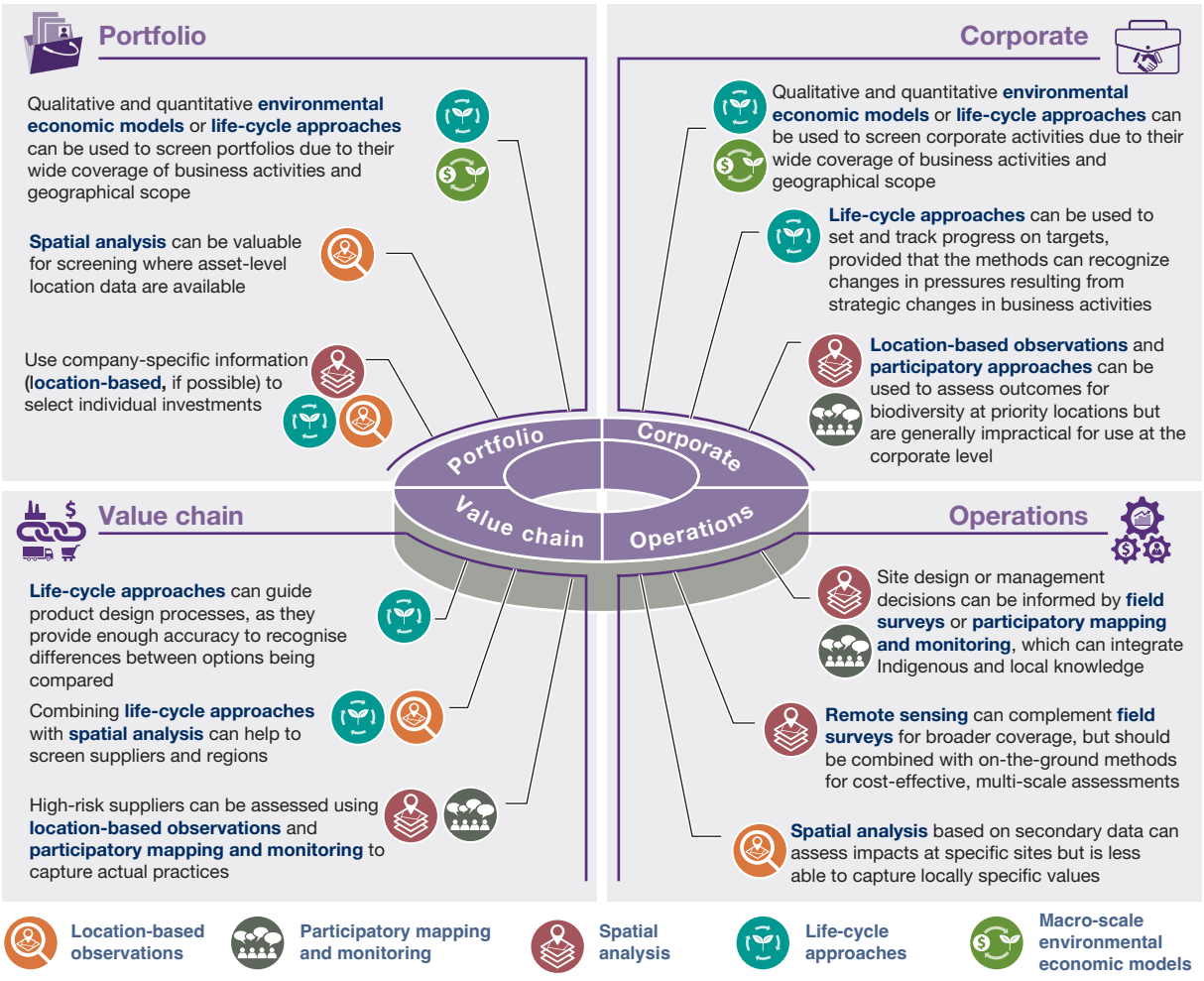


Figure SPM 6 **Examples of appropriate measurement approaches at different decision-making levels.**

Less than 1 per cent of publicly reporting companies mention their impacts on biodiversity in their reports, although the number doing so is growing in response to recent reporting and disclosure standards and frameworks *(well established)* {4.5, 5.4}. Factors limiting measurement and reporting include motivational, institutional and resource-related barriers *(well established)* **(Table SPM.4)** {4.5.3}. Biodiversity impact and dependency assessments require expertise and can be costly to perform *(established but incomplete)* {4.5.1, 5.3.2}. There are currently few incentives for businesses to measure and disclose their impacts and dependencies *(established but incomplete)* {4.5.3}. Business uptake is influenced by regulatory demands, financial factors and reputational considerations. Sectors subject to site-level regulations, such as mining, conduct more biodiversity impact assessments than other sectors *(well established)* {4.5.3}. Financial institutions report more often than other sectors, likely driven by the existing and anticipated regulatory requirements mandating disclosures related to biodiversity and climate change *(well established)* {4.5.3}. Larger uptake could also be explained by the availability of tools created specifically for the financial sector *(established but incomplete)* {4.5.3}.

High-profile dependency assessments at the portfolio level have been conducted by central banks and financial institutions in an effort to understand exposure to nature-related financial risk (*well established*) {2.5.3, 4.2.4}. Central banks in at least eight countries and the European Central Bank have analysed the exposure of financial institutions to dependencies on biodiversity through their financing activities *(well established)* {2.5.3}. The analyses have raised awareness in the financial sector *(well established)* {2.5.3, 4.5.3}. However, those analyses do not differentiate between investments within sectors, consider the capacity of ecosystems to provide nature's contributions to people, or address change over time. To date, there has been limited uptake of the outputs of those assessments *(well established)* {2.5.3, 2.5.5, 4.5.3}. A recent survey among financial institutions representing 30 per cent of global market capitalization revealed that the three most-cited barriers to the uptake of nature-related risk assessment and management are access to reliable data, access to reliable models and access to scenarios *(established but incomplete)* **(Table SPM.4)** {2.5.5}.

C4 Site-specific location and activity data are needed for operations and value chains to improve impact and dependency assessments *(well established)*.

Because the impacts and dependencies of businesses on biodiversity are site-specific, information on the location of business activities and assets and on sourcing locations is needed to accurately measure the impacts and dependencies of business operations and value chains *(well established)* {2.2, 2.3, 2.4, 3.2, 3.3, 4.3, 4.4, 4.5.1, 4.5.2}. While some data exist that can assist operations-level decision-making, there are gaps in the availability and accessibility of those data and information on the origin of input materials (including genetic resources) used by specific businesses, especially in value chains. The gaps are due to traceability limitations, as many resources are traded and exchanged multiple times along the value chain *(well established)* {2.3, 4.4.4, 5.3.2, 5.6.2, 5.6.3}. Such knowledge gaps present a significant barrier to efforts by businesses to understand the full scale of impacts along their value chains, reducing the visibility of risks and inhibiting action to support improved practices at specific locations *(established but incomplete)* {4.4.3, 5.3.2, 5.6.3, 5.6.4.2}. To go beyond screening and begin measuring outcomes, information on practices (e.g., agricultural practices, mining methods and manufacturing techniques) at specific sites is also needed *(established but incomplete)* {4.4}. Currently, information on locations and associated management practices is not commonly collected or reported *(well established)* {4.4, 4.5}.

C5 Consistent scenario planning with regard to impacts and dependencies on biodiversity and nature's contributions to people can be used for coherent analysis of risks and opportunities *(established but incomplete)*.

Scenarios offer an opportunity for businesses to plan for possible futures and gain information about potential risks and opportunities arising from changes in biodiversity and nature's contributions to people *(well established)* {3.6.2, 4.2.4}. Uptake of scenario planning, however, remains low at all scales *(well established)* {4.2.4}. Information on likely future biodiversity trends and a variety of scenarios and models exist and could be used by financial institutions to take forward-looking decisions and predict future performance *(well established)* {2.2, 2.4.2, 2.5.5, 4.2.4}. Efforts to analyse short-term scenarios for extreme events, such as a complete loss of nature's contributions to people, including ecosystem services, are addressed in stress testing by some central banks *(established but incomplete)* {2.5.5, 4.2.4}. Scenarios can also be used to analyse long-term systemic risks for the whole economy resulting from biodiversity decline, including tipping points and cascading effects *(established but incomplete)* {2.4.5}.

C6 Actionable guidance is needed for measuring business dependencies on biodiversity and nature's contributions to people *(well established)*.

Many methods for measuring biodiversity and nature's contributions to people could be applied to the assessment of business dependencies. Their uptake and inclusion in business-focused tools is limited, especially for nature's contributions to people *(well established)* {4.5, 5.3.2, 5.4}.

In contrast, many of the tools and associated guidance that are applicable to business could also be used to assess impacts *(well established)* {3.3.2, 4.5}. Some available methods provide high-level dependency assessments of businesses and financial portfolios based on industry average information *(well established)* {4.2.3, 4.4}. Such assessments have been applied to screen potentially material dependencies *(established but incomplete)* {4.5}. Methods and metrics that measure nature's contributions to people by location could be used for dependency analyses of operations and value chains, especially in relation to material contributions; nevertheless, readily available methods for use by businesses are lacking for many non-material and regulating contributions *(well established)* {4.2.2}. A need remains for approaches that can be easily applied across business operations, considering the location-specific availability and delivery of the full range of nature's contributions to people *(established but incomplete)* {4.4}.

C7 Businesses can learn from Indigenous and local knowledge and fairly and equitably share benefits with Indigenous Peoples and local communities *(established but incomplete)*.

Indigenous Peoples and local communities hold extensive knowledge on biodiversity and its values, conservation, restoration and sustainable use *(well established)* {2.3.3, 2.3.7.1, 4.3.1}. There are examples of partnerships between businesses and Indigenous Peoples and local communities to develop new products and services that document and preserve Indigenous and local knowledge, share benefits fairly and equitably, and respect the rights of Indigenous Peoples and local communities, in accordance with national legislation *(well established)* {2.7.2}. However, those products and services have often not been recognized by profit-driven businesses *(established but incomplete)* {2.3.3, 2.7.1, 3.3.3, 4.3.1}. Approaches for measuring the impacts of business on biodiversity and nature's contributions to people generally do not adequately measure impacts on Indigenous Peoples and local communities or interweave business knowledge with Indigenous and local knowledge *(established but incomplete)* {3.3.3, 4.3.1}. The fact that most approaches are based on anthropocentric world views and instrumental values, rather than biocentric or pluricentric world views, influences the interpretation of business impacts and dependencies *(well established)* {4.3.2}. To improve engagement with Indigenous Peoples and local communities, businesses should recognize and respect the free, prior and informed consent of Indigenous Peoples and local communities, along with their respective rights, in accordance with national legislation *(established but incomplete)* {2.3.3, 2.7.1, 4.3.1, 5.2.2}. Businesses can improve their approaches by learning from businesses of Indigenous Peoples and local communities that have business models with clear social and ecological benefits, and ways of working that respect reciprocal people-nature relationships {2.7.2, 4.3.1, 5.7.3}. Collaboration between academia and Indigenous Peoples and local communities can help to interweave Indigenous and local knowledge, where appropriate. While this is occurring in some places, it rarely informs business assessments *(established but incomplete)* {4.3.1, 5.7.3}.

C8 Filling gaps in knowledge and its application can make the measurement of business impacts and dependencies on biodiversity more robust and relevant to decision-making *(well established)*.

Knowledge gaps in the measurement of business impacts and dependencies can be identified across five broad areas: (a) business-relevant data; (b) completeness of evidence; (c) applicability of methods; (d) data accessibility and transparency; and (e) adoption of methods **(Table SPM.7)**. Addressing each of these knowledge gaps would significantly improve applicability by businesses and improve business accountability. In relation to the needs and shortcomings in data, uptake and methods identified in this assessment, a core set of gaps in knowledge and practice exist, including low adoption of methods in business action (C3), gaps in business location and activity data (C4), a lack of consistent scenarios for biodiversity (C5), a lack of actionable guidance for measuring dependencies (C6), and insufficient interweaving of Indigenous and local knowledge (C7). Addressing these knowledge gaps will require coordinated public and private investment. Furthermore, a balance between the scientific rigour of measurements and the affordability and applicability of methods by businesses is also required in order to support business actions effectively. Closing these knowledge gaps would allow methods to be applied to a wider set of decision contexts, increase consistency in comparisons across businesses, portfolios and countries, and enable further action by businesses and financial institutions **(Table SPM.2)**.

Table SPM 7 **Gaps in knowledge and its application.**

Categories of knowledge gaps	Description
1. Business-relevant data Gaps characterized by a lack of data or standardized data, and gaps in data on specific topics or that meet specific criteria	Lack of consistent, self-reported, comprehensive data and information on dependencies and risks that are spatially and temporally specific to individual sectors or businesses, including data gathered by financial institutions (i.e., investors, lenders and insurers) in connection with their investees and clients {2.2, 2.5, 4.4, 5.3.2}
	Lack of granular, linkable data on locations of business activities across value chains and portfolios, which would enable spatial analysis of impacts and dependencies alongside biodiversity data {2.7, 3.3, 3.4, 4.4, 5.3.2, 5.6.3}
	Lack of data and models, including data to support baseline studies, especially in remote areas, on understudied subjects (e.g., invertebrates, soil organisms, marine ecosystems and genetic diversity), or on the functioning and capacity of ecosystems to provide nature's contributions to people {2.3, 4.2.2, 5.3.2}
	Lack of baseline data on the socioeconomic, cultural and environmental conditions of Indigenous Peoples and local communities, or on specific impacts on different subgroups within communities, such as women, children and older persons, prior to starting business activities, against which mitigation measures could be assessed {2.7, 3.6}
	Lack of data from remote-sensing tools and technology for monitoring land and sea use and changes therein, and on business activities affecting biodiversity and nature's contributions to people {6.3.4}
	Lack of scenarios and time series data over sufficiently long periods to show the effect of actions by businesses and others (including changes in policy) on biodiversity outcomes across national and subnational economies {5.2.3, 5.3.2, 5.5, 6.3.1, 6.3.2}
2. Completeness of evidence Gaps characterized by missing or underdeveloped scientific information and by a lack of availability of Indigenous and local knowledge	Incomplete knowledge within businesses of their impacts and dependencies on biodiversity and nature's contributions to people, including in relation to how biodiversity loss translates into business risk and informs action. Beyond economic value and productivity, knowledge is lacking on sociocultural valuation, relational values, quality, sustainability, trends and risk of loss {2.5, 2.8, 4.5, 4.6, 5.3.2}
	Insufficient evidence to identify and prioritize the actions needed to incentivize businesses with the greatest responsibility for and influence on biodiversity and nature's contributions to people to perform the most impactful actions {5.6, 5.7}
	Gaps in knowledge, data and documentation on species that are important to Indigenous Peoples and local communities and information on the rights and knowledge of Indigenous Peoples and local communities relating to benefits arising from the use of genetic resources, with due respect for free, prior and informed consent, in accordance with national legislation {6.3.4, 6.3.5}
	Gaps in knowledge about mechanisms linking transparency and risk disclosure (including visibility of failures) to improved biodiversity performance and outcomes, and about the conditions under which disclosure drives action {5.4, 5.6, 5.7}
	Inadequate understanding of ecological thresholds, tipping points and feedback loops and their links to the impacts of business on biodiversity {3.2}
	Insufficient studies on the effectiveness of and attitudes towards mechanisms, including economic and financial instruments, which are designed to shift financial flows away from industries that harm biodiversity and which consider how investments drive biodiversity loss {6.3.2}
	Limited verified and comparable case examples of business actions covering motivations, barriers, impacts and outcomes, and the factors underpinning success or failure to enable shared learning and improvement {5.5, 5.6, 5.7}
	Insufficient studies on methods that can be considered robust and are most useful for particular business contexts, including comparisons of the potential for different methods to influence both biodiversity outcomes and business practices {4.5, 4.6}
	Gaps in knowledge of the full array of impacts of business activities (including through the management of dependencies) on Indigenous Peoples and local communities in relation to biodiversity impacts and businesses' responses to biodiversity loss {2.7, 4.3.1, 4.5}
	Insufficient studies on the effectiveness in delivering positive outcomes of different mechanisms and types of action implemented by businesses and others, including mechanisms such as environmental and social impact assessments, certification schemes, behaviour change, partnerships and collaboration, and the effectiveness of policy implementation {5.6, 5.7, 6.3}
	Insufficient studies quantifying the indirect positive and negative impacts of businesses on biodiversity, including the pathways by which those impacts occur {3.2}
	Insufficient studies of synergistic effects, interactions and trade-offs between different business impacts on cultural significance and spiritual values and of their socioeconomic implications, including assessing cumulative impacts on Indigenous Peoples and local communities and rural and urban poor communities, and designing effective mitigation measures {3.6}

Table SPM 7

Categories of knowledge gaps	Description
3. Applicability of methods Gaps characterized by the inability of existing methods or aspects of existing methods to address fundamental components of the relationship between business and biodiversity in the context of business decisions	Insufficient approaches to addressing shortcomings in biodiversity accounting practices, such as the need to interlink management, financial and ecosystem/landscape accounts to provide specific, time-bound and measurable indicators for monitoring purposes, and to reflect biocentric or pluricentric world views {4.6}
	Insufficient approaches to appropriately incorporate or interweave Indigenous and local knowledge and the values and world views of Indigenous Peoples and local communities, and to support the participation of such knowledge holders, with their free, prior and informed consent, in accordance with national legislation {2.4, 2.7, 3.3, 3.6, 4.3.1, 4.6.2, 5.6, 5.7, 6.3.3}
	Lack of consistent scenario data and established modelling approaches for biodiversity-related risks to support consistent application and comparison of methods. Specifically, long-term futures are missing or not applied consistently and comprehensively in the identification of sustainable business strategies {2.4, 3.6, 4.6.1}
	Methodological challenges in using standardized business-relevant indicators and metrics for biodiversity-related dependencies, risks and opportunities {2.4}
	Lack of robust, standardized approaches to independent verification of businesses' claims about their contributions to, and delivery of outcomes for, biodiversity and nature's contributions to people {5.3.2, 5.6, 5.7.1, 5.7.2}
	Insufficient methods and data to translate and disaggregate global biodiversity goals into business-level, outcomes-based, time-bound targets at decision-relevant scales {5.2.2, 5.3.2, 5.6, 5.7}
	Insufficient applicability of methods across scales, for example to support financial institutions in using modelled data to assess portfolios and perform more detailed/local-level studies of dependencies {4.4.1, 5.6.4.2}
	Challenges in ensuring that methods can combine diverse data while balancing ecological, economic and social trade-offs; in fully reflecting the contributions of natural, produced, social and human capital to business activities; and in providing sufficient spatial and temporal detail {2.2, 2.3, 2.4}
	Lack of methods that go beyond species richness and other coarse measures to incorporate information on understudied species groups and measures of functional or genetic diversity {4.2.2}
	Lack of methods that can take into account different types of land use and reflect differences in the intensity of land use to support impact-related decision-making {4.4}
4. Data accessibility and transparency Gaps characterized by insufficient flows of information, knowledge or science among groups	Lack of clear consensus among consumers, investors and Governments on what constitutes an appropriate and credible business contribution to halting and reversing global biodiversity loss and securing nature's contributions to people {5.2.2, 5.3.2}
	Existing knowledge on biodiversity and nature's contributions to people is not accessible to all levels of the business community, including within businesses. This includes data gathered by businesses through their monitoring programmes {5.3.2, 4.5.4}
	Existing knowledge about the diverse contexts and specific characteristics of various Indigenous Peoples and local communities, including knowledge of their distinct cultural and ecological histories, unique livelihoods, world views and traditional practices, is not accessed by or accessible to businesses {4.5, 6.3.5}
	Existing knowledge about scientifically agreed/recommended methodologies is not accessed by or accessible to businesses, resulting in a disconnect between the needs of businesses to adhere to such methodologies and their applicability, availability and accessibility {4.5}
	Existing knowledge across businesses of their respective impacts and dependencies is typically not connected or visible to all relevant decision makers along the value chain {4.4, 4.5, 5.3.2, 5.6.3}
5. Adoption of methods Gaps characterized by low uptake of approaches and knowledge within specific contexts	Available sociocultural methods are not often used and are difficult to standardize and scale for business use and benchmarking {2.3, 3.3}
	Gaps characterized by low uptake of approaches and knowledge within specific contexts
	Available academic methods are only partially reflected in tools aimed at businesses; those tools and the associated data are fragmented and sometimes inaccessible {2.3, 3.3}
	Limited guidance and support for small and medium-sized enterprises to overcome acute capacity and resource barriers to act to address their biodiversity impacts and dependencies and to collaborate and partner with other actors in order to amplify their outcomes {5.3.2, 5.4, 5.7.3}
	Limited knowledge, data and documentation on Indigenous Peoples and local communities, and on their respective rights in accordance with national legislation; and in relation to benefits arising from the use of genetic resources, with due respect for free, prior and informed consent, in accordance with national legislation {6.2.2}





APPENDIX

APPENDIX

Communication of the degree of confidence



Figure SPM A 1 **The four-box model for the qualitative communication of confidence.**

Confidence increases towards the top-right corner, as suggested by the increasing strength of shading. Source: IPBES (2016).[20] Further details of the approach are documented in the *IPBES Guide on the Production of Assessments*.[21]

In the Methodological Assessment of the Impact and Dependence of Business on Biodiversity and Nature's Contributions to People, the degree of confidence in each main finding is based on the quantity and quality of evidence and the level of agreement regarding that evidence **(Figure SPM.A1)**. The evidence includes data, theory, models and expert judgment.

- ***Well established:*** There is a comprehensive meta-analysis or other synthesis or multiple independent studies that agree.
- ***Established but incomplete:*** There is general agreement, although only a limited number of studies exist; there is no comprehensive synthesis, and/or the studies that exist address the question imprecisely.
- **Unresolved:** Multiple independent studies exist but their conclusions do not agree.
- **Inconclusive:** There is limited evidence and a recognition of major knowledge gaps.

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Chapter **1**

SETTING THE SCENE[1]

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Chapter **1**

SETTING THE SCENE

EXECUTIVE SUMMARY

1 **The global economy depends heavily on biodiversity and nature's contributions to people and the interconnected challenges of biodiversity loss and climate change pose growing risks to financial systems and the global economy worldwide {1.1.2, 1.2.9, 1.3.1}.** Nature generates essential economic and social value through benefits such as food and fuel production, climate regulation, water purification, flood regulation, air filtration and aesthetic beauty. An estimated $44 to 58 trillion, or over half of global GDP, moderately or highly depends on ecosystem services. However, recent estimates likely understate the full economic value of the global dependency on biodiversity and the significant macroeconomic implications of biodiversity loss. Failing to account for, mitigate and adapt to these risks poses significant threats to financial stability and the global economy. Biodiversity loss and climate change are closely intertwined, sharing common drivers and mutually amplifying their impacts on water, food, and health systems (IPBES, 2024d; Pörtner *et al.*, 2021, 2023). Healthy and resilient ecosystems are vital for climate mitigation and adaptation, as they store and sequester carbon and reduce the impact of extreme weather events. In contrast, biodiversity loss weakens these natural capacities — reducing forests' and oceans' ability to store carbon and further accelerating climate change.

2 **A failure to account for nature and integrate its value into economic and financial systems has led to its degradation and the unprecedented rates of biodiversity decline globally {1.1.2, 1.3}.** Historically, the many values that nature provides to society have been invisible in the economy, financial system and corporate balance sheets. The contributions of nature to market values are not comprehensively or explicitly recognized within national accounts and economic indicators such as gross domestic product. Similarly, the valuable contributions that nature provides to business value chains and operations are often missing from corporate financial statements and disclosures. This omission has contributed to policies, incentives and pricing signals that disregard nature's values and, in many cases, lead to its degradation and loss.

3 **Businesses have impacts and dependencies on biodiversity that vary by sector, size, structure and geography. Business impacts on biodiversity can be positive or negative {1.2.5, 1.2.6, 1.2.7, 1.2.8}.** All businesses depend on biodiversity and nature's contributions to people. The type and magnitude of dependencies vary across sectors, sub-sectors, ecosystems and geographies. A dependency arises when businesses rely upon, or are affected or constrained by, nature's contributions to people, including ecosystem services. Financial institutions may depend on nature through the reliance of the businesses they invest in, lend to or insure. Business activities also impact biodiversity (reviewed in detail in **Chapter 3**). In this assessment, business impacts on biodiversity are defined as positive or negative changes in the quality or quantity of biodiversity resulting from land and sea use, direct exploitation of organisms, climate change, pollution or the introduction of invasive alien species. Such impacts may result in changes to the capacity of biodiversity to support social, economic and cultural functions. Businesses' impacts on biodiversity include direct, value chain, indirect and cumulative impacts and can be negative or positive, although evidence shows most impacts have been negative

4 **Business impacts and dependencies on biodiversity can result in a range of physical and transition risks that have financial implications for organizations {1.2.9}.** A business's nature-related risks refers to the "potential threats posed to an organization that arise from its and wider society's dependencies and impacts on nature". These risks may manifest as physical, transition, and systemic risks for a business. Nature-related physical risks to an organization result from the degradation or loss of biodiversity and nature's contributions to people that the organization depends on. These can be acute in the case of a short-term event or chronic if they involve longer-term shifts in the state of biodiversity. Nature-related transition risks to an organization may result from a misalignment of business behaviours or actions with efforts to conserve, restore or sustainably use biodiversity. These types of risks can be prompted by changes in regulation and policy, legal precedent, technology, or investor sentiment and consumer choices that may cause adverse business consequences. Systemic risks emerge from disruptions that collectively lead to collapse of the whole system. Despite growing awareness of the systemic risks that biodiversity loss poses to the global economic and financial system, there is still limited clarity on how these risks translate into businesses' balance sheets. However, a growing body of literature is developing on how systemic risks can be assessed and translated for businesses and financial institutions.

5 **Business impacts and dependencies on biodiversity can also result in a range of opportunities**

that have financial implications for organizations {1.2.10}. Nature-related opportunities for businesses and financial institutions can arise from both their dependencies and impacts on biodiversity and refer to activities that create positive outcomes for organizations and biodiversity. Opportunities may include the strategic transformation of business models, products, services, markets and financing mechanisms that deliver biodiversity benefits or activities that avoid, reduce, mitigate or manage nature-related risks. Potential opportunities for businesses stemming from their impacts and dependencies will vary across sectors, geography, local social and cultural contexts, and market and economic factors. A growing number of examples demonstrate opportunities that can deliver positive outcomes for businesses, biodiversity and other stakeholders.

6 Businesses also impact Indigenous Peoples and local communities (IPLCs) through the impacts and dependencies that they have on nature. These impacts can be positive or negative, with most impacts throughout history being negative {1.2.8.2}. Business impacts on biodiversity — both negative and positive — can create costs, benefits, risks and opportunities for the business as well as a range of affected stakeholders. The distribution of the benefits and costs of business impacts on biodiversity is unequal over time and space, and perceptions of what constitutes a good quality of life, as well as the value of nature, vary among different groups. Business activities may bring benefits to some groups while negatively affecting the quality of life of others. For example, IPLCs and urban populations (often composed of ethnic minorities) have often been negatively impacted by industrial activities. Unsustainable business practices can also compromise the quality of life of future generations. These impacts can lead different groups to change their behaviour in ways that either amplify or counteract the initial impact on biodiversity. To navigate these interactions, businesses need to consider the interconnected relationships between social and environmental impacts.

7 Few businesses currently understand and actively manage their impacts and dependencies on nature leaving many businesses exposed to unmitigated risks and unrealized opportunities {1.1.2, 1.2.7, 1.2.9, 1.2.10}. Few businesses have assessed their impacts on biodiversity and even fewer have assessed their dependencies on biodiversity. Because many dependencies on biodiversity can be intangible or difficult to measure, they are often underrepresented in decision-making. Methods for assessing dependencies on biodiversity and nature's contributions to people are generally less advanced than those for assessing impacts on biodiversity. Most available methods for quantifying business dependencies on nature focus on direct dependencies, with fewer approaches available for assessing dependencies within value chains, as discussed in **Chapters 3** and **4**. Because impacts and dependencies on nature can lead to a range of risks and opportunities, understanding these interactions can be important for informing business decisions, policies, and actions that may have financial implications for an organization.

8 Most business actions related to managing negative impacts on biodiversity and nature's contributions to people have been historically driven by regulation. More recently, businesses have focused on identifying and assessing nature-related risks and piloting these through voluntary disclosure and reporting initiatives {1.3, 1.3.2, 1.3.3, 1.4}. Throughout much of recent history, policy and regulations have mostly focused on the negative impacts that businesses may have on biodiversity and, thus, business actions have focused on reducing or managing their negative impacts. As businesses and financial institutions increasingly recognize their impacts and dependencies on biodiversity and the business value that nature-related opportunities and risks present – some are taking voluntary measures that go beyond regulatory requirements. For example, voluntary market-led initiatives for measuring and reporting on biodiversity are catalyzing business and financial institutions' efforts to understand, identify, assess, disclose and manage nature-related dependencies, impacts, risks and opportunities. While voluntary disclosures can drive greater understanding, accountability and transparency, they are not always effective at driving action in the absence of a strong enabling environment. Business actions and policies on biodiversity continue to lag behind reporting trends.

9 Transformative change is needed to conserve and restore nature in alignment with the Kunming-Montreal Global Biodiversity Framework. All actors in society will have to work together to advance an enabling environment in which businesses can contribute to the transformative changes needed to achieve a just and sustainable future {1.5}. Governments, the financial system, and other actors, (including civil society and IPLCs) have to work together, with businesses and financial institutions to promote and ultimately deliver the global systemic and transformative changes needed to support businesses' efforts to contribute to the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity.

1.1 SETTING THE SCENE

1.1.1 Purpose and intended audience

The Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) approved the undertaking of the Business and Biodiversity Assessment in 2023. This decision referred to the 'Scoping report for a methodological assessment of the impact and dependence of business on biodiversity and nature's contributions to people' (IPBES, 2023b).

The purpose of this methodological assessment (hereafter referred to as the Business and Biodiversity Assessment) is to strengthen knowledge on the relationships between businesses and biodiversity. It includes a critical review and evaluation of the diverse ways in which businesses depend on and impact biodiversity and methods to measure this interaction — including those occurring throughout value chains. The assessment also explores how this information can support businesses and financial institutions in making decisions that lead to better outcomes for biodiversity. Finally, it examines the roles of governments, the financial system, businesses and other stakeholders in creating an enabling environment for such improvements. Considerations of these issues as they relate to people, including Indigenous Peoples and local communities ('IPLCs'), are integrated into the assessment.

The primary audience of this assessment includes governments, businesses and financial institutions. In addition, the assessment is intended to be of value to civil society and IPLCs in their interactions with businesses.

The assessment aims to support efforts to achieve the 2050 Vision for Biodiversity — living in harmony with nature —, and the objectives of the Convention on Biological Diversity: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. It also seeks to enhance businesses' contributions toward just and sustainable futures, in line with global policy goals and frameworks such as the 2030 Agenda for Sustainable Development and its Sustainable Development Goals,[2] the Convention on Biological Diversity and the Kunming-Montreal Global Biodiversity Framework,[3] and the United Nations Framework Convention on Climate Change[4] and the Paris Agreement.[5] Hereafter, we refer more concisely to these global policy goals and frameworks as the Sustainable Development Goals, the Kunming-Montreal Global Biodiversity Framework, and the Paris Agreement. Underscoring urgency, the assessment highlights the need for enhanced business engagement in order to address the unprecedented decline in biodiversity globally.

A key consideration of this assessment is the clear link between biodiversity loss and climate change, which exacerbate each other, with common causes and effects on one another (Pörtner *et al.*, 2021, 2023; Weiskopf *et al.*, 2024a) and with implications for water, food and health (IPBES, 2024d; UNEP, 2023b). Functioning and resilient ecosystems play an important role in both mitigating and adapting to climate change by storing and sequestering carbon and reducing the impact of extreme weather events (IPBES, 2024d; Pörtner *et al.*, 2021). When biodiversity declines, forests and oceans lose their capacity to store carbon, leading to higher greenhouse gas levels and further accelerating climate change (IPBES, 2024d).

Chapter 1 provides a common framework for this assessment and lays out the context for understanding how businesses interact with biodiversity. It gives an overview of how business engagement on biodiversity has evolved, including through initiatives and frameworks. Additionally, it presents a definition of business — including financial institutions — and introduces a typology of business activities based on size, geography and sector for use within this assessment. Finally, the chapter defines key terms and gives examples of risks and opportunities that arise from interactions between businesses and biodiversity.[6]

1.1.2 Significance of undertaking the Business and Biodiversity Assessment

The significant value of nature and its importance for national economies and businesses globally is increasingly recognized (Dasgupta, 2021, 2025; WEF & PWC, 2020; World Bank Group, 2021) alongside the substantial risks that nature loss poses to the global economy (Alvarez *et al.*, 2025; Ranger *et al.*, 2023; TNFD, 2025d; United Nations Global Risk Report, 2024; WEF, 2024). Nature generates immense economic and social value by providing key benefits such as food production, carbon sequestration, and water and air purification. According to recent research, these services alone are valued at over $150 trillion per year — roughly twice the global Gross Domestic Product (BCG, 2021). Other reports estimate $58 trillion of global annual economic activity (value in 2023), equivalent to over half of global gross domestic product, is tied to sectors depending moderately or highly on nature and its services

2. Resolution adopted by the United Nations General Assembly, A/RES/70/1
3. Adopted by the Conference of the Parties to the Convention on Biological Diversity, in decision CBD/COP/DEC/15/4
4. United Nations, Treaty Series, vol. 1771, No. 30822
5. Adopted by the Conference of the Parties to the United Nations Framework Convention on Climate Change, Decision 1/CP.21.
6. A detailed explanation and comprehensive review of the process for selecting the literature for this chapter can be found in the data management report https://doi.org/10.5281/zenodo.12785911

(IPBES, 2024d; PwC, 2023). These estimates likely understate the full economic value of the global dependency on nature and the significant macroeconomic implications of nature loss. Failing to account for, mitigate or adapt to these risks poses a threat to financial stability (NGFS, 2023a, 2024a, 2024b). More generally, no economy or community could function without nature's contributions to people, such as food, fuel, water, clean air, and fertile soils (IPBES, 2018b, 2018c, 2018d, 2018e; Ranger *et al.*, 2023; Dasgupta, 2021).

This should be seen in the context of growth in global economic activity which has outstripped human population growth. Since 1992, human-produced capital (e.g., buildings and machinery) that improves economic productivity has increased by approximately 100 per cent per capita on average though with wide disparity among countries — while stocks of natural capital (ecosystems and natural resources) have been reduced by nearly 40 per cent (Dasgupta, 2021; IPBES, 2019a; Managi & Kumar, 2018).

Current economic and financial systems indirectly incentivize investments that harm biodiversity that supports water, food, human health, and climate regulation (Dasgupta, 2020). These harmful financial flows are estimated at up to $7.3 trillion per year (in 2023), whereas only about $220 billion are directed towards activities that have positive impacts (IPBES, 2024d; UNEP, 2023b, 2026). The private sector was responsible for the majority of the nature-negative finance flows in 2023, equivalent to approximately $4.9 trillion and around $2.4 trillion in public sector finance flows through subsidies were directed towards environmentally harmful activities (IPBES, 2024d; UNEP, 2023b, 2026). The degree to which sectors are sustainably managed, however, differs widely and some subsidies to these sectors may improve biodiversity outcomes (World Bank Group, 2023).

One reason why significant financing continues to flow towards activities that degrade biodiversity and not enough flows towards its protection, is the invisibility of biodiversity in the economy, the financial system and corporate balance sheets. This omission has led to policies, incentives and pricing signals that disregard nature's values and, in many cases, lead to its degradation and loss (Dasgupta, 2021; UNEP, 2010). For example, the contributions of nature to market values are not comprehensively and/or explicitly recognized within national accounts or economic indicators such as gross domestic product (Dasgupta, 2021). Similarly, the valuable contributions that nature provides to business value chains and operations are often missing from corporate financial statements and disclosures. For example, a study analysing more than 800 businesses between 2022 and 2024 showed that only 5 percent had measured and understood their impacts on biodiversity and just 1 per cent assessed their dependencies on biodiversity (WBA, 2024). Understanding a company's impacts and dependencies on nature is important because they can result in a range of risks and opportunities for the business (TNFD, 2023c).

Negative externalities — costs not included in market prices or decision-making — across the fossil fuel, agriculture and fisheries sectors are estimated at $10–25 trillion per year (IPBES, 2024d). These reflect significant harmful impacts on biodiversity, climate, water and human health (IPBES, 2024e). One study estimated that the unpriced business impacts on biodiversity, including unsustainable land and water use, greenhouse gas emissions, air pollution and waste that can degrade natural capital amounted to approximately $7.3 trillion per year (using 2009 values) (Trucost, 2013). Mismanagement of nature-related issues by 10 large businesses alone has resulted in financial losses of $83.2 billion, stemming from the physical risks associated with business dependencies on biodiversity and the transition risks resulting from business impacts on biodiversity (BloombergNEF, 2023). A growing body of evidence now exists on the financial effects of nature-related risks for businesses across sectors, geographies, and time horizons, which include impacts on revenues, costs, asset values and access to capital (Alvarez *et al.*, 2025). Thus, several studies have documented the financial reasons for businesses and financial institutions to address nature-related risks and opportunities.

As attention to the financial and economic importance of biodiversity grows, businesses will need clear, science-backed approaches, indicators, tools and metrics for effective decision-making (EREA, 2024; TEEB, 2012). Numerous frameworks, methods and tools now exist to support businesses to better understand, manage and disclose their interactions with biodiversity (Beck-O'Brien & Bringezu, 2021; IUCN, 2023; Katic *et al.*, 2023; Science Based Targets Network, 2024; TNFD, 2023d). Legal reporting requirements on biodiversity risks and impacts are progressing but with mixed signals across regions. For example, all French financial institutions must disclose both biodiversity- and climate-related risks and impacts (LOI n° 2019-1147 du 8 novembre 2019 relative à l'énergie et au climat (1), 2019). The European Union's Corporate Sustainability Reporting Directive initially marked a major step toward greater corporate transparency and accountability on environmental and social risks (European Union, 2022). However, recent changes have weakened its ambition as under the European Commission's Omnibus I package about 80 per cent of businesses are excluded from the Directive's scope and mandatory biodiversity disclosure are delayed by two years, limiting reporting to only the largest companies (European Commission, 2025a, 2025c). While presented as simplification, this shift reduces visibility of climate- and nature-related risks across value chains and constrains the ability of businesses and financial institutions to assess physical and transition risks using consistent and comprehensive data (IIGCC *et al.*, 2025).

Increasing understanding and consistency across different approaches, frameworks and tools available for businesses is important for effective, transparent, coherent and robust environmental governance (IPBES, 2024a). These efforts need to account for regional, ecosystem and sector-specific challenges. They also need to consider the capacity, technical and technological differences among businesses, and including micro-, small- and medium-sized enterprises, as well as those of IPLCs and marginalized populations (IPBES, 2024a; IPBES *et al.*, 2023). Businesses can also benefit from and have the opportunity to enhance their understanding of diverse values, worldviews and different approaches to valuing nature, while recognizing the contributions of IPLCs (Chettri & Sharma, 2022; Forest Peoples Programme *et al.*, 2020; Khalvati *et al.*, 2011; Pascual *et al.*, 2023). This assessment evaluates approaches to measure the interlinkages between businesses and biodiversity to enhance understanding, consistency, reporting and management of the ways in which businesses depend on, impact and interact with biodiversity. This evaluation also incorporates diverse knowledge systems, including Indigenous and local knowledge **(Annex 1.1)**.

The adoption of the Kunming-Montreal Global Biodiversity Framework in 2022 highlighted the importance of these issues and the need for enhanced business involvement to address unprecedented global declines in biodiversity (CBD, 2022; IPBES, 2019a). The Kunming-Montreal Global Biodiversity Framework adopts a 'whole of society approach' and each of the goals and targets is relevant not only to businesses individually but also to all sectors of the economy and society. Target 15 of the Framework emphasizes the need for businesses to identify, assess,

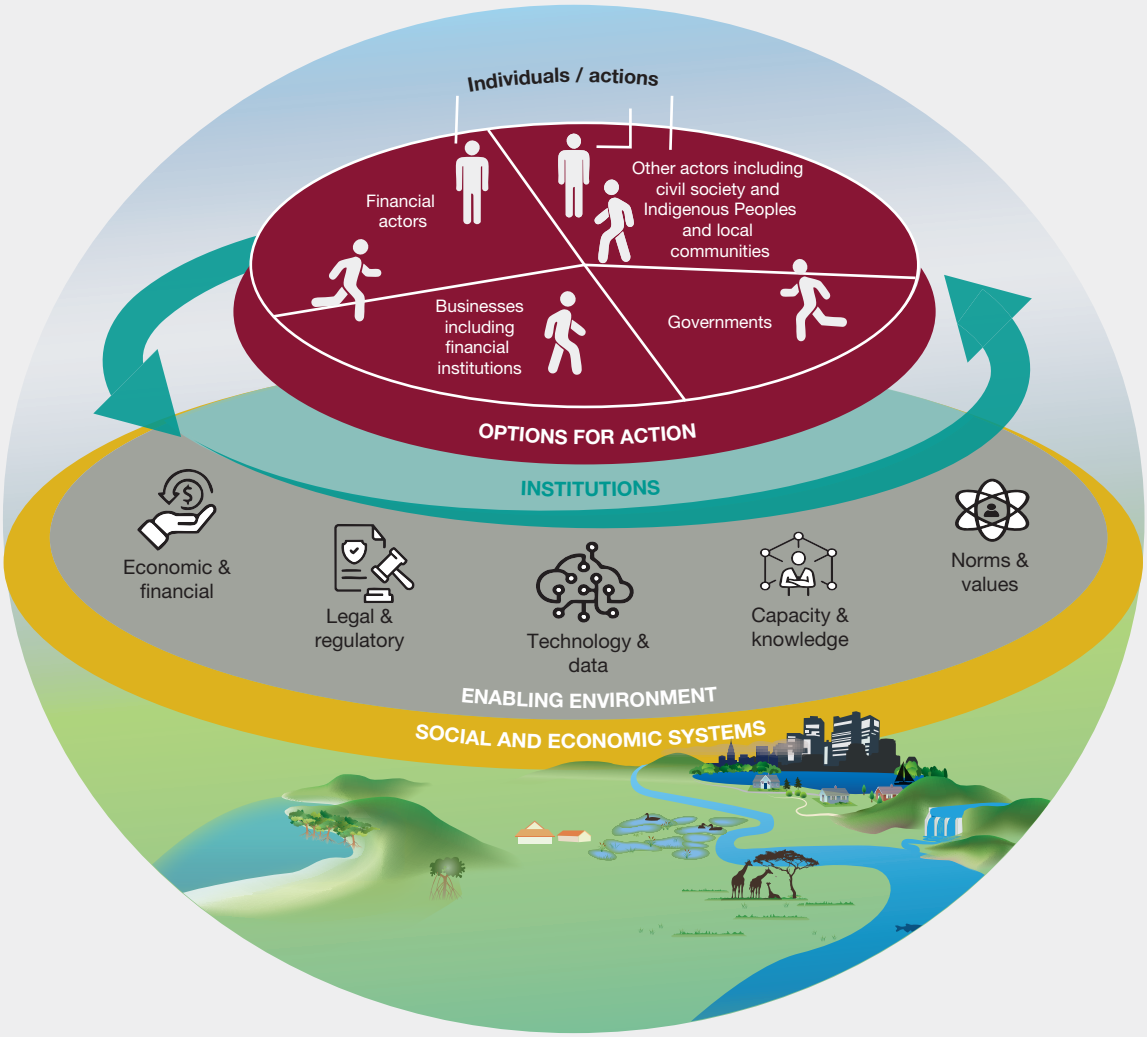


Figure 1 1 **Creating an enabling environment that supports businesses' outcomes for nature and society.**

and reduce their biodiversity-related risks and negative impacts while enhancing positive outcomes for biodiversity. This involves implementing legal, administrative or policy measures that mandate regular monitoring, transparent disclosure, and reporting on biodiversity dependencies and impacts, especially for large and transnational businesses and financial institutions, to drive sustainable production and consumption (CBD, 2022).

The Kunming-Montreal Global Biodiversity Framework also identifies an overall finance gap for biodiversity of $700 billion each year — the difference between current biodiversity-related financial flows and future investment needs by 2030 (IPBES, 2019a). The IPBES Nexus Assessment estimates this biodiversity finance gap to range from $300 billion to 1 trillion annually (IPBES, 2024e). These figures highlight a major need and an opportunity to repurpose capital and unlock new financial flows to support biodiversity. Also related to Target 18, this requires eliminating, phasing out or reforming subsidies that are harmful to biodiversity reducing them by at least $500 billion annually, while increasing positive incentives for the conservation and sustainable use of biodiversity. Positive incentives include economic, legal or institutional measures such as land purchases supported by public funds or grants, and legal agreements to preserve natural areas (CBD, 2022). Target 19 calls for mobilizing at least $200 billion each year in domestic, international, public and private biodiversity-related funding (CBD, 2022).

Achieving the Kunming-Montreal Global Biodiversity Framework's goals and targets requires transformative change across all levels of society, including national governments, subnational and local authorities, civil society, individuals, businesses and financial institutions. Transformative change is defined as "fundamental, system-wide shifts in views, structures, and practices" (IPBES, 2024c). When deliberately pursued for a just and sustainable world, such change can address the root causes of loss and decline of biodiversity and nature's contributions to people. At the same time, it is essential to recognize and strengthen existing views, structures, and practices that already align with sustainability — such as those of many IPLCs.

For businesses to participate in the transformative changes needed to halt and reverse biodiversity loss, the conditions under which they operate must be fundamentally reshaped. Creating an enabling environment[7] with strong incentives for the conservation and sustainable use of biodiversity can align business profitability with positive outcomes for biodiversity and society. These enabling conditions span legal and regulatory frameworks, economic and financial systems, social values, norms and culture, technology and data, as well as capacity and knowledge **(Figure 1.1)**. Such an enabling environment depends on coordinated action by governments, the financial system, other actors including civil society and IPLCs, and businesses themselves.

7. This categorization builds on the IPBES Nexus Assessment, which defines enabling conditions across six areas: financing incentives, equity, data and technology, capacity, norms and values, and policies and regulations (IPBES, 2024d). However, for this assessment, we have refined these categories to specifically reflect enabling conditions important for business.

Box 1.1 Indigenous Peoples and local communities, Indigenous and local knowledge, and the Business and Biodiversity Assessment.

At least 32 per cent of land globally is owned or governed, either legally or under customary arrangements, by IPLCs. Some 91 per cent of IPLCs' lands are in good or moderate ecological condition, with 65 per cent being ecologically intact. Nature managed by IPLCs is therefore globally significant (WWF *et al.*, 2021). The state of nature on IPLCs' lands reflects the fact that many IPLCs hold values and worldviews that differ from those that often dominate global political and economic decision-making — and which are often ignored (IPBES, 2022a). These diverse values such as prioritizing a reciprocal and harmonious relationship with nature and social equity, inform their social, cultural and economic activities, including their business activities (IPBES, 2023a; IPBES *et al.*, 2024). IPLCs' close relationships with land and nature also mean that they have developed dynamic bodies of integrated, holistic, social and ecological knowledge, practices and beliefs pertaining to the relationship of living beings, including people, with one another and with their environments, known as Indigenous and local knowledge. Improved acknowledgment and integration of their values and perspectives can support transformative change (IPBES, 2022a).

However, the nature managed by IPLCs is under increasing pressure, including from a range of business activities (IPBES, 2019b; WWF *et al.*, 2021). In practice, this often manifests in the encroachment of business activities on their lands and resources, with significant social, cultural, economic and environmental consequences (IPBES *et al.*, 2023, 2024). As a result, nature on many IPLC lands is declining — although still more slowly than in other areas (IPBES, 2019b).

Protecting and restoring IPLCs' collective custodianship of land, resources and nature and creating space for their values, cultures and own economic activities and businesses to flourish, and increasing their influence on decision-making in relation to business activities, is therefore critical to stemming the loss of nature.

The involvement of IPLCs in the production of this assessment is described in **Annex 1.1**.

1.1.3 Linkages with the IPBES conceptual framework

The Business and Biodiversity Assessment builds on the IPBES conceptual framework (Díaz *et al.*, 2015), which addresses how nature and its contributions to people underpin a good quality of life for humanity (IPBES, 2018b, 2018c, 2018d, 2018e, 2019a).

This assessment covers five direct drivers of the loss and change of biodiversity and nature's contributions to people by business operations, including those related to: 1) changing land/sea use, 2) unsustainable exploitation of biodiversity, 3) climate change, 4) pollution, and 5) introduction of invasive alien species. Since 1970, land-use change (mostly driven by agricultural conversion) has had the most significant negative impact on terrestrial and freshwater ecosystems (IPBES, 2019a). In marine ecosystems, fishing has had the greatest negative impact on nature in the past 50 years (target species, non-target species and habitats) (IPBES, 2019a).

These five direct drivers result from various causes, known as indirect drivers, which are shaped by worldviews, societal values and behaviours. These indirect drivers include demographic and sociocultural drivers, economic and technological drivers, institutions and governance, and conflicts and epidemics (Bjelle *et al.*, 2021; IPBES, 2019a; Marques *et al.*, 2019; Wiedmann *et al.*, 2013). Both indirect and direct drivers are influenced by underlying causes of biodiversity loss stemming from a disconnection from and domination over nature, the concentration of power and wealth, and the prioritization of short-term, individual and material gains over long-term sustainability (IPBES, 2024b). Collectively, these factors are leading to an unprecedented decline of biodiversity (1 million animal and plant species at risk of extinction, many within decades, and decline in most of nature's contributions to people, on which businesses and society depend) (IPBES, 2019a). Transformative change must address these underlying causes and the indirect and direct drivers they influence to achieve a just and sustainable world (IPBES, 2024c).

1.1.4 Linkages with upcoming and existing IPBES assessments

This assessment builds on previous work and summarizes the current state of knowledge on how businesses depend on and impact biodiversity, which can create business risks and opportunities. Upcoming IPBES assessments focus on contributing and supporting national and global efforts to monitor biodiversity and nature's contributions to people, as well as supporting countries and other actors in tracking progress and contributions towards the Kunming-Montreal Global Biodiversity Framework and the Sustainable Development Goals. Existing IPBES assessments have highlighted connections between businesses and biodiversity from various perspectives. This includes highlighting the direct drivers of biodiversity loss to which businesses contribute, which are changes in land and sea use, unsustainable direct exploitation of organisms, climate change, pollution, and invasive alien species as identified in the IPBES Global Assessment (IPBES, 2019a).

The IPBES Transformative Change Assessment identified three underlying causes of biodiversity loss: disconnection from nature, concentration of power and wealth, and prioritization of short-term individual and material gains. It also underscores the urgent need to address interconnected crises — the loss and decline of biodiversity, and the projected collapse of key ecosystem functions — through transformative action. Overcoming these challenges requires not only changes in actions and strategies but also shifts in underlying values, worldviews, and systems. The Transformative Change Assessment offers insights for governments, businesses, civil society, and IPLCs on how to engage with transformative change for a just and sustainable world (IPBES, 2024b).

The Nexus Assessment evaluates the complex interlinkages between biodiversity loss, changes in water availability and quality, food insecurity, risks to health, and climate change (IPBES, 2024e). It underscores the importance of nexus approaches in addressing these linked challenges, preventing isolated decisions that could lead to misalignment, trade-offs, or unintended consequences (IPBES, 2024e).

The Assessment of Invasive Alien Species and Their Control further identifies businesses as drivers responsible for the introduction and spread of invasive species between and within countries, specifically through global trade (IPBES, 2024a). The Assessment of the Diverse Values and Valuation of Nature emphasizes the need to shift the values associated with political and economic decision-making, including those by businesses, to be more aligned with sustainability goals, and highlights different pathways for achieving this, including green economies, degrowth, earth stewardship and biodiversity protection (IPBES, 2022a).

The IPBES Assessment of the Sustainable Use of Wild Species provides a detailed description of the various extractive activities such as fishing, gathering, logging and terrestrial animal harvesting that often result in exploitative use of wild species (IPBES, 2022d). Sustainable use of wild species, therefore, calls for diversification of global value chains, policy instruments that effectively regulate resource extractive activities and the recognition of biocultural practices of IPLCs as necessary for promoting sustainable use (IPBES, 2022d).

Several IPBES assessments focus on documenting the importance of biodiversity and nature's contributions to people for economies at regional scales across each continent (IPBES, 2018b, 2018c, 2018d, 2018e) and at the global scale (IPBES, 2019a). The Global Assessment of Biodiversity and Ecosystem Services provides a useful summary of status and trends of biodiversity and nature's contributions to people, making clear that measures of biodiversity and nature's contributions to people have shown declines for decades. This IPBES Global Assessment made also clear that more than 90 per cent of deforestation worldwide is primarily driven by the expansion of agricultural commodities (IPBES, 2019a). Between 1980 and 2000, one hundred million hectares of tropical forest were lost, mainly as a result of cattle ranching in Latin America and plantations in Southeast Asia (80 per cent of which are for palm oil) (IPBES, 2019a). These assessments serve as important resources in biodiversity-related decision-making (CBD, 2022). They also elaborate on management and policy options, including the role of business activities in halting or reversing biodiversity loss.

The Assessment of Land Degradation and Restoration acknowledges that land degradation drivers and processes vary in severity both within and between countries and impacts the full range of human-altered systems, including drylands, agricultural and agroforestry systems, savannahs, forests and aquatic systems associated with these areas (IPBES, 2018a). Business-related drivers and processes (which the present assessment can help better establish) are also relevant to inform progress towards land degradation neutrality by 2030.

The Assessment of Pollinators, Pollination and Food Production highlights that more than three quarters of leading global food crops rely to some extent on pollinators for yield and/or quality. Furthermore, animal pollination directly contributes to 5-8 per cent of current global crop production, with a market value of $235 – 577 billion (in 2015). It also highlights that current intensive agricultural practices threaten pollination. Adopting sustainable agricultural practices and reversing the simplification of agricultural landscapes are key strategies to address the risks associated with pollination decline. These insights are particularly relevant for businesses involved in the food and agriculture sector (IPBES, 2016a).

The Methodological Assessment of Scenarios and Models highlighted "fit-for-purpose" qualitative and quantitative scenarios and models to produce knowledge and evidence for informed policymaking, including business strategy development. It also recommended that all stakeholders, including the private sector, build capacity in the use of fit-for-purpose scenarios and models and improve accessibility of data sources (IPBES, 2016b).

1.2 KEY CONCEPTS

A clear and common understanding of key terms such as nature, biodiversity, ecosystem services, natural capital, nature's contributions to people, and businesses are needed as a starting point to understand the interaction of businesses and financial institutions with nature.

1.2.1 Biodiversity and nature

The Convention on Biological Diversity (CBD, 2011) defines "biodiversity" as the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and freshwater ecosystems, and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species, and of ecosystems.

Nature underpins and sustains human quality of life. Nature, in the context of IPBES, refers to the natural world with an emphasis on the diversity of living organisms and their interactions among themselves and with their environment (Díaz *et al.*, 2015). Non-living components of the natural world that do not interact closely with living organisms, such as deep aquifers, mineral and fossil reserves, and wind, solar, geothermal and wave power, are also part of nature, but not the focus of IPBES (Brondizio *et al.*, 2019; Díaz *et al.*, 2015; IPBES, 2019a).

The degree to which humans are considered part of nature varies considerably across disciplines and knowledge systems (Brondizio *et al.*, 2019; Díaz *et al.*, 2015). Within the context of natural sciences, nature includes categories such as biodiversity, species, genotypes, populations, ecosystems, the biosphere, ecosystem functioning, communities, biomes, Earth life support's systems, and their associated ecological, evolutionary, biogeochemical processes and biocultural diversity. Within the framework of economics, it includes categories such as biotic *natural* resources, *natural* capital and *natural* assets (Chaplin-Kramer *et al.*, 2023). Within a wider context of social sciences and humanities and interdisciplinary environmental sciences, it is referred to within categories such as *natural* heritage, living environment, or the non-human. Within the context of other knowledge systems, it includes categories such as Mother Earth (shared by many IPLCs around the world), and Pachamama (South American Andes), among many others. Nature's intrinsic values are independent of any human considerations of its worth or importance, whereas instrumental and relational values are human-centered (Pascual *et al.*, 2017).

This assessment predominantly uses the term "nature", particularly when referring to the natural world in general. The term "biodiversity" is used in specific contexts where it is more appropriate, such as when describing approaches for measuring distinct components of biodiversity.

1.2.2 Ecosystem services and nature's contributions to people

Nature's contributions to people refer to all of the contributions, positive and negative, of nature to people's quality of life (Díaz *et al.*, 2015, 2018). Ecosystem services, a term widely used in the economic and ecological literature, and in the business community, are defined as the benefits that people obtain from ecosystems (Millennium Ecosystem Assessment, 2003). The two concepts overlap in describing people's dependence on nature. The inclusive concept of nature's contributions to people adopted by IPBES fully includes ecosystem services as one culturally relevant concept of people-nature interactions (Brondizio *et al.*, 2019; Díaz *et al.*, 2018; Hill *et al.*, 2021).

This assessment uses the broader term "nature's contributions to people", unless there is a reason to specify ecosystem services. For example, where a particular study has segmented and referred to individual ecosystem services, or where the term is part of the name or methodology of an approach, the term "ecosystem services" is used.

1.2.3 Business

There is no universally accepted definition of business or a typology of businesses, generally or for the specific purpose of assessing impacts and dependencies between businesses and biodiversity and nature's contributions to people.

For the purposes of this assessment, business is defined as an entity that is voluntarily involved in the production, exchange and distribution of goods or services that are sold for currency (Donaldson & Walsh, 2015). This definition naturally includes for-profit businesses taking part in regular monetary transactions for purposes that include creating profit. The definition also encompasses state-owned enterprises that engage in the production, exchange and distribution of goods and services for sale to satisfy objectives that may include broader national welfare goals (Boardman & Vining, 1989; Christiansen, 2011; Lawson, 1994; Putniņš, 2015).

Organizations engaging in the production, exchange and distribution of goods and services for sale and for purposes that include creating social, environmental, or community value — including but not limited to those labelled social enterprises, purpose-driven businesses, and hybrid organizations — are considered businesses in this report (Bocken *et al.*, 2014; Busch *et al.*, 2018; Feger & Mermet, 2022; Gartenberg *et al.*, 2016; Slawinski *et al.*, 2021; Vlasov, 2021). In this assessment, family-owned organizations and individuals (or other "smallholder" units) producing, exchanging or distributing goods or services for sale are also considered (Dou *et al.*, 2019; Golez, 2015; Kariyapperuma & Collins, 2021). Individuals or entities operating in the informal sector — defined here as encompassing activities outside of formal markets subject to regulatory, legal and tax oversight and not contributing to formal economic accounting metrics like

Box 1 2 IPLC businesses, traditional economies and livelihoods.

IPLCs carry out a diverse range of economic activities as part of their traditional economies and livelihoods, including in the exercise of their collective autonomy and self-governance or as activities for their basic sustenance. Not all of these activities are categorized as businesses. Similarly, IPLCs may sometimes engage in business activities — usually as individuals — that have no relation to their identity as IPLCs, and do not need to be analysed separately from other types of businesses.

In this assessment, IPLC businesses are understood by reference to several key characteristics. They will generally be owned by IPLCs and governed collectively or contribute to collective objectives. IPLC businesses can be diverse and may vary significantly on their organizational objective, structure, size, business type, degree of formality and recognition. Although many IPLC businesses seek to generate profit, they will often be guided by other values such as benefit sharing, equity, fairness, a relationship of reciprocity with nature and respect for customary laws, governance and principles (IPBES *et al.*, 2023, 2024).

Some examples include: in Bolivia, Indigenous and local communities selling vicuña fiber sourced sustainably from live-shorn animals (CITES, 2019); in Brazil, the Wai Wai Indigenous People operating a Brazil nut business (Instituto Socioambiental, 2024); Indigenous communities in Bolivia involved in the chocolate industry (FAO, 2019); and in Fiji, the Tifajek Mudpools and Hot Springs, a tourism venue established on customary land by Indigenous business (Scheyvens *et al.*, 2020).

IPLC businesses may be developed from traditions, customs and Indigenous and local knowledge and may make use of in-depth local ecological information developed and transmitted over generations. IPLC businesses may be governed by customary law and regularly incorporate principles of sustainability (for example, looking seven generations forward in decision-making) (IPBES, 2023a). The values that inform IPLC business will often stem from, and support, close spiritual and cultural connections to ancestral lands and territories. This assessment acknowledges this important history and recognizes that many IPLCs have strong cultural and spiritual relationships with nature.

gross domestic product (Gërxhani, 2004; ILO, 1972) — are also defined as businesses as long as they engage in the production, exchange and distribution of goods and services for sale.

Governments, public authorities, civil society, policymakers, consumers and non-governmental organizations are not defined as businesses. Likewise, individuals producing goods and services for the primary purpose of subsistence or barter are also excluded from the definition of business. While these entities all generate value and regularly have important dependencies and impacts on nature — and may occasionally produce, exchange or distribute goods and services for sale — their primary activities do not align with the commercial focus that defines businesses in this context. However, although some elements of this assessment may still be relevant to them, they are not the primary focus.

This assessment recognizes the considerable diversity of entities that fall within the broad category of "business". While all businesses have a role to play in addressing their relationship with nature, the extent and nature of that role varies depending on factors such as size, location, sector and geographic location and the scale of their impact and dependencies on nature. This assessment is primarily focused on those businesses with the greatest impacts and dependencies on biodiversity, which include large, small and medium-sized enterprises and transnational businesses.

1.2.4 Financial institutions

This assessment distinguishes between financial institutions and the broader financial system. Financial institutions — such as banks, insurance businesses, asset owners and managers, public development banks, and investment funds (as discussed in **Chapter 5**) — may provide financial goods and services to businesses and individuals in the form of loans, insurance and investments. When financial institutions engage in the production, exchange, or distribution of goods and services for sale, they are considered businesses for the purposes of this assessment. However, we specifically highlight financial institutions when their nature-related dependencies, impacts, risks, or opportunities differ significantly from those of other types of businesses.

In addition, this assessment considers financial institutions in the context of the broader financial system in which they operate. This includes central banks, financial regulators and supervisors, and international financial institutions and standard-setting bodies. Such financial institutions operating in the broader financial system are not considered businesses within this assessment but are recognized for their important role in shaping the financial system. The financial system also encompasses the legal rules, regulatory frameworks and business practices that govern financial transactions. The financial system influences the conditions within which businesses operate and is explored further in **Chapter 6**.

1.2.5 Typology of business activity

A typology of business activity serves as a foundation for exploring business impacts and dependencies on biodiversity and nature's contributions to people. Although there is no universally accepted typology of business activity, this assessment characterizes businesses based on traits frequently emphasized in related scholarly and grey literature. The key differentiating properties of business used in this assessment are sector, size and geography **(Table 1.1)**.

The typology of business sectors used in this assessment follows the International Standard Industrial Classification (ISIC) System (UN, 2008). This system classifies entities on the basis of activities that use inputs (e.g., capital, labour, energy, materials) to produce goods and services (UN, 2008). Alternative typologies that classify business sectors based on revenues, sales and other formal metrics may not fully capture activities in the informal sectors or those conducted by IPLCs actors. Although the ISIC system does not distinguish between formal and informal activities or necessarily between market and non-market activities, its classifications are intended to capture businesses in both the formal and informal economic sectors (UN, 2008) (for further details see **Annex 1.2**).

The ISIC system offers other advantages in the context of this assessment. First, it is global rather than regional. Common alternative classification systems — including but not limited to the Brazilian Classificação Nacional de Atividades Econômicas (CNAE), the Chinese Industrial Classification for National Economic Activities, the European Nomenclature des Activités Économiques dans la Communauté Européenne (NACE), the Indian National Industrial Classification (NIC), or the North American Industry Classification System (NAICS) — may lack global generality. Second, the ISIC system is administered by the United Nations Statistics Division and based on internationally agreed-upon definitions. The system provides classifications generally consistent with the existing grey literature (CBD, 2022; IPBES, 2019a; UNEP, 2022; WBCSD, 2022). It is compatible with the United Nations System of Environmental and Economic Accounting, the system of national accounts, and other common global classifications like the Global Industry Classification Standard (GICS). Third, although the system

Table 1 1 **Typology of business activity by size, region and sector using the ISIC classification system.**

Baseline typology of business				
By size	Micro < 5 participants	Micro 6 - 50 participants	Medium 51- 500 participants	Big > 500 participants
By region	Africa	The Americas	Asia and the Pacific	Europe and Central Asia
By sector	**Description**			
	Agriculture, forestry, and fishing			
	Mining and quarrying			
	Manufacturing			
	Electricity, gas, steam, and air conditioning supply			
	Water supply; sewage, waste management, and remediation activities			
	Construction			
	Wholesale and retail trade; repair of motor vehicles			
	Transportation and storage			
	Accommodation and food service activities			
	Information and communication			
	Financial and insurance activities			
	Real estate activities			
	Professional, scientific, and technical activities			
	Administrative and support service activities			
	Public administration & defence; compulsory social security			
	Education			
	Human health and social work activities			
	Arts, entertainment, and recreation			
	Other service activities			
	Activities of households as employers			
	Activities of extraterritorial organizations and bodies			

is based on incumbent sectors in any given time, the system is adaptable, periodically updated and flexible[8].

This assessment defines a typology of business geography, largely following IPBES regional assessments: the Americas; Africa; Asia and the Pacific; and Europe and Central Asia. Although some businesses may have multiple locations to satisfy legal, tax, organizational and other objectives, for the purposes of this assessment entities are assigned to a geography on the basis of primary location of the activities that use inputs to produce goods and services. This assessment may also identify broader geographies as transnational, encompassing entities with operations in at least one region outside of the "home" geography.

8. The "Exploring Natural Capital Opportunities, Risks and Exposure – ENCORE" tool, which helps assess sector impacts and dependencies on nature, has shifted from using the GICS classification to the International Standard Industrial Classification (ISIC) system (ENCORE, 2025). Some related initiatives (e.g., TNFD, 2022, 2025a); UNDP SDG Investor Platform; Business for Nature; the International Sustainability Standards Board) use the Sustainable Industry Classification System (SICS) developed by the Sustainability Accounting Standards Board (SASB) now part of the IFRS Foundation and the International Sustainability Standards Board (ISSB). SICS shares many features with the ISIC system and key differences are organizational rather than substantive.

1.2.6 Value chains

Understanding impacts and dependencies of business on biodiversity and nature's contributions to people requires an understanding of value chains. A value chain is defined as "the full range of activities, interactions, resources and relationships required to bring a product or service from conception through production, delivery, consumption and end-of-life" (Kaplinsky & Morris, 2000). The related concept of supply chain refers to "the linear sequence of processes, actors and locations involved in the production, distribution and sale of a commodity from start to finish" (TNFD, 2023d).

Supply chains often focus on the sequence of suppliers contributing to a final product, while a value chain emphasizes the value created throughout its full process (SustainAbility, UNEP & UNGC, 2008). This assessment's value chain definition is intended to encompass common aspects of supply chain definitions.

Value chains include various elements. They involve stakeholders such as suppliers, manufacturers, distributors, retailers and customers. External actors also play a role, including strategic partners, business associations, standard setting organizations, governments and communities, all influencing the financing, geographical, geopolitical and regulatory landscape (TNFD, 2023d). Value chains cover activities such as the physical transformation and transportation of goods and services; knowledge; human resources, marketing and other operational inputs and processes (Kaplinsky & Morris, 2000). They include logistical pathways from material sourcing to consumption, complex interactions in space, time, and feedback processes that reflect both human and natural system dynamics (Moretti *et al.*, 2023). Additionally, they show how control, coordination and power may be exercised among stakeholders (Gereffi, 2019; Gereffi *et al.*, 2005).

Other assessments and much of the scholarly literature use the terms value chain and supply chain interchangeably. Many scholars and organizations use both terms without clear definition. As there is no universally accepted use of the terms, this assessment defaults to "value chain" as defined to be maximally inclusive of concepts commonly associated with both value and supply chains in the scholarly and grey literatures. 'Supply chain' is used only when a specific narrower concept is intended and articulated. In the context of this assessment, and when considered from the perspective of any business, the concept of value chain should be understood as referring both to upstream and downstream activities.

1.2.7 Business dependencies on nature

All businesses depend on biodiversity and nature's contributions to people. The type and magnitude of dependencies vary across sectors, sub-sectors, ecosystems, and geographies as detailed in **Chapter 2**. A dependency arises when businesses rely upon, or are affected or constrained by nature's contributions to people, including ecosystem services, while financial institutions may depend on nature through the reliance of the businesses they invest in, lend to or insure (reviewed in detail in **Chapter 2**). Businesses depend directly on biodiversity for inputs such as water, fiber, animal-based energy and genetic materials for their operations and value chains (Natural Capital Coalition, 2016; NCFA & WCMC, 2018). Businesses also depend on a range of regulating and non-material nature's contributions to people such as wild pollination, pest control, water quality and climate regulation for the agriculture sector while those operating in the real estate sector may depend on nature´s scenic beauty (BCG, 2021; TEEB, 2012).

Business dependencies on biodiversity can result in negative impacts if they exceed sustainable levels, which can ultimately pose risks to the business itself. The extent of these risks depends on factors such as the magnitude of the dependency, the availability of substitutes, competition over natural resources and the long-term availability, accessibility and reliability of a sustainable supply of the nature's contributions to people, all of which vary by location (A4S, 2024; TNFD, 2023c).

Despite how important nature-related dependencies can be for an organization, few businesses have assessed them (WBA, 2024). Because many dependencies on biodiversity can be intangible and or difficult to measure, they are often underrepresented in decision-making (Mengist *et al.*, 2020; Dasgupta, 2021). Most scientific studies on the dependencies of businesses on biodiversity and ecosystem services have focused on a few sectors including agriculture, forestry and fishing, arts, entertainment and recreation, and water supply and waste management sectors. As reviewed in **Chapters 3** and **4**, methods for assessing dependencies on biodiversity and nature's contributions to people are generally less advanced than those for assessing impacts on biodiversity, with most available methods for quantifying business dependencies on nature focused on direct dependencies, and fewer approaches available for assessing dependencies within value chains.

1.2.8 Business impacts on nature

Business activities also impact biodiversity (reviewed in detail in **Chapter 3**). In this assessment, business impacts on biodiversity are defined as positive or negative changes in

the quality or quantity of biodiversity resulting from land and sea use, direct exploitation of organisms, climate change, pollution, or the introduction of invasive alien species (IPBES, 2019a). Such impacts may result in changes to the capacity of biodiversity to support social, economic and cultural functions. Businesses' impacts on biodiversity include direct, value chain, indirect and cumulative impacts and can be negative or positive (TNFD, 2023d), although the evidence shows most impacts have been negative (see **Chapter 3**).

1.2.8.1 Types of business impacts on nature: direct, value chain, indirect and cumulative

Businesses have direct, value chain and indirect impacts on biodiversity and its contributions to people. A business's direct impacts refer to those within its direct control and may arise from activities such as resource extraction (e.g., mining and drilling), deforestation or other vegetation clearing for agriculture, manufacturing, transportation and the sale of goods. A business's value chain impacts result from the impacts incurred through its upstream or downstream value chain. Indirect impacts result from activities that were catalyzed by a business's actions but extend beyond its direct operations or value chain. For example, mining operations are expanding in biodiversity-rich biomes (Maus *et al.*, 2022) resulting in direct damage to biodiversity from ecosystems' alteration, such as clearing old-growth forests, to access and extract mineral deposits (Sonter *et al.*, 2018). Indirect impacts include population growth in surrounding areas driven by jobs, improved transportation and energy infrastructure, which in turn increase pressure on biodiversity and its contributions to people beyond sites directly controlled by mining businesses (Sonter *et al.*, 2017). Mining operations can also foster migration with long-lasting impacts and transformation of economic, political and physical landscapes (Botchwey *et al.*, 2019; Crawford *et al.*, 2015).

Indirect impacts can also stem from businesses' financing and investing activities. It can be more difficult to measure and attribute indirect impacts to a single business, although these impacts can have significant implications for nature and its contributions to people (Kramer *et al.*, 2023). A recent study found that ten European banks with the highest financing shares were responsible for about 40 per cent of the global biodiversity impacts linked to European area businesses (ECB, 2023).

When assessing businesses' impacts on biodiversity, it is also important to consider cumulative changes in the state of biodiversity over time (Houdet & Teren, 2022). Cumulative impacts occur when the impacts from multiple businesses combined with impacts from other actors in an area have additive or interactive effects that are greater than would be expected from their individual activities occurring in isolation. Considering cumulative impacts is essential for a comprehensive assessment of businesses' impacts on biodiversity and nature's contributions to people (more details in **Chapter 3**). For example, marine and coastal ecosystems are threatened by cumulative impacts from overfishing, land- and sea-based pollution, rising sea temperatures and ocean acidification (IPBES, 2019a; Simeoni *et al.*, 2023). These combined pressures can interact, potentially pushing ecosystems past critical tipping points, leading to irreversible losses (Armstrong *et al.*, 2022; Bai *et al.*, 2022; Flores *et al.*, 2024; Heinze *et al.*, 2021; Simeoni *et al.*, 2023). Similarly, intensive land management practices combined with the impacts of climate change lead to stronger decline in ecosystem multifunctionality — the ability of ecosystems to provide ecosystem services — in both grasslands and croplands, posing significant risks to the agriculture sector (Scherzinger *et al.*, 2024). When multiple factors contribute to environmental challenges, determining attribution can be challenging but remains essential for effective risk management and informed decision-making.

1.2.8.2 Positive and negative impacts of business on nature

Businesses, including financial institutions, are pivotal in driving economic activity in sectors that contribute to jobs, health, food production, economic development and many other factors associated with quality of life. For example, sectors such as agriculture and livestock, fisheries, forestry, infrastructure and mining deliver many benefits to society but activities in these sectors also heavily contribute to biodiversity loss (IPBES, 2024c). Businesses may have both positive and negative impacts on biodiversity and nature's contributions to people, which will vary based on factors such as sector, size and geography.

Businesses negatively impact nature and its contributions to people by influencing the major drivers of biodiversity loss (IPBES, 2019a). Examples of negative impacts from businesses include the conversion and degradation of ecosystems, the overharvesting of wild species for trade, food or medicine (e.g., fisheries, timber), pollution from chemicals, plastic and other forms of packaging (Cowger *et al.*, 2024), the spread of invasive species through global trade, and greenhouse gas emissions from business activities (Hulme, 2009; IPBES, 2019; Thomson & Fairbairn, 2023).

Businesses can also have positive impacts on biodiversity and nature's contributions to people, however, as noted in **Chapter 3**, these are often not tracked in a standardized way, and are smaller than the negative impacts that businesses have on biodiversity. For example, businesses have had positive impacts on biodiversity by restoring forests, pollinator habitat important for food production, and watersheds or wetlands that support habitats for birds

and mitigate flooding (Ingram *et al.*, 2022; WBCSD, 2017). While positive impacts on biodiversity combined with a reduction in negative impacts are both important actions for businesses to take, all impacts on biodiversity need to be compared to a baseline. Furthermore, it is critical that business contributions to biodiversity outcomes incorporate alignment with the mitigation hierarchy to ensure that activities are indeed positive for biodiversity (Maron *et al.*, 2023). In addition, for businesses to align with global goals for nature such as those set out within the Kunming-Montreal Global Biodiversity Framework, they will need to do more than merely compensate for negative impacts, they will need to deliver biodiversity improvements relative to a baseline.

Within this context, the concept of businesses, financial institutions and others being "nature positive" or contributing to "nature positive" outcomes has emerged since 2021 across multiple fora and initiatives, particularly in Europe and North America. The central principle of the concept is that business-as-usual is "nature negative" and needs to become "nature positive" (Locke *et al.*, 2021; Milner-Gulland, 2022).

However, definitions and interpretations vary and the concept is used in different ways in different contexts (Pollination, 2024; zu Ermgassen *et al.*, 2022). As increasing numbers of businesses and initiatives adopt the language of "nature positive", including in their names, it is unlikely that a single, universally accepted definition is needed or could cover all uses of the term, or apply across all regions (SBTN, 2024b). Prior to the adoption of the Kunming-Montreal Global Biodiversity Framework, efforts were promoted by a group of NGOs to make the concept a central tenet of the framework (Locke *et al.*, 2021). The mission of the framework agreed at COP15 is to "take urgent action" by 2030, where actions are the focus of effort. The outcome of those actions is expected to "halt and reverse biodiversity loss and put nature on the path to recovery", recognizing these outcomes will only be achieved over a longer timeframe in the period beyond 2030. However, the concept of nature positive – as variously defined – typically claims outcomes over a much shorter period and cannot therefore be said to align with or represent the Goals and Targets of the Kunming-Montreal Global Biodiversity Framework (Convention on Biological Diversity (CBD), 2022).

Box 1 3 Business impacts on Indigenous Peoples and local communities.

IPLCs' interaction with business is complex. On the one hand, many IPLCs are business actors, often operating in more sustainable ways than other businesses and guided by diverse values. Sometimes, IPLCs have chosen to engage in business; sometimes they had to engage as a result of displacement, loss of access to traditional livelihoods or forced urbanisation. In other cases, IPLCs would like to operate businesses but are faced with barriers (IPBES *et al.*, 2024).

On the other hand, IPLCs are also very often affected by the operations of other businesses. Some business interactions with IPLCs can be positive, for example the rooibos benefit sharing agreement in South Africa (Rooibos Council, 2022). However, IPLCs overwhelmingly report negative interactions with business, for example experiences of dispossession of their lands and resources for mining or agribusiness, extractives, oil and gas, infrastructure development, commercial logging and timber concessions (Scheidel *et al.*, 2023; Dobinson *et al.*, 2023; Pictou *et al.*, 2021), toxic pollution of their environment (Fernández-Llamazares *et al.*, 2020), loss of access to or desecration of sacred sites (Barclay & Steele, 2021), unacknowledged and unauthorised use of Indigenous and local knowledge (Shiva, 2016; Wynberg, 2023), violations of their biocultural rights (Girard *et al.*, 2022) or threats or killings of human rights defenders (Butt *et al.*, 2019).

Often these negative business impacts have had deleterious impacts on IPLCs because of their strong cultural and spiritual relationships with, and dependencies on nature. For many IPLCs, impacts on nature and people are deeply intertwined and the separation between these impacts is artificial (IPBES, 2024a).

Because of IPLCs' high dependence on nature, negative impacts on biodiversity experienced by IPLCs will usually also have significant social and human rights impacts (Scheidel *et al.*, 2023b). In some cases, such impacts can lead to these groups adopting more unsustainable practices as a coping mechanism, amplifying environmental harm. In addition, efforts by businesses to manage environmental impacts, for example by using conservation or biodiversity offset areas, may also have negative impacts on IPLCs by dispossessing or limiting their access and use (Bidaud *et al.*, 2017, 2018; Jones *et al.*, 2019). IPLCs also often struggle to receive equitable benefits when businesses exploit their resources. Even when projects they participate in achieve targets like reducing deforestation or lowering carbon emissions, they may still be excluded from equitable gains.

At the same time, IPLCs often hold deep local ecological knowledge that can be critical to understanding and monitoring impacts on biodiversity (Hill *et al.*, 2020; Lyver *et al.*, 2018; Balehegn, 2016). In their own interaction with nature, IPLCs often have either low negative impacts or positive impacts on biodiversity (Chettri & Sharma, 2022; Sangha *et al.*, 2021). Guidance tailored to the private sector exists to support businesses in their engagement with IPLCs and affected stakeholders when identifying, assessing and disclosing impacts and dependencies on biodiversity and nature's contributions to people (SBTN, 2024a; TNFD, 2023b).

Business impacts on nature – both negative and positive – create costs, benefits, risks and opportunities for business and affected stakeholders (TNFD, 2023c). The distribution of the benefits and costs of the impacts from business activities is unequal over time and space and perceptions of what constitutes a good quality of life, and of the value of nature, vary among different groups (IPBES, 2022b). Business activities may bring benefits to some groups while negatively affecting the quality of life of others. For example, IPLCs have been directly impacted by industrial activities (Scheidel *et al.*, 2023a) and the urban poor (often ethnic minorities) have been affected by air pollution caused by industrial activity (Leonova & Rentschler, 2022). Unsustainable business practices can also compromise the quality of life of future generations. These impacts can lead different groups to change their behaviour in ways that either amplify or counteract the initial impact on nature (**Box 1.3** illustrates examples of impacts on IPLCs). To navigate these interactions, businesses need to consider the interconnected relationships between social and environmental impacts.

1.2.9 Nature-related risks: physical, transition and systemic

Risks are defined as the potential for negative or adverse consequences for societies and ecosystems (IPCC, 2023; UNDRR, 2019). In the context of businesses, nature-related risks refer to the "potential threats posed to an organization that arise from its and wider society's dependencies and impacts on nature" (TNFD, 2023c). From an economic perspective, biodiversity loss presents significant risks to the global economy (UNEP, 2021) and has been identified as the highest-ranked global risk that could negatively impact a significant proportion of global gross domestic product, business and populations or natural resources over the next 10 years, according to the World Economic Forum (WEF, 2025b).

In the business and finance context, climate- and nature-related risks are categorized as physical, transition (TCFD, 2017) and systemic risks (TNFD, 2023c). Nature-related physical risks to an organization result from the degradation or loss of biodiversity and nature's contributions to people that businesses depend upon and impact (NGFS, 2023a; TNFD, 2023d). These can be acute in the case of a short-term event. For example, deforestation combined with heavy rainfall events in Rwanda has resulted in severe flooding and sedimentation of water resources that decreased production of hydroelectricity plants in the country, resulting in significant costs (IUCN, 2015). Physical risks can also result from chronic stressors if they involve longer-term shifts in the state of biodiversity (TNFD, 2023d). For example, declining water quality has been correlated with declining real estate values (Nicholls & Crompton, 2018). Nature-related transition risks to an organization may result from a misalignment of economic actors with actions to protect, restore and reduce negative impacts on biodiversity (TNFD, 2023d). These types of risks can be prompted by changes in regulation and policy, legal precedent, technology, investor sentiment and consumer choices that may cause adverse business consequences (NGFS, 2023a). For example, consumer preferences and media scrutiny of businesses linked to deforestation in their supply chains have created significant reputational and market risks for some food and agriculture businesses (Bromley, 2023).

Systemic risks emerge from disruptions that collectively lead to the collapse of the whole system. These risks often start at seemingly minor thresholds that escalate into widespread breakdowns through a chain of interactions and contagions, where one incident sets off a sequence of others, leaving the system unable to stabilize after a shock (TNFD, 2023d). Systemic risks can result from ecosystems crossing tipping points – such as the irreversible melting of ice sheets in Greenland and Antarctica, the collapse of the Atlantic Ocean circulation system, and the transformation of the Amazon rainforest into a dry savanna (Möller *et al.*, 2024), which could have far-reaching economic, social, and ecological consequences. According to recent projections, there is a roughly 45 per cent probability that these tipping points could be reached within the next 300 years (Möller *et al.*, 2024; Willcock *et al.*, 2023).

Despite growing awareness of the systemic risks that nature degradation and loss pose to the global economic and financial system, there is still limited clarity on how these risks translate into corporate/financial balance sheets (Carvalho *et al.*, 2023). However, a growing body of literature is starting to shed light on how these risks can be assessed and translated for businesses and financial institutions (Alvarez *et al.*, 2025; BloombergNEF, 2023; Green Finance Institute, 2024; Marsden *et al.*, 2024; Ranger *et al.*, 2023; TNFD, 2025d). While some sectors and regions recognize that their impacts and/or dependencies on biodiversity create risks for businesses (CERES, 2024; Norwegian Ministry of Climate and Environment, 2024; Ranger *et al.*, 2023), many businesses remain unaware (WBA, 2024). A growing range of tools and datasets is becoming available to help businesses, investors and other stakeholders better understand and manage their exposure to nature-related risks and impacts (TNFD, 2025c). For example, scenario analysis is a useful tool for supporting organizations in better understanding the risks they face and has been used for assessing climate-related risks of businesses (TCFD, 2020). Recently, guidance has been developed to support central banks and supervisors (NGFS, 2023b), financial institutions and large multinational businesses (TNFD, 2023a), with using scenario analyses to assess nature-related financial risks.

1.2.9.1 Financial effects from nature-related risks

Evidence of the financial effects of nature-related risks is extensive across sectors and scales, but company-specific data is limited due to reliance on publicly available sources. The strongest evidence exists for financial effects linked to water scarcity, liability and policy and reputational risks, while full causal chains from nature loss to financial outcomes remain underexplored (Alvarez *et al.*, 2025; TNFD, 2025d). Nature loss can have significant macroeconomic, macroprudential and microprudential consequences, posing systemic risks to financial system stability (NGFS, 2023a).

Financial institutions within the broader financial system — including central banks and supervisors — are increasingly working to understand how nature-related risks affect both the broader economy and financial stability (Banque de France, 2021; DNB & PBL, 2020; Hadji-Lazaro *et al.*, 2024; NGFS & INSPIRE, 2021; NGFS, 2023b, 2023a). These risks become material when biodiversity loss inhibits business operations or impacts supply chains. For example, ecosystem conditions such as reduced water availability can have a critical impact on business operations for beverage businesses (Weber & Saunders-Hogberg, 2018). Furthermore, environmental degradation can result in risks such as reduced creditworthiness of affected businesses, higher capital investment needs and costs and lower productivity (NGFS, 2023a). A decline in creditworthiness can, in turn, create risks for banks, lenders and insurers.

To address these challenges, central banks and supervisors are advancing efforts to assess corporate dependencies on biodiversity as part of their credit and lending evaluations (ACPR, 2024; ECB, 2023; NGFS, 2023a, 2024a), recognizing that poorly managed dependencies can translate into nature-related risks. For example, the Organization for Economic Co-operation and Development (OECD), in collaboration with the Hungarian Central Bank, developed a supervisory framework that translates biodiversity risks into financial risks and conducted a technical assessment of these risks within Hungary's economy and financial system (OECD, 2023). Similarly, the Financial Stability Board has reviewed how financial authorities are addressing the implications of nature-related risks (FSB, 2024). **Table 1.2** presents a few examples of central banks and supervisors evaluating portfolio exposures to nature-related risks, especially focusing on sectors that are highly dependent on biodiversity. These efforts aim to identify and measure the nature-related risks facing financial institutions and their potential impacts on overall financial stability.

Table 1 2 **Examples of central banks and supervisors assessing nature-related portfolio exposures in high-dependency sectors.**

Region/Entity	Key nature-related exposure	Source
Brazilian Banks	46 per cent of corporate loan portfolios are exposed to biodiversity loss, with significant lending to sectors highly dependent on ecosystem services.	Calice *et al.* (2021)
Dutch Financial Institutions	Dutch financial institutions alone have €510 billion in exposure to biodiversity-related risks.	DNB & PBL (2020)
French Financial Institutions	42 per cent of securities market value is linked to businesses that are highly or very highly depending on at least one ecosystem service.	Banque de France (2021)
Euro Area Corporate Loans	Within Europe 72 per cent of businesses and 75 per cent of corporate loans highly depend on at least one ecosystem service.	Boldrini *et al.* (2023)
Georgian Commercial Banks	46 per cent of Georgian commercial banks' lending is potentially exposed to biodiversity-related physical risks due to moderate to high or very high dependence on one or more ecosystem services. 54 per cent of these banks' business lending portfolios may face high transition risk from lending to sectors with strong impacts on those ecosystem services.	Nikuradze & Tvalodze (2023)
Malaysian Commercial Banks	54 per cent of the commercial loan portfolio is exposed to sectors highly dependent on ecosystem services, with key vulnerabilities in surface water (29 per cent), carbon storage (26 per cent), and flood/storm protection (16 per cent). Additionally, 87 per cent of loans are to sectors that strongly impact ecosystem services, particularly through greenhouse gas emissions (61 per cent), water use (55 per cent), and terrestrial ecosystem disruption (43 per cent), indicating significant transition risk exposure.	World Bank & Bank Negara Malaysia (BNM) (2022)

Nature-related risks can also lead to legal liabilities, illustrated by litigation against businesses and financial institutions linked to ecosystem damage, especially through global supply chains (NGFS, 2024b).

Banks, insurers and investors are exposed to nature-related risks through their lending, underwriting and investment activities – particularly when financing sectors with significant dependencies or impacts on biodiversity, or businesses operating in sensitive locations such as key biodiversity areas (Calice *et al.*, 2021; DNB & PBL, 2020; van Toor *et al.*, 2020). For example, when banks and investors finance certain practices in high-risk sectors — such as seafood (wild-caught fisheries and aquaculture), ports, maritime transportation, marine renewable energy, and coastal or marine tourism — these activities may require thorough risk assessment and, in some cases, exclusion from financing (UNEP FI, 2021). Similarly, investors may be exposed to risks from portfolio holdings linked to deforestation and associated human rights abuses, particularly when financing certain commodities in high-risk regions (UNEP FI & PRI, 2025).

Nature-related risks are also important for insurers as biodiversity degradation and loss can affect their underwriting activities across their insurance value chain and through the activities of associated actors (ACPR, 2024; EIOPA, 2023; NGFS, 2023a; UNEP FI, 2023a, 2025b). This includes exposure via goods and services from upstream claims, as well as through insured assets and processes, liabilities and human health and life covered in downstream underwriting portfolios (UNEP FI, 2025b). Efforts have focused on identifying pathways to capture the risk reduction benefits provided by reef habitats into insurance premiums (Reguero *et al.*, 2020). However, there are only a few examples of insurance products that integrate the risk reduction benefits of biodiversity (Asian Development Bank (ADB), 2022; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2023; Schelske *et al.*, 2021; Swiss Re Institute, 2020).

1.2.10 Nature-related opportunities

Nature-related opportunities for businesses and financial institutions can arise from both their dependencies and their impacts on biodiversity and refer to activities that create positive outcomes for organizations and biodiversity through positive impacts or mitigation of negative impacts on biodiversity (TNFD, 2023d). These include the strategic transformation of business models, products, services, markets and financing mechanisms that deliver biodiversity benefits or activities that avoid, reduce, mitigate or manage nature-related risks. Opportunities for businesses stemming from their impacts and dependencies will vary across sector, geography, local social and cultural contexts, and market and economic factors.

A growing number of examples demonstrate opportunities that can deliver positive outcomes for businesses, biodiversity and other stakeholders. For example, recent studies show that sustainable land management, agroforestry, cover crops and improving grazing intensity may grow in value from the current $200 billion to $542 billion annually by 2030 and quadruple to $737 billion by 2050 (UNEP, 2023b). Meta analyses across multiple continents have shown that diversified farming systems are at least as profitable as simplified ones, and in some cases more profitable, while delivering positive outcomes for biodiversity and climate (Sánchez *et al.*, 2022). Multiple examples show that projects and investments that are focused on delivering positive outcomes for biodiversity and nature's contributions to people — especially in agriculture — can be profitable, commercially viable and scalable (The Climate Champions Team *et al.*, 2024).

The business case for investing in nature-based solutions that deliver key benefits for business — such as regulation of water quality or water quantity — has been demonstrated globally (CPI, 2024; Green Finance Institute Hive *et al.*, 2025; Green *et al.*, 2024; UNEP Copenhagen Climate Centre (UNEP-CCC), 2025; WBCSD, 2017, 2024). Businesses have found that such investments can be more cost-effective than built alternatives, require less capital investment, have lower long-term operational and maintenance costs and can reduce labour requirements (WBCSD, 2017). Such solutions, including conservation or restoration of tropical forests, mangroves or seagrass meadows, can also offer significant co-benefits such as carbon storage or sequestration (Anderson *et al.*, 2019; Buma *et al.*, 2024; Griscom *et al.*, 2017; Seddon, 2022; UNEP Copenhagen Climate Centre (UNEP-CCC), 2025; Weiskopf *et al.*, 2024b). In some cases, carbon revenues from nature-based solutions have helped make investments in nature restoration and sustainable land management financially viable (UNEP, 2023b). However, although natural climate solutions are important for mitigating climate change, they do not lessen the urgent need for direct emission reductions in high greenhouse gas-emitting sectors (Anderson *et al.*, 2019; Buma *et al.*, 2024).

Efforts to halt and reverse biodiversity loss are also spurring new business products, services and models in sectors such as chemicals, fashion, mining, forestry and agri-food (BloombergNEF, 2024; Business for Nature, n.d.-c; TNFD, 2025f; UNEP, 2023a; UNEP FI, 2024; WBCSD, 2023; WEF, n.d.). Specific examples include commercial opportunities such as advanced agricultural machinery manufacturers, startups focused on environmental DNA, businesses optimizing water use and wastewater treatment to improve resource efficiency and businesses operating in the circular economy space (BloombergNEF, 2024). In addition, sectoral transitions can also create substantial lending, investment and underwriting opportunities for financial institutions (WEF, 2020; WEF & Oliver Wyman,

2024). For example, WEF (2020) identified fifteen systemic transitions with annual business opportunities valued at $10 trillion and the potential to create 395 million jobs by 2030 — pathways that can support both people and nature while strengthening resilience to future shocks (WEF, 2020; WEF & Oliver Wyman, 2024).

1.3 EVOLVING BUSINESS ENGAGEMENT WITH BIODIVERSITY AND NATURE'S CONTRIBUTIONS TO PEOPLE

In the absence of external pressures, regulatory incentives or clear business reasons, businesses and private markets often fail to integrate the values of biodiversity and nature's contributions to people into their investments, sourcing decisions and operations, reflecting classic market failures. Biodiversity loss represents a "negative externality", where the costs of environmental damage are imposed on others without compensation. Biodiversity and ecosystem services can be viewed as "public goods" (Costanza, 2008) that are underprovided by private markets due to "free riding", where individuals benefit from public goods without paying fully for them (Stiglitz, 1977). Additional barriers such as "technology lock-in" and "stranded asset" considerations further hinder integration of nature´s values into business decision-making" (Caldecott, 2017; Unruh, 2000). As biodiversity is lost and degraded globally, the supply of these public goods declines and, consequently, the costs of delivering these benefits rises. Although many aspects of biodiversity and its contributions to people have historically been considered public goods, they can be managed as private goods when property rights or resource tenure are secure and clearly defined, as in cases of IPLCs management (Ostrom, 2010, 2015).

Because of these dynamics, throughout much of recent history, policy and regulations have mostly focused on addressing the negative impacts that businesses may have on biodiversity and nature's contributions to people. For example, in the late 20th century, the public became more aware of environmental concerns from human activities, including those linked to businesses and their activities. Multilateral agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), signed by over 180 parties, were established to protect species from extinction attributable to trade, development and growth (CITES, 1973).

Environmental impact assessments, introduced in the 1970s and now embedded in national laws and multilateral agreements, are used mainly at project level as a tool to identify, predict, evaluate and mitigate the biophysical, social and other relevant effects of development proposals prior to major decisions and commitments (Arabadjieva, 2016; El-Fadl & El-Fadel, 2004; Morgan, 2012; UN, 1992). The mitigation hierarchy is a common approach in environmental impact assessments across sectors to prioritize avoiding negative impacts on biodiversity and minimizing, restoring, and as a last resort, offsetting any residual impacts (Phalan *et al.*, 2018). Environmental impact assessment processes face limitations, especially when economic priorities prevent businesses from applying the mitigation hierarchy (Bond *et al.*, 2020). Nonetheless, they can help predict operations-specific impacts and support biodiversity measures (Hugé *et al.*, 2020; Mandai & Souza, 2021), and have informed international standards, safeguards and guidelines for assessing project impacts (ADB, 2023; GEF, 2019; World Bank, 2017).

By the late 1980s and 1990s, growing recognition of biodiversity's economic value and the benefits of its conservation (Daily, 1997; Stiglitz, 1977, 1998; Wilson, 1999) and the rise of the concept of sustainable development — popularized by the Brundtland Report in 1987 and the Rio Earth Summit in 1992 — encouraged businesses to integrate environmental and social considerations (UN, 1992). The United Nations Global Compact in 2000 (UNGC, 2000) and the Johannesburg Summit in 2002 set guidelines on corporate responsibilities and multi-stakeholder collaboration (Latapí *et al.*, 2019; Dasgupta 2021).

Most recently, attention has focused on the financial impacts and risks that businesses and financial institutions will face as a result of biodiversity loss (TNFD, 2023d). In addition, emphasis has shifted to focus on businesses' dependencies on biodiversity, alongside their impacts on biodiversity (Natural Capital Coalition, 2016). This represents a shift from a historical focus on the negative impacts that businesses have on biodiversity. As businesses increasingly address both their impacts and dependencies on biodiversity and how these can create risks or opportunities for their organization, they realize that in many contexts there is a business case for reducing negative impacts and advancing opportunities that restore, protect or sustainably manage biodiversity (Alvarez *et al.*, 2025).

1.3.1 Integration of climate and nature actions, including human rights interlinkages

Adopted in 2015, the Paris Agreement became a turning point for businesses and financial institutions on climate change. Building on experience gained under the United Nations Framework Convention on Climate Change, the

business community began applying approaches for reducing greenhouse gas emissions (Pörtner *et al.*, 2021). Links between climate and biodiversity are now increasingly understood and recognized (Pörtner *et al.*, 2021). For example, at the United Nations climate change conference in 2021, the Glasgow Leaders' Declaration on Forests and Land Use — endorsed by 145 countries — pledged to mobilize public and private climate finance. This declaration highlights the crucial and interconnected roles of all types of forests, biodiversity and sustainable land use in achieving the Sustainable Development Goals, including balancing human-caused greenhouse gas emissions and removals by natural processes (carbon sinks), adapting to climate change and maintaining other benefits to people (UN, 2021). Because biodiversity loss and climate change are interdependent and produce compounding impacts on people and nature, addressing these issues in isolation of one another can lead to trade-offs and undermine opportunities of positive outcomes for people, nature and the climate (IPBES, 2024d).

1.4 RECENT FRAMINGS OF THE INTERACTIONS BETWEEN BUSINESS, FINANCIAL INSTITUTIONS AND NATURE

1.4.1 Initiatives and frameworks guiding business and financial institutions actions on nature

As businesses and financial institutions increasingly recognize their impacts and dependencies on biodiversity and the related business value, opportunities and risks, some are taking voluntary actions beyond regulatory requirements. For example, voluntary market-led initiatives for measuring and reporting on biodiversity are catalysing business and financial institutions' efforts to understand, identify, assess, disclose and manage nature-related dependencies, impacts, risks and opportunities. **Table 1.3** provides an overview of several, current (as of 2025) voluntary initiatives and coalitions that are playing roles in supporting these efforts. These initiatives reflect a growing recognition of the financial risks posed by biodiversity loss and the opportunities for improving biodiversity outcomes and business performance (CISL, 2020b; Lammerant, 2021; PRI, 2024a; TNFD, 2025d; WEF, 2025a; WEF & PWC, 2020).

An initiative that has catalyzed voluntary nature-related disclosures and related efforts by businesses and financial institutions is the Taskforce on Nature-related Financial Disclosures (TNFD). The TNFD followed a similar structure to the Task Force on Climate-related Financial Disclosures (TCFD). The TCFD was a market-led initiative created by the Financial Stability Board that released its climate-related financial disclosure recommendations in 2017 on the information that businesses should disclose to support investors, lenders and insurance underwriters in appropriately assessing and pricing risks related to climate change (TCFD, 2017). Both the TNFD and TCFD recommendations share four core pillars — governance, strategy, risk management, and metrics and targets.

A key development in the way businesses assess nature-related issues involves the concept of materiality. Various frameworks and guidance documents increasingly encourage businesses and financial institutions to evaluate the materiality of nature-related issues in their decision-making processes (CISL, 2020b; EFRAG, 2024a; IFRS, 2023; TNFD, 2023d). However, the concept is interpreted differently across sustainability reporting standards and initiatives (UNEP–WCMC & UNEP FI, 2025). Under the *single materiality — or financial materiality* — approach, materiality is defined solely in terms of how information may affect a company's financial performance. It focuses on identifying information that could influence the decisions of investors and other primary users of financial reports. Information is considered material if its omission, misstatement or obscuring could reasonably be expected to affect these users' decisions based on the company's sustainability disclosures (EFRAG, 2024a). This is the approach adopted by the International Sustainability Standards Board (ISSB), which aims to meet the information needs of capital markets and focuses on the financial impacts of sustainability issues on enterprise value (IFRS, 2023).

There is growing evidence that nature-related risks can have material financial effects on businesses and financial institutions — by influencing cash flow, cost of capital, and access to finance over various time horizons (CISL, 2020a; TNFD, 2025d). These risks can, in turn, shape investor decisions and capital allocation. Yet, despite these clear linkages, nature-related issues are often not recognized as financially material in corporate reporting under the single materiality perspective (TNFD, 2025d). In contrast, the *double materiality* approach expands the scope of assessment to include not only how nature-related issues affect the company, but also how the company's activities impact biodiversity and people. This approach is supported by Global Reporting Initiative (GRI) standards, and Carbon Disclosure Project (CDP) questionnaires and is embedded in the European Sustainability Reporting Standards (ESRS), which require organizations to report both on the impacts of their activities on the environment and society, and on how

sustainability matters affect the organization (CDP, 2023a; EFRAG, 2024a; GRI, 2022). Double materiality enables a more holistic understanding of a company's dependencies and impacts on biodiversity, which can generate both risks and opportunities (EFRAG, 2024a).

While the TCFD applied a financial materiality lens to meet the needs of investors, lenders, and insurers on climate, the TNFD adopts a more flexible approach — allowing for financial, impact or double materiality, depending on the user's reporting objectives and context.

Table 1 3 **Selected voluntary market-led measurement and reporting initiatives.**

Name	Actors	Description	Current Status of Users/ Outreach[9]	Sources
Real economy actors (non-sector specific)				
The Science-based targets network (SBTN) for nature	Corporates and cities	Provides guidance for businesses and cities to set climate and nature targets that respect sustainability and social equity principles. The approach offers a method for setting targets using scientific principles, but it does not yet support businesses to set truly science-based targets for biodiversity.	Limited: As of October 2024, three businesses have publicly adopted science-based targets for nature, beginning with freshwater and land.	Science Based Targets Network (SBTN) (n.d.)
Business for Nature	Global, national and sector business associations, alongside leading conservation organizations	Global coalition of over 100 partner organizations aiming to accelerate the transition to a nature-positive economy by mobilizing business leadership. Their 2030 strategy focuses on shaping global and regional policy direction and enabling national-level implementation.	High: Over 100 partner organizations and a network of 1500+ businesses through the Nature is Everyone's Business Call to Action for governments to adopt policies now to reverse nature loss in this decade.	Business for Nature (n.d.-a)
The Nature Positive Initiative	Conservation organizations, business and finance coalitions	Since 2019, institutions come together to support broader, longer-term efforts to deliver outcomes for biodiversity	Limited: 28 alliances and institutions comprise their core stewardship group.	Nature Positive Initiative (n.d.)
CDP Biodiversity	Businesses, cities, states and regions	A global non-profit operating an independent environmental disclosure system for businesses, capital markets, cities, states, and regions to manage their environmental impacts. The platform covers disclosures on climate, water, forests, and biodiversity. As of 2023, 23,293 businesses reported on climate, 4,815 on water, 1,152 on forests, and 11,453 on biodiversity.	High: As of 2023, 11,453 businesses reported biodiversity-related disclosures, up from 7,974 in 2022.	CDP (2025)
Frameworks and initiatives for corporates and financial institutions				
Taskforce on Nature-related Financial Disclosures (TNFD)	Corporates, financial institutions, market service providers	A market-led initiative launched in 2021 with 40 members. Its mandate is to develop a framework for identifying, assessing, and disclosing impacts and dependencies on nature and associated financial risks and opportunities for organizations. In addition to its disclosure recommendations, the TNFD has developed guidance, including an approach called Locate Evaluate Assess Prepare "LEAP" to help businesses and financial institutions to assess nature-related dependencies, impacts, risks and opportunities.	High: In the latest status report in 2025, 620 businesses, including financial institutions, committed to start making nature-related disclosures between fiscal years (2024-2027) on their material nature-related issues following the recommendations of the TNFD.	TNFD (2023c, 2024c, 2025e)

9. Current user status is considered limited when fewer than 30 institutions are actively participating; medium when participation ranges from 30 to 100 institutions; and high when more than 100 institutions are actively engaged, with a growing membership or user base.

Table 1 3

Name	Actors	Description	Current Status of Users/ Outreach[9]	Sources
The Partnership for Biodiversity Accounting Financials (PBAF)	Financial institutions	Framework for financial institutions to assess and disclose the impact and dependencies of their loans and investments on biodiversity.	Medium: As in July 2025, 71 financial institutions joined.	PBAF Global (n.d.)
Finance for Biodiversity Pledge	Financial institutions	Launched by a group of 26 financial institutions in 2020. These institutions have committed to collaborate, engage, assess their own biodiversity impact, set targets, and report on biodiversity matters through their finance activities and investments	High: 200 signatories.	Finance for Biodiversity Foundation (n.d.)
Nature Action 100	Investor engagement	Global investor engagement initiative aiming to drive corporate ambition and action to reduce nature loss in key sectors including biotechnology and pharmaceuticals, chemicals, consumer goods retail, food, food and beverage retail, forestry and packaging, household and personal products, and metals and mining.	High: As of July 2025, more than 230 institutional investors — representing over $30 trillion in assets under management or advice — from around the world participate.	Ceres & Nature Action 100 (2024)
Sector or Topic-Specific				
The Finance Sector Deforestation Action (FSDA) initiative	Financial institutions	Launched in 2021, involves 34 financial institutions with more than $8 trillion in assets. The participating investors have committed to use best efforts through 2025 to eliminate deforestation connected to the operations of the businesses in their investment portfolios, by adopting deforestation policies, assessing and disclosing deforestation risks, and mitigating these risks.	Medium: All FSDA members (34 investors) now have a deforestation policy in place. In contrast, only 25 per cent of financial institutions globally with "net zero" or other climate commitments have any deforestation policy, according to the Deforestation Action Tracker.	FSDA (2024)
UN-Convened Finance Alliances (Asset Owner and Banking Alliances, Principles for Responsible Banking and Sustainable Insurance)	Mainstream finance: Institutional investors, commercial banks and insurers	In 2024, 553 financial institutions — collectively representing over $125 trillion in assets — were members of UN-convened alliances or initiatives from institutional investors, banking and insurers. These industry-led alliances have dedicated working groups on nature-related issues, tailored to institutional investors, banks, and insurers. They have developed guidelines, documented emerging practices, and launched pilots on assessing, disclosing and managing nature-related considerations into financial portfolios. For example, the Net-Zero Asset Owner Alliance has published expectations on eliminating deforestation from company supply chains, urged policymakers to mandate reporting and end harmful subsidies, and called on data providers to improve transparency and align metrics with reporting frameworks.	High: Tailored guidance and practice documents and commitments for different financial institutions, with high participation of mainstream financial institutions (over 500) and therefore, high usability.	UNEP FI (2023b, 2024, 2025b), UNEP FI & PRI (2025)
Forest 500	Businesses and financial institutions	A public data initiative by Global Canopy to identify high-risk businesses and financial institutions, enable peer comparison, and benchmark progress on deforestation. As of 2025, only 16 businesses (3 per cent) are considered leaders, with strong commitments across all forest-risk commodities and clear evidence of implementation. In contrast, 316 businesses (63 per cent) fall into the late majority, showing partial or poorly implemented commitments — often focusing on high-profile commodities like palm oil while neglecting major drivers like beef. Meanwhile, 168 businesses (34 per cent) are classified as laggards, with no public deforestation commitments; 24 of these have shown no progress over a decade.	High: Over a decade, Forest 500 has tracked the 500 most influential businesses in the global trade of nine key forest-risk commodities — beef, leather, soy, palm oil, timber, pulp and paper, cocoa, coffee, and rubber — assessing their deforestation commitments and performance.	Thomson, E. (2025)

In parallel, businesses are also seeking to understand and manage the value that natural capital provides to businesses and financial institutions. Approaches such as ecosystem services valuation and natural capital accounting can support businesses and financial institutions with understanding and tracking how their impacts and dependencies on biodiversity as identified through a materiality assessment translate into monetary financial values, and business risks or opportunities for the organization (Buckwell & Morgan, 2022; Mohr & Thissen, 2022). While this is a growing area of interest and practice as demonstrated by several businesses globally, the integration of natural capital values and accounting into business decision-making is currently not wide spread (J. C. Ingram *et al.*, 2024).

An obstacle to business action on biodiversity is the challenge of applying metrics and setting goals related to biodiversity compared to climate change. While there is a quantitative target for the global economy to decarbonize its greenhouse gas emissions by mid-century as per the Paris Agreement, there is no single, quantitative goal to guide actions on biodiversity. A number of initiatives have been established to support businesses and financial institutions in setting and measuring progress towards actions for biodiversity, building on those established for climate change as an example **(Table 1.3)**. Other initiatives are working at the interface between biodiversity or nature and business to advance sector guidance and roadmaps for business strategies and actions that align with the Kunming-Montreal Global Biodiversity Framework and nature transition plans, which may be integrated with climate transition plans for a business (Business for Nature, n.d.-c; TNFD, 2024b; TPT, 2024; WBCSD, 2024; WEF, 2023). It is important that actions described as such improve the state of biodiversity in measurable ways (Maron *et al.*, 2023).

Standards also exist to guide businesses in measuring, managing and reporting on biodiversity and broader nature-related aspects. These include the Global Reporting Initiative (GRI) Biodiversity Topic Standard (GRI, 2024a) and the International Sustainability Standards Board's (ISSB) IFRS S1, issued in 2023, which outlines requirements for disclosing sustainability-related risks and opportunities, including those on nature-related aspects under a financial materiality perspective (IFRS, 2023). The International Finance Corporation's Performance Standard 6 on biodiversity conservation and sustainable management of living natural resources outlines the mitigation hierarchy to guide businesses in how to avoid, reduce and manage risks and impacts, and sets requirements for stakeholder engagement and project-level disclosure (IFC, 2012). More recent guidance, such as the biodiversity finance reference guide, provides insights on investment and finance activities that help protect, maintain, or enhance biodiversity and ecosystem services (IFC, 2023). An assessment of seven commonly used standards and frameworks for assessment and disclosure on nature-related issues — including CDP, European Sustainability Reporting Standards (ESRS), Global Reporting Initiative (GRI) standards, ISSB standards, Natural Capital Protocol, Science Based Targets Network target setting guidance and TNFD framework — shows growing alignment in key concepts and methods across these frameworks (UNEP-WCMC & UNEP FI, 2024, 2025).

Many of these frameworks still lack ecosystem-specific guidance and offer limited support for monitoring and managing ecological systemic risks, due to limited research (UNEP-WCMC & UNEP FI, 2024, 2025). In addition, there is a need to ensure these approaches are grounded in science and informed by the best available research (Andersen *et al.*, 2021; Karolyi & Tobin-de la Puente, 2023; UNEP-WCMC & UNEP FI, 2024; Vörösmarty *et al.*, 2018). Greater consistency and interoperability across standards remain an important issue. This is reflected in ongoing alignment efforts, such as GRI–TNFD and EFRAG–TNFD mapping, and upcoming harmonization between ISSB, CDP, TNFD and GRI (EFRAG, 2024a, 2024b; GRI, 2024b; TNFD & EFRAG, 2024).

1.4.2 Implementing businesses' and financial institutions' actions on nature: climate and biodiversity metrics, targets and policies

Although awareness of the need for sustainable business practices is growing, nature-related issues often receive lower priority than climate change (Capgemini Research Institute, 2023; McKinsey & Company, 2023). Biodiversity and climate change are often treated separately, despite being deeply interconnected. There is also growing recognition that businesses need to integrate human rights considerations into their approach to both issues (GBIHR, 2023; ILO and UNEP FI, 2023). Integrated climate and nature policies and actions can help identify and manage potential trade-offs and synergies between climate change and biodiversity interventions (Mariani *et al.*, 2024; Wüstemann *et al.*, 2017).

Businesses and financial institutions can help advance global commitments such as those under the Paris Agreement, the Kunming-Montreal Global Biodiversity Framework and the 2030 Agenda for Sustainable Development by linking action on climate, biodiversity and people. While some businesses are beginning to adopt this integrated approach, some businesses have called for greater action, especially by governments, to incentivize policy alignment across these agendas (Business for Biodiversity & We Mean Business, 2021).

Despite the growing momentum and important contributions of recent market-led initiatives to increasing transparency and guiding science-based actions, measurement, target setting, reporting and disclosure initiatives will not be sufficient on their own to drive meaningful action on nature loss (Irvine-Broque & Dempsey, 2023). A high-level review of Fortune Global 500 businesses shows that 83 per cent have climate-related targets or at least acknowledge climate change (+ 15 per cent). In contrast, while 51 per cent of businesses acknowledge biodiversity loss, only 5-6 per cent have set targets related to biodiversity and 13 per cent have set targets related to forests (McKinsey & Company, 2022, 2023). An analysis of the integration of biodiversity into corporate disclosures of Fortune 200 businesses for the years 2012, 2014 and 2016 in addition to their websites in the year 2019 showed that most disclosures and reporting on biodiversity were minimal, inconsistent and vague with respect to the information provided (Hassan *et al.*, 2022). Similarly, a 2024 analysis of corporate disclosures produced by 369 businesses in Latin America, Canada and the United States found that 94 per cent of businesses assessed had disclosed against at least one of the TNFD disclosure pillars, but overall alignment with the full set of TNFD recommendations was limited (EY, 2024).

An analysis of 650 sustainability filings for fiscal year 2024 under the European Union's Corporate Sustainability Reporting the Directive shows that around 30 per cent of preparers reported biodiversity metrics, with similar disclosure rates across financial and non-financial sectors — including some that did not deem biodiversity financially material but reported on it regardless. Disclosure levels vary widely: sectors with direct land or ecosystem impacts, such as construction (~60 per cent), electricity & gas (62 per cent) and real estate (64 per cent), lead adoption — for example, 100 per cent of Spanish and French construction businesses and 85 per cent of French real estate businesses report biodiversity metrics. Country variation is also significant, with higher disclosure in France (49 per cent), Sweden (44 per cent), Austria (44 per cent), and the Kingdom of the Netherlands (39 per cent), and lower uptake in Italy (18 per cent) and Germany (23 per cent) (EFRAG, 2025).

Business actions and policies on biodiversity continue to lag behind reporting trends. There is currently a substantial gap between the proliferation of reporting initiatives and guidance frameworks for businesses and financial institutions to measure, manage and report on their impacts and dependencies on nature, and business actions adopting and implementing the recommendations. For example, as of 2023, 201 businesses and financial institutions, constituting 40 per cent of those with substantial exposure to tropical deforestation, have not established a single policy to address deforestation (Thomson & Fairbairn, 2023). Ninety-two financial institutions that are deemed most exposed to deforestation still lack deforestation policies covering their investments and lending to businesses in key forest-risk commodity supply chains. In 2022, these institutions provided $3.6 trillion in finance to businesses with the highest deforestation risk exposure (Thomson & Fairbairn, 2023). In 2022, an unprecedented 1,043 businesses disclosed their progress in managing deforestation to CDP – an approximately 300 per cent increase compared to 2017. However, despite acknowledging risks, only a limited number of businesses claimed to be on track towards eliminating deforestation from their supply chains (CDP, 2023b).

Voluntary, industry-led initiatives currently far outnumber regulatory efforts. Meaningful progress, however, cannot rely solely on voluntary, market-led action; public intervention, including regulation and public funding, is essential (Kedward *et al.*, 2023). A 2024 Financial Stability Board study highlights how TCFD and International Sustainability Standards Board (ISSB) standards played a crucial role in advancing climate risk disclosure, influencing individual jurisdictions to set or propose voluntary or mandatory climate-related disclosure requirements (FSB, 2024). A similar trajectory was emerging for nature-related risks, as seen with the European Sustainability Reporting Standards. However, the EU´s sustainability framework now appears to be weakening (European Commission, 2025b, 2025c). Businesses and investors have warned that maintaining the core elements of the Corporate Sustainability Reporting Directive and the Corporate Sustainability Due Diligence Directive is critical to redirecting capital toward future-oriented technologies and sectors. They emphasize that transparency, regulatory certainty and a stable policy environment are essential to achieving growth, supporting decarbonization, and enabling responsible businesses and investors to contribute to the EU's goals for a competitive and sustainable economy (IIGCC *et al.*, 2025). While disclosures can drive business action, they are effective only when supported by a strong enabling environment (see **Section 1.5**).

1.5 ELEMENTS OF AN ENABLING ENVIRONMENT THAT SUPPORTS POSITIVE OUTCOMES FOR BIODIVERSITY

Governments, the financial system, businesses, financial institutions and other actors (including civil society, IPLCs, individuals acting as consumers and investors) can work together to create an enabling environment where businesses contribute to a just and sustainable future aligned with the goals and targets set out in the Kunming-

Montreal Global Biodiversity Framework. **Chapter 5** reviews key barriers and roles the business community can play in this context while **Chapter 6** summarizes "options for action" for each of the other key actors in detail. Indeed, multi-actor collaboration across all of these groups is needed to advance an enabling environment that supports the transformative changes required to secure biodiversity and nature's contributions to people for the long-term.

The IPBES Transformative Change Assessment (IPBES, 2024b) notes five key strategies to advance deliberate transformative change (many of which are of relevance in this chapter and considered in **Section 6.1.4**):

1) Conserving and regenerating places of value to nature and people

2) Driving systemic change in sectors most responsible for nature's decline

3) Transforming economic systems for nature and equity

4) Transforming governance systems to be integrated, inclusive, accountable and adaptive

5) Shifting societal views and values to recognize interconnections between humans and nature.

Governments, the financial system and other actors (including civil society and IPLCs) have to work together with businesses and financial institutions to promote and ultimately deliver the global systemic and transformative changes needed to support businesses' efforts to contribute to the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity. To catalyze such changes, all actors in society will need to work together to advance an enabling environment across the following factors:

1) Legal and regulatory: Policies, laws, and regulations that incentivize sustainable business practices, enforce accountability and integrate biodiversity considerations into decision-making.

2) Economic and financial: Sufficient funding for biodiversity protection and restoration, the integration of nature's value into economic and financial systems, and alignment of financial incentives that promote biodiversity conservation flows with activities that support positive outcomes for biodiversity while eliminating harmful subsidies and activities that degrade biodiversity.

3) Norms and values: Societal awareness, cultural shifts, and collective action that drive demand for responsible business practices and reinforce accountability both from governments as well as from businesses.

4) Technology and data: Credible, accessible and decision-useful measurement tools, data, and technology that are based on the best available science to inform business decisions, improve impact assessments, and enhance transparency and accountability.

5) Capacity and knowledge: Developing skills and understanding of biodiversity-related standards and reporting frameworks, as well as partnerships and knowledge-sharing to support sustainable business models and practices.

Such an enabling environment can foster and support business models and actions that meet commercial and/or enterprise objectives while also supporting positive outcomes for biodiversity. For businesses to fully contribute to this future, a combination of barriers will need to be removed and enabling factors advanced that encourage business actions and decisions to align with and/or support positive outcomes for biodiversity (e.g., IPBES, 2024b, 2024e; WBCSD, 2021). These barriers are reviewed in more detail in **Chapters 5** and **6**.

1.5.1 Policy, legislation and regulatory frameworks

Governments and financial systems shape the policy, legal, and regulatory frameworks that influence business operations. They can introduce measures such as policies, laws, and regulations that incentivize or require businesses to address their dependencies and impacts on biodiversity. Enhanced public disclosure of business impacts and dependencies on biodiversity can lead to increased accountability and support enforcement of laws and policies. Civil society and businesses can influence these frameworks through lobbying, advocacy, and participation in electoral processes.

Governments can adopt a range of policies to direct business practices toward beneficial outcomes for nature and people. These policies include incorporating biodiversity considerations into trade policies and requiring strategic environmental and impact assessments for new projects before they begin, alongside effective land use planning and zoning. Moreover, developing and enforcing National Biodiversity Strategies and Action Plans (NBSAPs), and aligning them with National Climate Action Plans (NDCs) and economic development plans through integrated policies (World Bank, 2022), can help regulate and monitor the impact of businesses on nature and climate, contributing to sustainable development and safeguarding human rights (CBD, 2023c). Government and regulatory agencies can encourage or require disclosure on nature-related dependencies, impacts, risks, and opportunities from businesses, investors and other financiers. In addition,

government agencies also play a key role in collecting and providing robust, consistent and credible biodiversity data for business decision-making and disclosures (Ingram *et al.*, 2024).

At the domestic level, national or regional regulation in some regions has focused on decreasing negative impacts and increasing transparency on business impacts on nature. Examples include biodiversity net gain requirements in the United Kingdom; and the European Union's regulations on deforestation-free products, on nature restoration, and on corporate sustainability due diligence, put in place to drive business action on some aspects of nature (EC, 2022, 2023; Environment Act 2021, 2021; European Council, 2023).

At the international level, the Convention of Biological Diversity and the Kunming-Montreal Global Biodiversity Framework play a central role related to engaging businesses and the financial sector in efforts to promote conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of its benefits (CBD, 2023b). Businesses can contribute to, or impede, achieving related goals and targets (CBD, 2022, 2023b).

The financial system, in collaboration with governments, is crucial in creating a regulatory environment that incentivizes businesses to reduce negative impacts and implement actions and investments that protect, restore, and preserve nature. Central banks, financial supervisors, public development banks, international finance institutions, and financial standard-setting bodies can encourage more effective and coordinated efforts of financial institutions to consider nature-related aspects in their products and services like loans, investments, and insurance policies. For example, the International Finance Corporation Performance Standards provide guidance that private sector clients are to meet throughout all stages of an investment made by the International Finance Corporation (IFC, 2012).

1.5.2 Economic and financial frameworks

The Kunming-Montreal Global Biodiversity Framework recognizes the importance of economic and financing systems for achieving the 2030 goals and sustainably managing, conserving and restoring biodiversity globally. The framework calls for eliminating, phasing out or reforming subsidies harmful to biodiversity, scaling up positive incentives that promote the conservation and sustainable use of biodiversity, and increasing public and private finance for biodiversity. It also encourages innovative schemes and calls on institutions to optimize co-benefits and synergies associated with addressing the climate and biodiversity crises together. Finally, it highlights the role of collective action and improving transparency, effectiveness and efficiency of resources given and used (CBD, 2023a).

1.5.2.1 Integration of nature into financial and economic systems

Efforts to make nature "visible" on balance sheets and internalize the costs of nature loss and degradation are critical for encouraging business and government action on biodiversity (Dasgupta, 2021). One way to do this is through natural capital accounting that provides structured and consistent systems for tracking physical and economic measurements of stocks and flows of natural capital, including information on the extent and condition of ecosystems. Natural capital accounting — specifically the System of Environmental-Economic Accounting that was adopted by the United Nations Statistical Commission in March 2021 — allows environmental data to consistently link with conventional economic measures in the System of National Accounts (United Nations Statistics Division, 2023). Businesses use the statistics generated from national accounts for a variety of purposes and decisions, however, natural capital has historically received limited attention within the system of national accounts resulting in an underrepresentation of the values that nature provides to society in national economic indicators and statistics (Nordhaus *et al.*, 1999). Currently, approximately 90 countries are addressing this limitation by developing national natural capital accounts aligned with the System of Environmental-Economic Accounting at a country-wide level to more fully integrate the value of nature into decision-making (United Nations Statistics Division, 2023). In addition, approaches such as gross ecosystem product are also developing as a way to capture and integrate the value of nature at economy-wide levels to inform and support policy making (Ouyang *et al.*, 2020; Zheng *et al.*, 2023). However, natural capital accounting may not capture all of the important values of biodiversity, particularly those that are non-material or non-monetary. In addition, it is important to track both the biophysical as well as monetary values of nature at national and sub-national levels, noting that in some cases biophysical measurement and tracking may be sufficient for informing decisions and policies (Bagstad *et al.*, 2021).

Although the System of Environmental-Economic Accounting is aligned with national-level accounts, businesses have begun using approaches that allow them to systematically track the value of nature for their business. Some businesses have begun corporate-level natural accounting (Forico, 2023), which allows them to systematically track the value of nature to their business on an annual basis. Other businesses have adopted approaches such as integrated profit and loss accounting

to track the costs of their environmental impacts, including those related to nature (Kering, 2023; Natura &Co, 2023).

Currently, many fiscal policies make destroying nature less expensive than protecting it, with public finance flows via subsidies that contribute to environmentally harmful activities being much higher than the amount of public finance available for activities that support biodiversity (Dasgupta, 2020; UNEP, 2026). To align business returns with positive outcomes for nature and society, fiscal measures and policies can eliminate, phase out, or reform tax incentives and subsidies that promote environmental destruction, and increase incentives that promote conserving and sustainably using biodiversity.

In addition, another major barrier to positive action on nature is the limited public and private financing directed toward activities that deliver positive outcomes for nature. As outlined in **Section 1.1.2**, the biodiversity financing gap is estimated at a range from $300 billion to 1 trillion per year, while achieving the Sustainable Development Goals related to water, food, health, and climate change will require at least $4 trillion annually (IPBES, 2024e). Financial institutions can help businesses reduce their impact on nature by financing, lending and insuring activities that support positive outcomes for nature such as regenerative agriculture, sustainable forestry, and low-carbon technologies, and engaging in systemic change through policy, capacity-building and collaboration initiatives (PRI, 2024b; UNEP, 2023a; UNEP FI, 2023b, 2025b; WEF & Oliver Wyman, 2024).

A promising example of the use of private financing to support biodiversity is the Cali Fund that was adopted by the Conference of the Parties to the Convention on Biological Diversity at it's 16th meeting. The Cali Fund is designed to enable businesses and institutions that commercially benefit from the use of Digital Sequence Information provided by nature to financially contribute to the fund, which will distribute funds to developing countries, countries with economies in transition and IPLCs to support projects that support biodiversity and progress towards the Kunming-Montreal Global Biodiversity Framework (CBD, 2025a).

Both traditional and innovative financial instruments are being implemented to incentivize governments, businesses and financial institutions to unlock more financing for biodiversity (UNDP, 2018; WEF, 2024; Zu Ermgassen *et al.*, 2025). These opportunities can be led by public actors — such as multilateral development banks, central banks, foundations, national or subnational governments — and include a range of instruments like grants, subsidies, national payment for ecosystem services schemes, sovereign bonds, procurement and official development aid. Examples include the government-led payments for ecosystem services programmes, implemented since the mid-1990s in Costa Rica and since 2003 in Mexico. These long-standing programmes have conserved millions of hectares of forest and benefited local communities in both countries (Izquierdo-Tort *et al.*, 2025; UNDP, 2018). In addition, private actors, including commercial banks, insurers, investors and corporates, have deployed instruments such as sustainability-linked loans, nature-focused project finance, nature impact funds, insurance products, and venture capital to generate financial returns and support positive outcomes for biodiversity (UNEP, 2023a; WEF & Oliver Wyman, 2024; Zu Ermgassen *et al.*, 2025). However, tracking and monitoring of how financing is used and directed towards influencing biodiversity outcomes will be increasingly important (Kedward, *et al.*, 2023).

Blended finance approaches are critical for unlocking more capital for biodiversity by combining public and private capital (CPI, 2024; WEF & Oliver Wyman, 2024). Blended finance involves the strategic use of concessional, public, or philanthropic capital to mobilize additional private investment for projects that deliver positive social, environmental, or climate outcomes while still offering financial returns. For example, debt-for-nature swaps, such as those implemented in the Seychelles, Belize, Barbados, Gabon, the Bahamas, Ecuador and the Galapagos Islands, have utilized blended finance approaches to refinance or restructure sovereign debt and unlock funding for conservation and resilience efforts (Escovar-Fadul *et al.*, 2025; The Nature Conservancy, 2024).

1.5.3 Social norms, values and culture

The drivers of biodiversity decline and the opportunities to address them are highly informed by the ways in which nature is valued in political and economic decisions (IPBES, 2022c). Historically, business and government policies have often prioritized a narrow set of values, particularly economic and monetary values, while much less consideration has focused on the values of nature associated with IPLCs' world-views of nature (IPBES, 2022c).

By including Indigenous perspectives, business decisions and strategies can adopt approaches that have greater alignment with local, cultural values (Berkes *et al.*, 2000), which may lead to stronger relationships with local stakeholders where businesses source and operate. There is also growing recognition that businesses should integrate social and human rights considerations, such as impacts on IPLCs, poor and marginalized groups, rural communities, women and other vulnerable groups,

when assessing their dependencies and impacts on nature. For example, both TNFD and SBTN guidance recognize this and provide guidance for businesses to engage with stakeholders in the landscape, including IPLCs (IFC, 2007; SBTN, 2024a; TNFD, 2023b). Although this guidance references international frameworks such as the UN Guiding Principles on Business and Human Rights, industry-led processes may have limitations in areas requiring authoritative Indigenous leadership (UNEP FI, 2025a). Such more integrated approaches, however, are still emerging and need more concerted attention and development (Martin-Ortega *et al.*, 2022; Schilling-Vacaflor, 2021).

Businesses and financial institutions can also influence social norms and values through actions that publicly signal an organization's positions on biodiversity (Booth *et al.*, 2024). Examples may include a business or financial institution publishing a nature strategy and goals, tracking and reporting progress towards goals, and publishing nature-related disclosures, all of which may encourage investment from and cooperation with like-minded businesses (Booth *et al.*, 2024; Goyal, 2006; Zerbini, 2017). Organizations can also support shifts in social norms and values by developing key processes and decisions related to biodiversity that other organizations then adopt and use. For example, the International Finance Corporation established performance standards to provide its clients with guidance on how to identify risks and impacts as part of its efforts to encourage sustainable business practices, which include avoiding, minimizing, restoring, and offsetting biodiversity impacts (IFC, 2012). Other large organizations that influence significant amounts of international financing have also adopted the International Finance Corporation Performance Standards (EDFI, 2022; Norfund, 2021), demonstrating the influence that large financial institutions such as the International Finance Corporation can have on shaping market norms.

Civil society plays a crucial role in advancing social norms, values and culture needed to support transformative changes by educating consumers, advocating for sustainable practices and enhancing transparency in business operations and, thus, empowering stakeholders to make more informed decisions (G. Ingram, 2020). Additionally, civil society has helped develop biodiversity monitoring strategies and verification systems that include IPLC participation, knowledge and perspectives (Danielsen *et al.*, 2022). Many non-governmental organizations also actively shape biodiversity priorities globally by engaging in planning and implementing restoration and conservation initiatives, and advocacy campaigns, collaborating with businesses, governments and IPLCs to restore degraded ecosystems and enhance biodiversity, and defining targets and priorities for conservation and restoration locally, nationally and globally.

Additionally, civil society has an important role to play in holding businesses and governments accountable for their social and environmental impacts (Ingram, 2020). The report from the United Nations High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities provides recommendations to prevent "net-zero" from being undermined by false claims and greenwashing (United Nations, 2022). Specific recommendations of the role of civil society and non-governmental organizations include the need to increase transparency and accountability and aligning lobbying and advocacy efforts (United Nations, 2022; WBA, 2024). For example, civil society can play a key role in calling out poor progress on nature-related initiatives such as failure to halt deforestation (CDP, 2023a, 2023b, 2025; Thomson, 2025; Thomson & Fairbairn, 2023). In addition, civil society in partnership with the business community, as discussed in many examples in **Section 1.4**, can lead initiatives that provide guidance and key insights on biodiversity to investors, and encourage companies and financial institutions to integrate biodiversity into their practices, engagement strategies and financing decisions (BankTrack, 2023; ShareAction, 2023).

1.5.4 Technology and data that enable business decisions

Many businesses lack access to high-quality, credible, comparable and decision-relevant biodiversity-related data (Natural Capital Coalition, 2019; TNFD, 2024a) and, as importantly, often lack the internal capacity to process, translate, interpret and apply data for informing business and investor decisions. Efforts to address business needs for high quality biodiversity data and data analytics are growing rapidly and may accelerate improvements in the credibility, collection, consistency and connection of nature-related data sets.

A range of biodiversity-related datasets, tools and technologies are now available and rapidly evolving for different purposes, including assessing, monitoring and tracking changes in the extent or condition of ecological systems (Besson *et al.*, 2022). A publicly accessible and widely used example includes ENCORE, which businesses and financial institutions use as a high-level screening tool to identify biodiversity-related dependencies and impacts at the portfolio, sector, and company levels (ENCORE, 2025). WWF's Risk Filter Suite, including a biodiversity and water risk filter, is also used for risk screening (WWF, n.d.). For commercial users, the Integrated Biodiversity Assessment Tool (IBAT) supports early-stage impact, risk and opportunity screening, drawing on databases of protected areas, the IUCN Red List of threatened species, and key biodiversity areas. IBAT was established in 2005, provides high-quality, comparable and decision-relevant data that now serves

more than 10,000 users, generating about 10,000 reports annually (IBAT, 2021).

However, there remains a need to continue to increase access to and translation of global, regularly updated, location-specific and consistent biodiversity data relevant for businesses (McKenzie *et al.*, 2025). International guidelines are needed related to biodiversity data but are currently lacking. Efforts to develop principles for producers and managers of scientific data including biodiversity data have addressed key issues such as findability, accessibility, interoperability and reusability that may make it easier for businesses and others to access data on biodiversity (Wilkinson *et al.*, 2016).

Accessing biodiversity-related data can be especially challenging for businesses with complex supply chains. Although corporate visibility into Tier 1 suppliers (direct suppliers) has increased in recent years, fewer businesses have reliable data on Tier 2 suppliers (suppliers of suppliers) and even fewer can trace their supply chains back to locations where raw materials are sourced (Alicke & Foster, 2024). Asset location data for nature-related risk analysis are often incomplete, inconsistent, and limited in scope or quality, with company disclosures selective and voluntary, public registers restricted to certain sectors or unreliable, third-party datasets non-standardized, incomplete or outdated, and commercial data costly and license-restricted (Christiaen *et al.*, 2025). This lack of visibility into where businesses interface with biodiversity makes it difficult for large multi-national businesses with complex, geographically dispersed supply chains to understand and manage their impacts and dependencies on biodiversity. Various advances in data and technology can help businesses address these knowledge gaps, which are presented in more detail in **Chapter 4.**

Business engagement with biodiversity and the context in which it occurs is expected to continue evolving. This evolution is likely to respond to developments related to, for example, nature transition plans and the rapidly increasing influence of artificial intelligence see **Box 1.4**.

1.5.5 Capacity & knowledge

An additional challenge for businesses and financial institutions in engaging with biodiversity is that many businesses frequently lack the internal capacity to process, interpret, translate and apply relevant data for informing business and investor decisions (Ingram *et al.* 2024). Interdisciplinary collaborations among corporate sustainability scholars and conservation biologists can be helpful in this context (Panwar *et al.*, 2023). In addition, civil society can play an important role in capacity-building for businesses through the development of knowledge sharing platforms, resources and tools that can support businesses and financial institutions, in understanding and managing their impacts and dependencies on biodiversity and the risks and/or opportunities they present to the organization. Such resources and trainings should be tailored to support capacity-building on biodiversity at multiple levels within an organization including the board of directors, executive leadership teams, managers, and others (Finance for Nature, n.d.; TNFD, 2025b; WBCSD, 2025). In addition, more effort is needed to support businesses and IPLCs on ways to engage and collaborate with each other on nature-related issues.

Box 1 4 **Examples of emerging implications of artificial intelligence and machine learning for businesses' interactions with biodiversity and nature's contributions to people.**

Artificial intelligence and machine learning have the potential to influence and transform biodiversity monitoring, species modelling, and conservation management, with implications for businesses. Examples include: (i) automated species identification: convolutional neural networks can classify millions of camera-trap images, dramatically reducing manual analysis time (Norouzzadeh *et al.*, 2018; Tabak *et al.*, 2019), (ii) increased accessibility: open-source workflows are expanding access to artificial intelligence tools for non-experts (Brook *et al.*, 2025), and (iii) improved model efficiency: new approaches using smaller datasets enable more applied transfer and active learning (Bothmann *et al.*, 2023; Duggan *et al.*, 2021).

Field validation, such as at the Northeast Tiger and Leopard National Park has confirmed the reliability of these models in real field conditions (Tan *et al.*, 2022). Beyond image classification, artificial intelligence supports ecological modelling and prediction, for example, through multispecies deep networks and using data collected by citizens to better predict plant community composition (Brun *et al.*, 2024) and integrating machine learning-based models in ecosystem service mapping (Kass *et al.*, 2024). Mobile robotics are also being tested for real-time data collection and species identification (Panigrahi *et al.*, 2023).

However, knowledge gaps and challenges remain, including data imbalance, model interpretability, computational costs, and limited generalization (Cipriano *et al.*, 2025; Xu *et al.*, 2024). Moreover, the environmental and ethical concerns of large language models are also under increasing scrutiny, stressing the importance of sustainable artificial intelligence design (Rillig *et al.*, 2023).

1.5.6 Partnerships and collaborations for transformative change

Fostering an enabling environment and catalyzing transformative change to halt biodiversity loss globally will require partnerships across government, the financial system, businesses and financial institutions, and other actors (including civil society and IPLCs). **Section 1.4** highlights a broad, growing, and dynamic landscape of initiatives, frameworks and collaborations among key actors that are driving these developments.

Landscape-scale collective action partnerships and investments among business and other stakeholders are emerging globally (TCGF, 2022). For example, the private sector, district governments, civil society and local communities have worked together to reduce deforestation, degradation of forests and peatland, and fire risk in the Siak Pelalawan Landscape Programme (SPLP) in the Siak province of Indonesia (TCGF, 2022). Similarly, the African Forest Landscape Restoration Initiative is a continent-wide partnership launched in 2015 between African governments, NGOs, technical groups like IUCN and NEPAD, private financiers (e.g., World Bank) and local communities and aims to restore over 100 million hectares of degraded land by 2030 — targeting food security, climate resilience and biodiversity recovery. As of late 2021, countries had committed more than 127 per cent of the target area (AFR100, n.d.).

Strategic collaborations among businesses, financial institutions and civil society can also influence policy agendas. For example, in the margins of the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity, over 400 business and finance institutions from 53 countries participated in the "Make it Mandatory" campaign led by Business for Nature, a non-governmental organization, that sought to encourage governments to adopt mandatory requirements for disclosure by business within Target 15 as part of the Kunming-Montreal Global Biodiversity Framework (Business for Nature, n.d.-b). As part of the "Moving Together on Nature" campaign, 154 financial institutions signed a statement calling for an ambitious Kunming-Montreal Global Biodiversity Framework to be adopted at COP15 to provide a clear mandate for economic actors, including financial institutions, to take meaningful action to halt and reverse biodiversity loss. This campaign was coordinated by the Principles for Responsible Investment (PRI), the United Nations Environment Programme Finance Initiative (UNEP FI), and the Finance for Biodiversity Foundation (Finance for Biodiversity Foundation, n.d.; PRI *et al.*, 2022).

Collaborations are also important for unlocking financing and funding, from public and private sectors, to support biodiversity and reach the targets of the Kunming-Montreal Global Biodiversity Framework. For example, debt-for-nature swaps implemented in the Seychelles, Belize, Barbados, Gabon, the Bahamas, Ecuador, the Galapagos Islands, and El Salvador have involved unique collaborations across national governments, philanthropies, development finance institutions, insurance businesses, non-governmental organizations and others to unlock additional funding for biodiversity and support the achievement of national and international commitments, such as National Biodiversity Strategies and Action Plans (NBSAPs) and Nationally Determined Contributions (NDCs) (Escovar-Fadul *et al.*, 2025; The Nature Conservancy, 2024; World Bank, 2018).

Collectively, these projects are expected to mobilize billions in conservation funding and help governments enhance protection and management of terrestrial, freshwater and marine ecosystems (Escovar-Fadul *et al.*, 2025; The Nature Conservancy, 2024). Another example includes the Living Amazon Mechanism that promotes conservation and regeneration in the Amazon region while fostering sustainable livelihoods (Green Finance Institute Hive *et al.*, 2025). By linking businesses with Amazonian producers, it offers financing at competitive interest rates and targeted support to strengthen supply chains, increase production and build community resilience (CPI, 2024; Green Finance Institute Hive *et al.*, 2025). Similarly, the Global Fund for Coral Reefs (GFCR) is helping to mobilize 100s of millions of dollars for businesses and projects that support coral reef conservation globally through a blended finance approach that strategically combines grants, concessional finance and commercial investments to increase capital available for marine conservation initiatives (Global Fund for Coral Reefs (GFCR), 2025). The grants and concessional finance help reduce the perceived risk of investing in coral reef-focused projects or businesses, making them more attractive to private investors. Such blended finance approaches, along with other examples in **Section 1.5.2.3** demonstrate the potential impacts that can result from strategic partnerships across public and private sectors.

Actions by all actors, working individually and together in partnerships across multiple sectors and parts of society, will be needed to deliver the global systemic change required for businesses to contribute to the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity (CBD, 2025b).

1.6 SUMMARY

Nature continues to decline at unprecedented rates, threatening the stability and future of social, ecological and economic systems around the world. The Kunming-Montreal Global Biodiversity Framework was a landmark agreement that seeks to reverse these trends and lays out clear targets that must be met to restore, conserve and sustainably manage nature and halt its decline. Achieving these goals will require a whole of society approach, including the involvement and leadership of businesses and financial institutions.

Businesses and financial institutions will also be financially impacted by the loss of biodiversity and, at the same time, are drivers of biodiversity loss globally. In addition, there is a growing recognition that business opportunities can emerge from actions and investments that positively impact biodiversity.

Businesses and financial institutions impact and depend upon many aspects of biodiversity and its contributions to people, with variations across sectors, geography and size and scope of operations, supply chains, and investments. However, many businesses and financial institutions do not yet have a complete understanding of their impacts and dependencies on biodiversity, and how they may lead to risks and opportunities for their organizations, their stakeholders, and IPLCs. Numerous frameworks, tools, methods and approaches have been developed to support businesses and financial institutions in filling some of these knowledge gaps and in understanding, reporting, and managing their impacts and dependencies on biodiversity (as reviewed in **Chapters 2**, **3** and **4** of this assessment). Addressing these knowledge gaps is an important step for businesses to implement the changes needed to achieve the goals of the Kunming-Montreal Global Biodiversity Framework and maintain resilient, profitable business operations, value chains, and investments. While the number of businesses and financial institutions that are aware of and reporting on biodiversity related issues has grown significantly in recent years, few business strategies and actions related to positively impacting biodiversity have been documented.

Key actors across multiple aspects of society will need to work together to advance the enabling environment that will bolster business actions, financing activities and decisions that positively impact biodiversity and avoid its loss. The enabling environment needed to catalyze the transformative changes required to meet the Kunming-Montreal Global Biodiversity Framework goals and targets must include policies, legislation and regulations; economic and financial frameworks; social norms, values and culture; technology and data; and capacity and knowledge that foster and incentivize the restoration, conservation and sustainable management of biodiversity globally.

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Chapter **2**

HOW DOES BUSINESS DEPEND ON BIODIVERSITY?[1]

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Chapter **2**

HOW DOES BUSINESS DEPEND ON BIODIVERSITY?

EXECUTIVE SUMMARY

1 All business sectors depend on biodiversity and associated nature's contributions to people *(established but incomplete)* {2.2}. Businesses depend on aspects of biodiversity or nature's contributions to people for their business operations. This dependency is at their operational level and through reliance on biodiversity throughout the value chain {2.2.1}. Businesses not only depend on material nature's contributions to people, but also on regulating and non-material benefits {2.2.1, 2.5.4}. Dependencies on biodiversity span over distances and time {2.2.3}. Limited understanding of dependencies can undermine long-term, sustainable business practices.

2 The magnitude and risk of dependencies vary highly across businesses with some businesses and economies having larger dependencies than others *(established but incomplete)* {2.2.2, 2.5.3}. Economies of countries depend considerably on biodiversity: for some countries, their gross domestic product (GDP) depends between 36 per cent and 98 per cent moderately or highly on ecosystems {2.4.3}. Examples show that the individual nature's contributions to people can make up 8 per cent of a country's GDP and contribute billions to national economies, such as pest control services at $70 million, pollination services for agriculture at $12-34 billion and habitat provision that supports species of interest to tourism at $22-39 billion {2.5.2}. The associated physical risk depends on the magnitude of the dependency, substitutability of nature-related dependencies, competition over resources and the long-term availability, accessibility and stability of a sustainable supply of the nature's contributions to people, which all vary across space {2.2.2}. Dependencies become impacts on biodiversity if their magnitude is larger than sustainable use levels {2.2.1}, and these impacts can negatively affect other stakeholders as well as the business itself {2.8} **(Chapter 3)**. Dependencies vary across sectors, and within sub-sectors, across different natural conditions and geographies (*well established*) {2.5}.

3 The physical, transition and systemic risks associated with business dependencies on biodiversity and nature's contributions to people are acknowledged but rarely assessed and quantified, despite the risk to nature, businesses and society *(established but incomplete)* {2.2.4, 2.5.5}. Physical dependency risks are highly specific to individual businesses and their context, but methods are lacking to reliably quantify differences in nature-related dependencies between businesses, sectors, production methods and regions {2.4.3, 2.5.5}. Entities in the enabling business environment, including the financial sector, share businesses' nature-related dependencies {2.5.3}. Transition risk assessments related to market, economic, technological or regulatory changes in transitions towards sustainability are emerging in the financial sector but otherwise rare {2.5.3}. Risk assessments that use systems-thinking to quantitatively assess systemic future risks to business dependencies on biodiversity or nature's contributions to people remain limited and constitute a knowledge gap.

4 To date, the knowledge base on business dependencies is largely focused on a few sectors *(well established)* {2.5}. The scientific knowledge base on the dependency of businesses on biodiversity and nature's contributions to people has focused on a few sectors {2.5}. Sectors which have been studied most, especially at subnational scale, include the agriculture, forestry and fishing, arts, entertainment and recreation, and water supply and waste management sectors {2.5.4}. The majority of sectors have not been studied.

5 There are considerable differences in the amount of academic evidence for dependencies on different types of nature's contributions to people *(established but incomplete)* {2.5}. Studies in the agricultural sector mostly focus on the role of pollinators in crop production {2.5.2, 2.5.4}. All sectors use water supply, purification or flow regulation for production or in their value chain. Some sectors depend more on non-material nature's contributions to people, while others rely more on regulating nature's contributions to people, for instance, flood or pest control {2.4.1, 2.4.3}. More evidence is available for Europe, the Americas and Asia than for Africa and Oceania (*established but incomplete*) {2.8}.

6 A variety of methods has been used to document the dependencies of business on nature's contributions to people *(well established)* {2.3, 2.4}. Methods include environmental-economic models, biophysical and ecological approaches, participatory monitoring and mapping approaches, monetary valuation methods, socio-cultural valuation methods {2.3}, as well as scenario analysis, integrated & synthesizing methods and socio-cultural valuation methods {2.4}. Biophysical and

ecological approaches and monetary valuation methods are used often {2.3.2}. There is less evidence for dependencies based on socio-cultural valuations {2.3}. Most dependency studies use quantitative methods, metrics and indicators to assess a diverse set of values, but this may risk overlooking values that are more accurately expressed in qualitative terms including some socio-cultural and community values {2.3.5}.

7 Different methods express dependencies in different metrics, but there is no standardized set of metrics for business dependencies on biodiversity or nature's contributions to people *(established but incomplete)* {2.5}. Quantitative measurements of dependencies of businesses on nature's contributions to people are not consistent, and units of measurements also vary {2.4.3}. Biophysical and ecological approaches mainly capture dependencies in terms of metrics such as increased yields in production, tons of crops or timber harvested, volumes of water consumed or quality of products {2.4.3, 2.5.4}. Economic models and monetary valuation methods assess economic value and risk to businesses in monetary units {2.4.3, 2.5.4}. Emerging regulatory pressure such as the European Union's Corporate Sustainability Reporting Directive is pushing towards more standardization in metrics and reporting standards {2.4.3}.

8 Most methods to assess business dependencies on biodiversity and nature's contributions to people are focused on examining direct dependencies, with fewer methods suited for assessing upstream value chain dependencies *(established but incomplete)* {2.3, 2.4}. Methods such as biophysical and ecological assessments and monetary valuation are well-established for capturing direct dependencies; and provide context-specific data if applied at local scales {2.3.2, 2.3.4}. However, value chain dependencies, such as raw material transport or intermediary nature's contributions to people supporting production, are less frequently captured. For trade dependencies, large-scale environment-extended economic models are required, but these methods rarely use context-specific data, making them suitable for screening and ex-ante evaluation but less so for monitoring and evaluation {2.3.1}. Combining multiple approaches to measure value chain dependencies is necessary to assess the full scope of business reliance on biodiversity and thus the associated risks and opportunities for resilience within supply chains, but require more spatially and temporally detailed approaches {2.2.3, 2.4.1}. Factors contributing to this include data gaps on the location and magnitude of business activities and a lack of traceability of material flows and impacts through value chains.

9 Uptake of available methods that can provide information on business dependency on nature's contributions to people is lacking *(well established)* {2.5}. Business dependence on ecosystem services is significant but understudied. Two recent reviews of the practices of large global businesses find that less than 1 per cent have assessed their dependencies {2.5.5}. Growing uptake is providing evidence of the potential of dependency assessment for identifying business opportunities and mitigating nature-related risks, and for governments to monitor compliance with sustainability regulations {2.6.1, 2.6.2}. Important barriers for uptake of nature-related risk management include access to reliable data and reliable models and scenarios {2.5.5}. Various integrated decision-support methods can help assessments of different values and dependencies {2.4.1}, but guidance on assessing dependencies at every step of the value chain and attributing these to individual businesses is lacking.

10 Conventional businesses can be dependent on Indigenous and local knowledge and can learn from the ways in which Indigenous Peoples and local communities' businesses support and protect biodiversity *(established but incomplete)* {2.7}. Indigenous Peoples and local communities have relationships with nature and are among the stakeholder groups most directly dependent on nature, as their ways of life and livelihoods are often closely connected to nature for food, medicine and cultural and economic activities {2.7.1}. Indigenous Peoples and local communities often have cultural values that recognize the mutual interrelationships between nature and people {2.7.1}. Indigenous and local knowledge, including insights related to medicine and art, is not only critical to assess dependencies, but also a valuable source of innovation and product development that has both inspired and been used by businesses {2.7.2}. Indigenous business models provide examples of business activities within environmental and social sustainability boundaries, but this type of knowledge has been disregarded and neglected {2.7.2}.

11 Nature-related dependencies of businesses also arise from their interactions with Indigenous Peoples and local communities and other businesses. This interconnection yields significant positive and negative consequences in terms of risks and opportunities *(established but incomplete)* {2.7}. Business activities can either improve or harm biodiversity and nature's contributions to people upon which they, and other businesses and local communities depend {2.7.2}. Business dependencies on nature can conflict with Indigenous Peoples and local communities' rights and restrict their access to land. For example, demand for minerals vital to the clean energy transition has escalated these risks, with mining projects frequently overlapping Indigenous territories: 80 per cent of lithium projects are located on Indigenous lands, and water scarcity in these

regions compounds the risks of pollution {2.7.2}. Overexploitation of ecosystems can have adverse effects on commercial activities and on Indigenous Peoples and local communities.

12 Businesses must navigate complex trade-offs between profitability and broader societal needs in the context of their dependencies on nature's contributions to people, while realizing synergies provides opportunities that are rarely seized *(established but incomplete)* {2.8}. Shared dependencies and objectives of businesses and other societal actors on biodiversity give rise to trade-offs and synergies {2.8}. Trade-offs, evidenced in multiple studies, affect not only business profitability but also conservation and sustainable use of biodiversity, Indigenous Peoples and local communities, and other social and environmental priorities. Synergies present opportunities for partnerships and collaborations to secure value chains, mitigate risks, reduce conflicts, enhance equitable benefit sharing and enhance business operations, but their realization is less well evidenced {2.8}. Such synergies require innovative approaches that account for diverse values, worldviews and power dynamics to ensure that sustainability efforts create positive outcomes across different sectors and communities {2.5}. Different methods are available to support civil society and public and private sector entities design incentive schemes to promote and award sustainable behaviour {2.6}. Integrating these considerations into corporate decision-making can help businesses transition from merely mitigating negative impacts to actively contributing to environmental and social well-being through managing their dependencies sustainably {2.6.2, 2.8}.

13 Knowledge gaps remain for context-specific dependencies for several regions and sectors, but do not prevent short-term action towards dependency assessment and risk mitigation *(well established)* {2.9} Existing tools allow measuring certain nature's contributions to people in certain locations, but large knowledge gaps and data constraints remain in quantifying spatial and temporally explicit dependencies using scientifically-robust data {2.2.3}. Biophysical and ecological approaches are mostly used but often lack sufficient context-specific data – especially in remote areas, for under-studied species and for dependencies along the value chain – limiting accurate nature dependency measurement and predictive models {2.3.2}. Standardized business-relevant indicators and metrics for assessing nature-related dependencies and risks are absent {2.4.3}. The use of scenario analysis and long-term outlooks is rare and limited to short-term shock assessments rather than longer-term dynamics {2.4.2, 2.5.5}. Due to these gaps, the lack of long-term, longitudinal studies limits understanding of sustainable business reliance on biodiversity and nature's contributions to people.

2.1 INTRODUCTION

All businesses are dependent on biodiversity for sustainability, resilience and financial performance (Dasgupta, 2021; zu Ermgassen *et al.*, 2022). The dependence of human well-being and economic activity on biodiversity was highlighted in the late 1990s (Costanza *et al.*, 1997; Daily, 1997) and widely publicized in the Millennium Ecosystem Assessment (2005) and the Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019a). Costanza *et al.* (2021) estimated that only about 22 per cent of the global ecosystem value is reflected in global gross domestic product (GDP), yet provisioning ecosystem services,[2] such as food, raw materials and recreation alone, account for 36 per cent of global GDP. PricewaterhouseCoopers (PwC) reports that over half (55 per cent) of global GDP – about $58 trillion – is generated in economic sectors moderately or highly dependent on biodiversity (Evison *et al.*, 2023; White *et al.*, 2020). This dependency extends beyond just species to their genetic resources such as digital sequence information (DSI) used by many sectors for economic reasons (Brink & Van Hintum, 2022; ICF *et al.*, 2020). Ecosystem degradation poses economic risks for businesses. As countries across the globe adopt natural capital accounting, they recognize the dependence of their economies and businesses on biodiversity. Similarly, leading businesses across diverse industries are recognizing the importance of integrating natural capital into their strategy and operations, and the financial sector is assessing natural-capital related risks and opportunities in relation to its investments (White *et al.*, 2020). For example, the Dutch asset manager ACTIAM evaluates natural capital impacts and dependencies of businesses it invests in, believing these influence financial performance (White *et al.*, 2020). Local communities are also increasingly recognizing natural capital as an investment opportunity to increase community resilience (Musavengane & Kloppers, 2020).

Businesses and sectors depend on biodiversity in different ways. Biodiversity serves as a direct input in production. Businesses use raw materials to produce goods and services that are sold to consumers or other businesses. Examples include the use of wood in construction, water in manufacturing, or plants or microbes in pharmaceuticals. When substitutes exist, dependency risk is lower, but some businesses rely entirely on natural raw materials. Biodiversity enables production processes, as seen in crop production's dependence on bee pollinators. Pollinator-dependent crops account for 30-35 per cent of the global crop production (Klein *et al.*, 2007). Dependencies extend

2. This Chapter uses both the terms nature's contributions to people and ecosystem services. The first is consistent with the IPBES framework; the latter is often used in academic studies as well as government and private sector reports.

through value chains. Therefore, business dependence on biodiversity poses physical business risks when biodiversity is degraded. The exposure to biodiversity dependency risks of Bloomberg World Index listed companies in terms of total enterprise value is estimated to be four times larger than their exposure to biodiversity impact risk (Carvalho *et al.*, 2023a). For example, in 2018 about 21 per cent of the largest global listed businesses and $20 trillion (17 per cent) in total enterprise value were exposed to material biodiversity dependency risk (Carvalho *et al.*, 2023a).

Many business dependencies on biodiversity remain unrecognized or unquantified by individual businesses and other actors, despite the risk to businesses and society. Worldwide, the uptake of biodiversity policies in listed businesses has increased rapidly over the past two decades, supported by frameworks like those of the Global Reporting Initiative (GRI) and Taskforce on Nature-related Financial Disclosures (TNFD) (Combe *et al.*, 2024), promoting actions towards dependency measurement. Still, evidence collated in this Chapter suggests that only an estimated 30 per cent of all sectors account for their dependence on biodiversity. Barriers include difficulty in measuring nature's contributions to people, low willingness to adopt biodiversity policies, lack of scientific environmental expertise in business, and lack of data and standardization of dependency measurement (Bent *et al.*, 2024).

There are many methods and metrics for quantifying dependencies and their values. Current methods include environmental-economic models, biophysical and ecological approaches, participatory monitoring and mapping approaches, monetary valuation methods, socio-cultural valuation methods, as well as integrated scenario analysis and synthesizing methods and socio-cultural valuation methods. Metrics range from contributions to product quality or quantity in volumes or hectares, to monetary values. While different methods and metrics capture the context-specificity of biodiversity and nature's contributions to people, the lack of standardization complicates comparisons across options or across businesses, aggregating different dependencies or understanding synergies, trade-offs and associated risks and opportunities. By effectively understanding and managing their dependencies on biodiversity, businesses can mitigate risks related to biodiversity loss, seize opportunities that support positive outcomes for biodiversity, society and the businesses themselves, and drive transformative change for sustainability and resilience in biodiversity, societies and economies.

To summarize the existing knowledge base, the authors of this chapter conducted a literature review.[3] Initially, a snowball search of 20 papers yielded 1,934 publications, of which 151 papers were fully reviewed. Data was extracted on the type and magnitude of the dependency, sector and product, country and ecosystem, type of nature's contributions to people and methods, metrics and data used, to assess the diversity and robustness of dependency assessments. A subsample was analyzed to explore the magnitude of sectoral dependencies. The review was complemented with additional papers and expert analyses to ensure global coverage.

This chapter covers the following topics:

- Typology of dependencies, concepts of risks and magnitudes {2.2}
- Methods and approaches for assessing dependencies {2.3}
- Integrating methods, scenarios and metrics {2.4}
- Magnitude of dependencies and associated risks {2.5}
- Implications for society of business dependencies on nature {2.6}
- Implications for Indigenous Peoples and local communities (IPLCs) of business dependencies on nature {2.7}
- Trade-offs and synergies in dependencies {2.8}
- Knowledge gaps {2.9}

2.2 TYPOLOGY OF DEPENDENCIES

2.2.1 Characterizing dependencies of businesses on biodiversity

Businesses dependency on biodiversity varies and can be classified into direct dependencies at the level of business operations, and dependencies through the value chain of a business. Operational dependencies involve natural assets or raw materials that a business requires for its production process like timber, water and medicinal and aromatic plants. For example, wood fibre is a direct physical input into paper production. Beyond material benefits, business operations also depend on biodiversity's regulating and non-material contributions that enable production or mitigate negative business impacts. For example, pollination enables food production and wetlands provide bioremediation of waste. Nature-based tourism highly depends on

3. Data management report referring to the literature review conducted for Chapter 2 https://doi.org/10.5281/zenodo.12790967

species richness or abundance, an example being wildlife recreational services in protected areas in Africa (Manley & Egoh 2024). Beyond direct dependency, businesses depend on biodiversity through the upstream value chain, sourcing products from other businesses that depend on biodiversity. Downstream in the value chain, they also depend on biodiversity, for instance for consumer product disposal and the treatment of waste, that relies on bio-based treatment technologies and nature's assimilative capacities.

Figure 2.1 illustrates operational level and value chain dependencies on biodiversity by sector (using International Standard Industrial Classification (ISIC) sector classification codes). For example, cotton farming operations depend on pollination, while clothing factory operations depend on access to clean water, and through their value chain on pollination for cotton used in garment. Department stores depend for their operations on flood regulation at store locations, and through their value chain on water and pollination for the manufacturing of the clothing they sell. This highlights that businesses across sectors have operational and value chain dependencies that come from all three categories of nature's contributions to people: material, regulatory and non-material, both directly at operational level and through the value chain. While this chapter uses a classification based on nature's contributions to people, ecosystem service terminology is common in business reporting.

Various scientific and business publications and initiatives describe business dependency from operational and value chain perspectives. The Exploring Natural Capital Opportunities, Risks and Exposure database (ENCORE, n.d.) characterizes operational dependencies through dependency pathways, with value chain dependencies arising from upstream trade links (dependence on economic activities in the value chain) and downstream in the value chain (consumption of outputs of direct operations by other economic sectors).

Business dependence and impact on biodiversity are closely linked. Negative impacts degrade ecosystems, reducing the stock of natural capital and the flow of benefits businesses rely on. For example, business dependency on water becomes a business impact if ecosystems or resources are not used or extracted sustainably (see **Section 2.2.2**). **Chapter 3** of this assessment explores these impacts further. To showcase the diversity of dependencies that can occur throughout the value chain, **Table 2.1** provides examples of business dependencies from across the world.

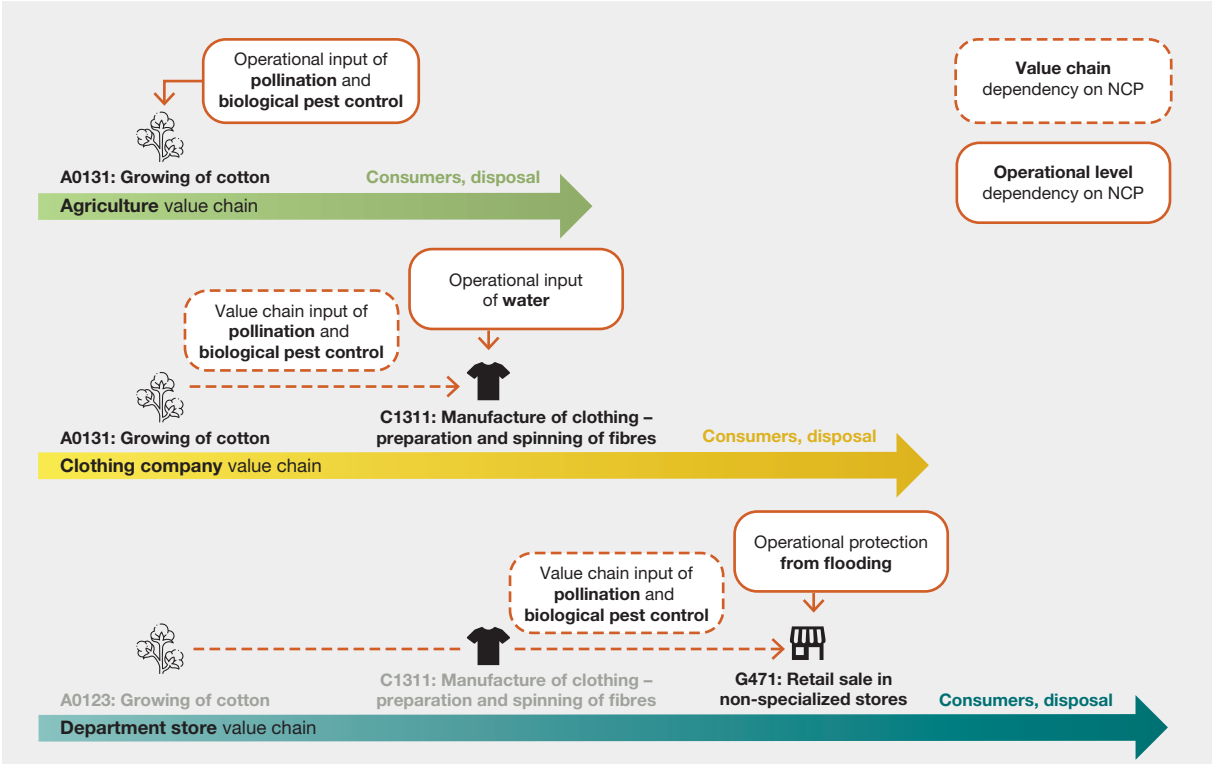


Figure 2 1 **The characterization of business dependencies on nature's contributions to people (NCP).**

Shown through a conceptual example of different sectors in the clothing value chain. The codes indicate the ISIC sector classifications.

Table 2 1 **Examples of business dependencies on biodiversity across the world.**

Value chain stage	Dependency examples
Raw material	Redlich *et al.* (2018) demonstrate that increasing crop diversification at landscape levels can improve bio pest control and thus possibly reduce the use of insecticides and enhance crop productivity in Germany. Karp & Daily (2014) find that insectivorous birds and bats significantly reduced non-flying arthropod abundance by 35 per cent and 25 per cent, causing cascading consequences for coffee plantations in Costa Rica. For instance, bird-mediated control of herbivores is seen as a long-term prevention of pest outbreaks. Cassol & Sellitto (2020) show that in the beauty and personal care industry, biodiversity is integral to sourcing natural ingredients like oils, plant extracts, and minerals in Brazil. Many of these ingredients are derived from plant and animal species, each contributing distinct chemical compounds essential for product formulation.
Design, production and manufacturing of goods and services	Biomimicry represents technology and design inspired by biodiversity; Lurie-Luke (2014) states that innovations in materials research account for 50 per cent of biomimicry studies globally. Zander *et al.* (2015) show that climate regulation services help mitigate direct impacts on production by limiting productivity losses from heat stress in Australia. Reddy *et al.* (2015) describe the financial effect of reliable water availability and water-use rights on the operations of a chemical company in the United States of America. Hadji-Lazaro *et al.* (2023) show dependencies on water for manufacturing and mining in South Africa, including employment in these sectors.
Distribution and sales	Transportation businesses depend on road infrastructure that benefits from biodiversity-driven soil retention and erosion control. Healthy plant and root systems in diverse ecosystems help prevent soil erosion, which maintains road durability and reduces maintenance costs. Hochard *et al.* (2019) show that mangroves protect economic activity from the effects of tropical cyclones, preventing permanent losses in 22 countries across the tropics.
Consumption, use and repair	Cardinale (2011) describes how clean water is preserved by biodiversity-rich ecosystems that filter and purify water sources through complex biological interactions, based on commonly found algal species in North America.
Collection, recycling and disposal	Review studies by Bosch *et al.* (2019), Huis (2013) and Junge *et al.* (2023) show that insects can consume and decompose waste and, in return, are a protein source that enables the feeding of livestock without requiring high technical knowledge nor space. Similarly, black shoulder flies are increasingly used in recycling waste, and so are bivalve molluscs and algae for water purification. Researchers use DSI to improve the efficiency and effectiveness of waste management. Singh and Shyu (2024) describe how the profiling of microbial communities can be used in solid waste management.

2.2.2 Magnitude of dependency

To manage dependencies, businesses need to assess (a) the quantity of material or non-material use of biodiversity, (b) the state of biodiversity (stock) and changes therein, and (c) the benefit flow from biodiversity and changes therein; ideally translated into business costs and benefits (TNFD, 2023b). Measuring use and tracking stock and flow changes are key for risk assessment (see **Section 2.2.4**).

Biodiversity dependencies vary across sectors and countries. Agriculture depends heavily on water, but water savings and requirements vary across crops, with rice needing more water than most crops (Cao *et al.*, 2022). The information and communication technology sector relies on water for cooling, with 57 per cent of their cooling systems using potable water in some cases (Mytton, 2021), competing with other water uses. Businesses also vary in the type of nature's contributions to people they depend on. An assessment by the Finance for Biodiversity Foundation of the Morgan Stanley Capital International All Country World Index (MSCI ACWI) found that most businesses depend on surface and ground water and erosion control (see **Section 2.5.5**).

Countries, business and finance entities are increasingly accounting for dependencies (see **Section 2.5**). Governments use the internationally agreed System of Environmental Economic Accounting – Ecosystem

Accounting (SEEA-EA) framework to link the economy and environment with national accounts. At global and financial portfolio level, multiple studies have used the ENCORE database (ENCORE, n.d.), which provides qualitative scores of sectoral dependencies. These analyses show high dependencies for agriculture, forestry, fisheries and aquaculture, as do related sectors (food, beverages and tobacco). Dependencies are also significant for the construction sector, utilities, communications, energy, industry and basic materials (Carvalho *et al.*, 2023a).

2.2.3 Dependence related to spatial and temporal scales

Businesses' dependencies vary over space and time, influenced by spatial flows of nature's contributions to people (Kleemann *et al.*, 2020), temporal aspects like seasonality (Del Río-Mena *et al.*, 2020) and storage options (Willemen, 2020). Spatial flows include biophysical flows (e.g., downstream water regulation benefits), species movement (e.g., pollinators for agriculture, migratory

Box 2 1 **Dependencies in geographically distant regions for pollination services.**

Operational dependency: Reliance on pollination services varies across agricultural products. For instance, soybeans have a modest dependency on pollination (0.25 on a 0-1 scale), contributing 10–40 per cent to yields. Still, in Brazil, large-scale cultivation makes this economically significant (Giannini *et al.*, 2015). In contrast, oleaginous crops like coconut, as well as perennial and non-perennial crops and berries, see less economic benefit (**Figure 2.2**, values from Giannini *et al.* (2015).[4]

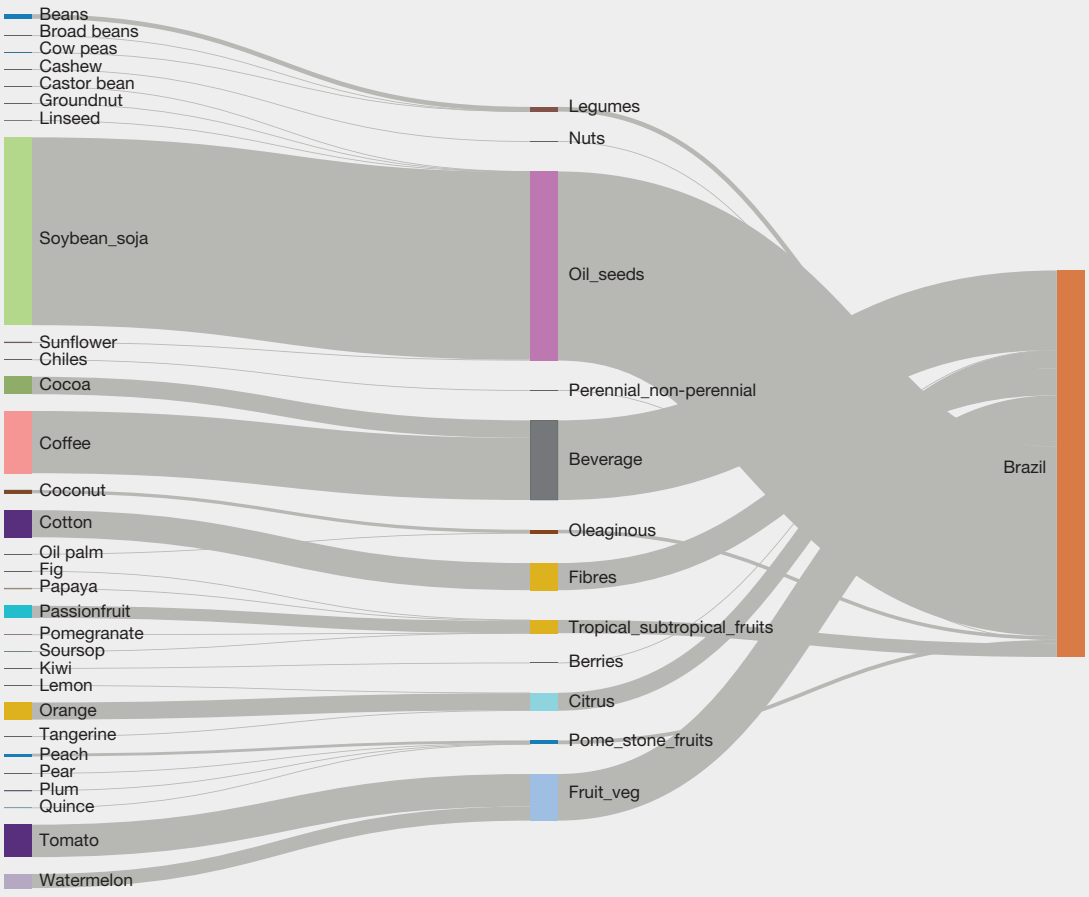


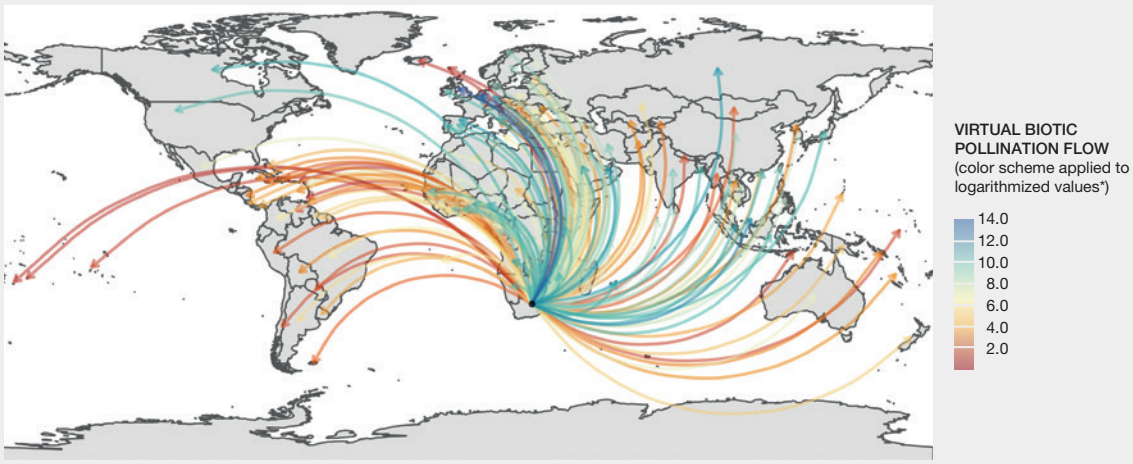
Figure 2 2 **Economic benefits of pollination services in USD for different crops and International Standard Industrial Classification subcategories in Brazil.**

The left column lists individual crops, while the middle column groups them into broader ISIC-based categories. For instance, beans, broad beans, and cowpeas are classified under "legumes". The width of the grey lines indicates the magnitude of the economic benefits of pollination services. Data source: Giannini *et al.* (2015).

4. Details of the analysis are provided in the accompanying data management report https://doi.org/10.5281/zenodo.17239488

Box 2 1

Value chain dependency: Many globally traded crops depend on nature's contributions to people. Approximately 50 per cent of traded crops rely on pollinators, with the majority originating from the Global South (Silva *et al.*, 2021).



*Check original values in the Data tab
Original data on international market was obtained from www.fao.org/faostat/en/@data/TM

Figure 2 3 **Virtual biotic pollination flow from South Africa (exporting country) to other countries from 2001 to 2015.**

"Virtual biotic pollination" refers to the proportion of total crop production dependent on wild pollinators, while virtual biotic pollination flow represents the internationally traded portion of this pollination-dependent production (logarithmic colour coding highlights major flows) (Silva *et al.*, 2021). This figure was reproduced from the Virtual Biotic Pollination Flow Tool Silva *et al.* (2021) and Lund University *et al.* (n.d.), which generates country-specific maps for selected years or for all years based on FAO's trade matrix dataset (Food and Agriculture Organization of the United Nations (FAO), 2024).

species for hunting), material transport (e.g., trade, foraging), or information flow (e.g., learning from species, artistic inspiration, mental wellbeing and joy from distant landscape) (Bagstad *et al.*, 2013; Schröter *et al.*, 2018; Sitotaw Molla *et al.*, 2024).

Business dependency involves all types of spatial flows, but trade-related dependencies are the most documented. Trade connects distal production systems along the value chain worldwide, in what is often called telecoupling over long distances, or meta-coupling in adjacent areas (J. Liu *et al.*, 2013) (See **Box 2.1**). Traded products depend on biodiversity in their region of origin, especially in agricultural, forestry and fisheries (A. Marques *et al.*, 2024). Other spatial dependencies include pest control by migratory bird species (e.g., migration routes from the Great African Rift and the Savanna Zone to Germany) (Kleemann *et al.*, 2020), tourism relying on cross-boundary wildlife migrations, and fisheries depending on surrounding fish populations. Understanding dependencies across scales can furthermore highlight power asymmetries and potential trade-offs or synergies (Martín-López *et al.*, 2019).

Temporal dependency refers to variations in business dependency on biodiversity over years and seasons (e.g., tourist season, crop flowering period, erosion regulation and weather) and whether services can be stored (e.g., materials, food, water). Rau *et al.* (2020) identify three types of temporal patterns of ecosystem services: 1) long-term linear dependency (e.g., forestry logging, carbon storage in carbon credit schemes); 2) periodic dependency, where ecosystem services buffer climate or other shocks (e.g., climate and water regulation for livestock during droughts); and 3) sudden, non-linear changes.

While spatial and temporal dependencies are well known, very few studies analyze them in detail.[5] For example, dependences have been studied for pollinators within natural vegetation in proximity to crop fields. Methodological challenges include data collection (e.g., tracking species or trade flows), capturing dependency variations (e.g., long- vs. short-term appropriation), and linking nature-related

5. Data management report referring to the literature review conducted for **Chapter 2** https://doi.org/10.5281/zenodo.12790967

dependency assessments to business tools (e.g., integrating geospatial models with cost-benefit analyses to quantify temporal and spatial dependencies).

Large knowledge gaps and data constraints remain in quantifying spatial and temporally explicit dependencies. Methods to better disentangle the contributions of natural and human input to a production process need to become more spatially and temporally detailed.

2.2.4 Business risks from dependencies

Nature-related dependencies reflect businesses' reliance on healthy ecosystems, while biodiversity-related risks arise from ecosystem degradation and biodiversity loss, impacting financial performance through higher operational costs and increased vulnerability to supply chain disruptions (Mandle *et al.*, 2024). Similar to climate-related risks, biodiversity -related risks include physical, transition and systemic risks (NGFS, 2024). *Physical* risks stem from ecosystem degradation and resulting loss of nature's contributions to people, affecting economic activity (TNFD, 2025), directly linking biodiversity loss to business financial performance. In 2020, global business representatives ranked biodiversity loss among the top five global economic risks (WEF, 2020b). *Transition* risks arise from market, economic, technology or regulatory changes transitioning towards sustainability. *Systematic* risks include non-linear and destabilizing cascading effects on assets, health, production, world prices, and ecological and financial systems.

High levels of dependencies pose increasing risks to businesses as biodiversity's stocks and flows continue to decline. Yet, these dependencies are often unrecognized in value chains and the enabling conditions of business activity (Dasgupta, 2021; Marques *et al.*, 2024; (Davies and Martini 2023)). This fundamental lack of awareness of physical risks which sometimes precedes lack of implementation of sustainability policies, increases the potential to overuse biodiversity beyond its carrying capacity and replenishable limits, potentially causing systemic risks like local and global food insecurity, land degradation or ecosystem collapse (IPBES, 2018; Willett *et al.*, 2019). These impacts may also disrupt value chains (Klein *et al.*, 2007; WEF, 2023).

The Intergovernmental Panel on Climate Change (IPCC) risk model, based on ISO 3100, disaggregates cause and effect into exposure, hazard and vulnerability. An adaptation of this framework for nature dependencies is presented in **Figure 2.4**.

In this framing:

- Risk is the consequence of a change in the availability of nature's contributions to people and is determined by exposure, hazard and vulnerability.

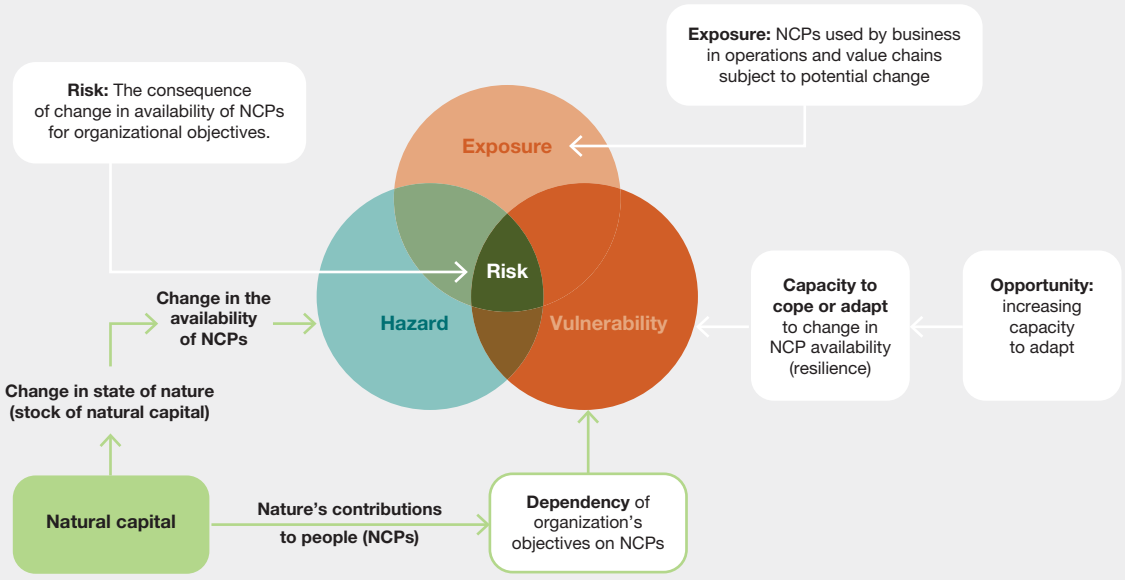


Figure 2 4 **Conceptual framework for understanding risks from business dependencies on nature.**

Based on concepts from IPCC, 2014: International Standards Organization, 2018; and TNFD, 2023a.

- Hazard results from changes in availability of nature's contributions to people. These changes can have natural causes, e.g., water availability may vary with seasons, but more often these can be human induced (IPBES, 2019b).

- Exposure to changes in the availability of nature's contributions to people in space and time can manifest both in an organization's operational activities (e.g., water use for irrigation) as well as any point in the value chain (e.g., sourcing of irrigated crops).

- Vulnerability is the degree to which a business is susceptible to, or unable to cope with, adverse effects of changes in availability of nature's contributions to people due to the decline of natural capital. For example, several sectors are highly vulnerable to water stress, including agriculture, manufacturing and energy (Davies & Martini, 2023). Vulnerability has two components: dependency and adaptive capacity.

- Dependency is the degree to which a business requires the use of a specific nature's contributions to people or natural capital stock, either directly or through trade in the value chain (See **Section 2.2.2**). The ability to satisfy dependencies relies on the state of natural capital – both the stocks and the flows.

- Adaptive capacity is the ability of organizations to adjust to the consequences of loss of nature's contributions to people. Adaptation can reduce *vulnerability* and create *opportunities* (positive outcomes) for organizations by:

  - *Changing exposure* – such as relocating production, considering suppliers or portfolio constituents operating in locations with lower exposure to hazards or considering the storage of nature's contributions to people if possible.

  - *Changing dependency* – such as substituting nature's contributions to people (e.g., artificial pest control), considering alternative products (e.g., dry shampoo in water-stressed markets), or supporting suppliers to increase the resilience of their operations. Evaluation of opportunities related to reducing dependency on nature's contributions to people via technological solutions should be evaluated also in terms of trade-offs and unintended consequences (Persson *et al.*, 2022).

  - *Changing hazard* – such as by reducing human impacts on biodiversity or investing in ecosystem restoration measures and nature-based solutions to enhance the state of natural capital to secure availability of nature's contributions to people. For example, investing in forest resilience bonds that enhances water supply (Madeira & Gartner, 2018).

Nature-related risks stem from natural capital scarcity, pressures causing stock and flow changes to decline, total demand (of business and other actors) and non-substitutability. Risk assessments must evaluate trends in natural capital, its availability, accessibility and substitutability. To identify risks, business and the financial sector use tools, such as risk scans, hotspot and scenario analyses (see **Sections 2.3** and **2.4**). The World Resources Institute's Corporate Ecosystem Services Review (ESR) helps businesses assess dependencies such as those on water regulation, pollination and soil fertility (Hanson *et al.*, 2012). By mapping services to business operations, businesses can identify critical 'pinch points'.

2.3 METHODS AND APPROACHES FOR ASSESSING DEPENDENCIES

This section reviews methods and approaches for assessing nature-related dependencies to inform sustainable resource management, by recognizing the connection to biodiversity in traded products, assessing risks and vulnerabilities, value chain uncertainties and resilience (A. Marques *et al.*, 2024). Methods and approaches are categorized into environmental-economic models, biophysical and ecological approaches, participatory monitoring and mapping, monetary valuation methods and socio-cultural valuation methods. The methods and approaches have varying scientific uptake, robustness and industry application. **Table 2.2** summarizes their robustness, reliability and uptake. **Section 2.4** describes complementary approaches to integrate methods, analyze scenarios, and metrics and indicators.

2.3.1 Environmental-economic models

Economic models integrated with environmental models or indicators assess economy-nature interactions for screening and comparing options. Methods include: (a) (partial) equilibrium and integrated models, and (b) ecological-economic modelling.

(a) (Partial) equilibrium and integrated models (macro): Integrated assessment models like the Integrated Model to Assess the Global Environment (IMAGE), partial equilibrium models like the Global Biosphere Management (GLOBIOM) model, and computable general equilibrium models like the Global Trade Analysis Project (GTAP) model, which use multi-regional input-output tables like EXIOBASE, study trade-influenced emissions, impacts and competition of

land at macro, i.e., high spatial, levels (regional-global), but also inputs and dependencies. Applications include water-energy-food and circular economy assessments (Banerjee *et al.*, 2020; Castelli *et al.*, 2024; McCarthy *et al.*, 2018).

(b) Ecological-economic modelling (micro): Ecological-economic models are built more from a local level to analyse general environment-economy interactions in land use systems, such as the dependence of agriculture on biodiversity (Drechsler *et al.*, 2022), aiming to include feedbacks and dynamics (Lawler *et al.*, 2014). Other studies combine economic models with ecological or hydrological models to assess single or multiple nature's contributions to people and their values. These are sometimes scaled up to (sub-) national levels (or beyond) in spatially differentiated assessments (Bateman *et al.*, 2013; Johnson *et al.*, 2023). Some studies combine macro-economic models with more micro-level spatial ecosystem models to demonstrate that the interactions and feedbacks between economic markets and policy and nature mean that nature loss produces economic loss, but also that nature investments pay off economically (Johnson *et al.*, 2023).

Robustness and uptake of environment-economic approaches: These approaches have strong scientific underpinnings and can provide systemic, economy-wide perspectives on dependencies and risks, especially when linking environmental and economic accounts (e.g., System of Environmental Economic Accounting – Ecosystem Accounting – SEEA-EA) or applying computable general equilibrium frameworks (Banerjee *et al.*, 2020; Zimmer *et al.*, 2023). The robustness of macro-level models lies in the integration of multi-sector, multi-regional datasets and the ability to simulate counterfactuals under alternative policy or management scenarios. However, their uptake in the private sector remains limited because most applications operate at national or global scales and lack the sectoral granularity, site-specific ecological data and product-level resolution required for corporate decision-making. Where used, they have primarily informed national accounting, strategic environmental assessment and large-scale resource management. The more micro-level, local models, if based on site-specific ecological and economic data, have high relevance for business, but most applications are currently not tailored to the needs of businesses. Wider adoption will require improved access to high-resolution trade, value chain and biophysical datasets, and closer collaboration between modelers, industry and statistical agencies to align outputs with corporate reporting needs.

2.3.2 Biophysical and ecological approaches

Biophysical approaches quantify the direct, physical relationships between business operations and biodiversity, using ecological data, spatial analysis and modelling to trace business dependency on ecosystem functions (MEA 2005). Methods include: (a) location-based observations, (b) life cycle approaches and (c) spatial analysis. Results from biophysical and ecological approaches are usually reported using metrices such as volume (e.g., volume of water), and land areas in hectares and tonnes (e.g., crops produced).

(a) Location-based observations, field surveys and remote sensing: Field-based ecological methods can be used to measure the abundance, stock and flow of nature's contributions to people and biodiversity and are useful for screening risks, comparing options and interventions, tracking progress and demonstrating impact, primarily at site-scale and for value chain analysis. A commonly used field-based method is the survey of species richness through capturing of bees to understand impact on pollination and associated crop yield in volumes or quality. At higher spatial scales, remote sensing data can be used to map land use and land cover changes with high spatial coverage.

(b) Life cycle approaches, life cycle assessments and biodiversity foot printing: Life cycle approach-based methods assess biodiversity dependencies and impacts across value chains by quantifying reliance on ecosystem functions, mainly for water, land, materials and energy. However, links to natural capital and supply changes are less established (Rugani *et al.*, 2019). Integrating ecosystem service supply and demand into life cycle assessments helps evaluate unsustainable use and nature-dependency risks (Liu *et al.*, 2020) and extends the International Organization for Standardization (ISO) definitions of life cycle assessments to quantify nature-enhancing business activities such as nature-based solutions (Alshehri *et al.*, 2023). Biodiversity footprinting adds species loss or ecosystem degradation metrics but focuses on impacts rather than dependencies (Chaudhary & Brooks, 2018; Institute for European Environmental Policy, 2021). These rigorous and data-intensive methods benefit from well-established life cycle assessment frameworks but may lack context-explicit reliability.

(c) Spatial analysis, biophysical and ecological models: These methods use spatial data and ecological models to map biodiversity elements (e.g., habitat extent, species populations), natural capital stocks and benefit flows that businesses depend on. They often intersect with environmental risk mapping and focus on the supply of nature's contributions

to people rather than the demand of the economy. Robustness comes from scientific models (e.g., species distribution, hydrological models). These methods allow for screening risk and comparing different strategies or project changes under different scenarios.

Robustness and uptake of biophysical and ecological approaches: Biophysical and ecological approaches enjoy substantial scientific uptake due to their quantitative biodiversity and strong ecological foundation. They offer robust and replicable results, thanks to clear ecological cause — effect linkages, with high reliability when quality data are available. However, data collection cost, especially in remote regions or for less-studied species, can create data gaps, limiting accuracy and coverage. Field surveys and experiments provide context-specific data and analysis but are costly for long-term monitoring. Dependency assessment remains less developed than impact assessment and requires refinement (Finance for Biodiversity Foundation, 2024; Gallai *et al.*, 2009).

2.3.3 Participatory monitoring and mapping methods

Participatory methods can be used in collaboration with stakeholders – both in the value chain and those who have a direct interest or stake in biodiversity on which business depends – for different reasons, from corporate responsibility to legitimacy and to co-design (Hoes *et al.*, 2021). Methods included in their application vary in the extent to which they are defined, designed and conducted by citizens and community members: (a) participatory mapping and co-assessment with communities, (b) Indigenous and local knowledge-based indicators and monitoring and (c) rights-based & ethical biocultural evaluations.

We include under this header also approaches supported by Indigenous Peoples that integrate Indigenous and local knowledge, community-led monitoring and co-management practices to assess biodiversity dependencies. They ensure business assessments include traditional knowledge and community-defined indicators (Tengö *et al.*, 2014). These approaches are increasingly recognized by global platforms (IPBES, 2019) and businesses operating nearby Indigenous territories.

(a) Participatory mapping and co-assessment: Businesses and citizens jointly map biodiversity and nature's contributions to people, blending scientific data with traditional and local spatial knowledge. This co-assessment identifies biodiversity components and pressures on habitats that are critical for both business operations and community well-being and can be used to co-create strategies for sustaining livelihoods and biodiversity. Methods may include oral approaches such as storytelling and community dialogues, as well as visual approaches such as geographic information systems, mental mapping and eco-cultural calendars (Robinson *et al.*, 2016; Tengö *et al.*, 2021).

(b) Indigenous and local knowledge-based indicators and monitoring: Many IPLCs use indicators derived from traditional knowledge, such as seasonal indicators to monitor ecosystem health. Businesses can collaborate with communities to use these Indigenous and local knowledge indicators to gauge their resource dependencies, and involve local communities in collecting data through citizen-based approaches, in some countries recognized as citizen science (Danielsen *et al.*, 2014).

(c) Rights-based & ethical biocultural evaluations: These approaches emphasize respecting Indigenous values and rights, and also other applicable rights of local communities, using ethical dialogues and impact assessments. Aligning biodiversity management with local worldviews – for instance around resource use in mining and biotrade industries – benefits businesses through ethical sourcing, reduced conflicts, and stronger social licenses to operate.

Robustness and uptake of participatory monitoring and mapping methods: Involving citizens and IPLC members in mapping and monitoring dependencies ensures contextual validity and high local robustness. However, these methods are highly site-specific and lack universal metrics. Especially in the context of Indigenous Peoples, the application of these methods is guided by principles of reciprocity, spirituality and stewardship (Termansen *et al.*, 2022). Therefore, their reliability depends on strong partnerships, trust and genuine community engagement (Sterling *et al.*, 2017). In some practical applications, genuine involvement of, and fair sharing of benefits with IPLCs has been limited (Termansen *et al.*, 2022). Scientific uptake of participatory mapping and monitoring approaches is increasing ((Berkes, 2012; Gómez-Baggethun & Barton, 2013) but uptake of results of participatory and co-production processes in decision-making remains limited (Turnhout *et al.*, 2020).

2.3.4 Monetary valuation methods

Monetary valuation methods translate biodiversity dependencies into monetary metrics, aiding business decisions on costs, benefits and risks. Originally from environmental economics (Dasgupta, 2021; TEEB, 2012), they support corporate sustainability by assessing biodiversity degradation or enhancement impacts on productivity, profitability and investment decisions. Common methods include (a) cost-based valuation, (b) revealed

preference approaches, (c) market price methods, (d) stated preference methods and (e) benefit transfer. These are useful for ex-ante comparisons or ex-post impact tracking in societal value terms.

(a) Cost-based valuation methods: Cost-based methods estimate the economic value of biodiversity by examining the costs a business or sector would incur if nature's contributions to people were lost or degraded as they would need to invest in costly technological or engineered solutions. These include replacement cost (the expense of substituting or restoring an ecosystem function), damage cost avoided (the damages averted by preserving nature's contributions to people) and mitigation cost approaches. These methods provide lower-bound value estimates if replacement action has been implemented (see also Freeman III *et al.* 2014).

(b) Revealed preference methods: Revealed preference methods, especially hedonic pricing and travel cost techniques, draw on actual market behaviours to infer the value of nature's contributions to people. By looking at how consumers spend money or how property prices differ in relation to environmental attributes, businesses can gauge how much biodiversity contributes to economic outcomes (Gibbons *et al.*, 2014; Zhang *et al.*, 2015).

(c) Market price methods: Market price methods use observable prices in existing goods markets (e.g., agricultural commodities, fisheries, water trading) to assess how changes in biodiversity or nature's contributions to people affect supply, demand and overall market dynamics. Specifically, production function approaches, factor income and bioeconomic modelling are useful in the context of assessing dependencies and valuing resource inputs in monetary terms. If nature's contributions to people are closely tied to the quantity or quality of a traded good, fluctuations in supply levels can be partly reflected in market prices.

(d) Stated preference methods: Stated preference techniques – such as contingent valuation and choice experiments – collect primary data and elicit how much individuals would be willing to pay (or accept) for changes in nature's contributions to people under hypothetical market scenarios. Businesses can use these methods to capture non-market values (e.g., cultural identity, brand goodwill) that consumers, employees or communities associate with biodiversity, and can inform the design of taxes or incentives schemes by providing insight into citizen and consumer preferences (TEEB, 2012).

(e) Benefit transfer methods: Benefit transfer (also called value transfer) involves adapting existing valuation estimates from one context (the 'study site') to inform decisions in a different but similar context (the 'policy or business site'). This can be especially useful when time or resources for primary valuation are limited.

Robustness and uptake of monetary valuation methods: Monetary valuation methods robustly translate biodiversity dependencies into financial metrics, aiding corporate strategy and reporting (Dasgupta, 2021; TEEB, 2012). Their reliability hinges on data quality and valuation assumptions, which may oversimplify ecological interdependencies (Pascual *et al.*, 2017). Scientific scrutiny and uptake are considerable. While cost- and market-based methods may overlook cultural or spiritual values, combining them with biophysical and socio-cultural approaches strengthens biodiversity dependency assessments within economic frameworks.

2.3.5 Socio-cultural valuation methods

Socio-cultural valuation methods capture the cultural, spiritual or heritage values of biodiversity dependencies through the lens of human values, preferences and cultural significance (Scholte *et al.*, 2015). They are increasingly recognized in business sustainability assessments for brand identity or customer goodwill. Common methods include: (a) expert elicitation, (b) participant observation, (c) document analysis, (d) perception assessments and (e) narrative assessments.

(a) Expert elicitation, Delphi and Q-method: These methods rely on relatively small samples of well-informed stakeholders to provide information about complex and uncertain topics, such as the importance of nature's contributions to people and biodiversity, the implications of dependencies and the effects of risk management. These methods are suitable when there is a lack of data or when collecting data is prohibitively expensive. While expert elicitation and Delphi techniques are consensus oriented, Q-methods aim to explore subjectivity and variation in opinions.

(b) Participant observation: For this method, a researcher engages in a particular social setting or group, observing the behaviours, interactions, and practices of the participants to understand the experiences of individuals or groups which are value expressions. Businesses can use these assessments to reinforce brand identity and ensure sustainable supply chain practices.

(c) Document analysis: This method extracts information about perceptions of dependencies from existing documentation, and is often used to study the enabling

environment, including policy frameworks, but can also be used to identify the values of different stakeholders, for instance using media analysis.

(d) Perception assessments: Businesses can use different types of ranking exercises or photo-elicitation methods to engage stakeholders (employees, customers, local communities) to understand which nature's contributions to people and biodiversity are perceived as most important, thereby revealing co-dependencies, synergies and trade-offs. These methods often involve larger samples and (semi-) quantitative analysis.

(e) Narrative methods: These methods provide qualitative data on dependencies and values of nature's contributions to people and biodiversity using focus groups, storytelling, workshops and interviews (Reed, 2008). They can be used to assess experienced changes over time and space, trade-offs and synergies, and provide context-specific data on dependencies.

Robustness and uptake of socio-cultural valuation methods: Socio-cultural valuation methods offer context-specific insights, with reliability depending on stakeholder representativeness and toll design (e.g., formal vs. informal feedback). Robustness improves with systematic frameworks such as Delphi surveys (Mukherjee *et al.*, 2015). These methods vary in skills, time and budget required. Scientific uptake is growing in interdisciplinary fields such as ecological economics and sustainability science. They provide insights that are critical for developing business initiatives that are both culturally sensitive and conservation-oriented (Chan *et al.*, 2012), as they capture relational and shared values (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services *et al.*, 2022) essential for comprehensive dependency assessments but often overlooked (Pascual *et al.*, 2017).

Table 2 2 **Selected and additional examples of business dependencies on biodiversity across key methodological approaches.**

The table also presents associated references and assessment of scientific uptake, reliability and resource requirements.

Approach and sub-method	Example of dependency	Scientific uptake, reliability & resource requirements
Environmental-economic models		
Equilibrium and integrated models	Alaskan tourism operators benefit from Steller sea lion protection; a Computable General Equilibrium model captures how shifts in wildlife conservation alter resource allocation and economic flows across industries (Finnoff & Tschirhart, 2008). Using a general equilibrium model, the agricultural dependency on pollination is estimated to be considerable and outweigh the abatement costs of several measures to protect pollinators in multiple European countries (Zimmer *et al.*, 2023).	Scientific uptake: Relatively advanced; mostly in academic or specialized consulting contexts. Reliability: High for system-level insights but sensitive to model assumptions. Resources: Requires robust data across economics, ecology, and social factors; can be computationally intensive.
Ecological-economic modelling	A spatially explicit model was used to find land allocation solutions for Oregon, USA, that sustain high levels of biodiversity as well as economic revenue (Polasky *et al.*, 2008). Regulating nature's contributions to people, such as drought control from tropical forests, supporting nearby agricultural producers by preventing drought events (Pattanayak & Kramer, 2001).	Scientific uptake: Established in policy and academic domains, limited in corporate applications. Reliability: High for macro-style insights; moderate for firm-level decisions without downscaling. Resources: Requires multi-disciplinary expertise and access to linked environmental-economic and trade datasets.
Biophysical and ecological approaches		
Location-based observations: Field surveys	Family farms depend on consistent rainfall and healthy soils for key staple crops (maize, millet, rice) in tropical regions (e.g., Brazil, Senegal, Vietnam) (Affholder *et al.*, 2013). Primary data from smallholder farms in Colombia was used to assess how natural pollination affects coffee fruit set. The combination with monetary valuation showed that losing native bees would cost $16.5/ha and losing honeybees would cost $129.6/ha (Bravo-Monroy *et al.*, 2015).	Scientific uptake: Common in agronomy, ecology, and environmental management. Reliability: Moderate to high, contingent on representative sampling and robust survey design. Resources: Requires trained field teams and adequate time for data collection.

Table 2 2

Approach and sub-method	Example of dependency	Scientific uptake, reliability & resource requirements
Biophysical and ecological approaches		
Location-based observations: Field surveys	Remote sensing can help identify both impacts and dependencies of dairy farming (Reid & Castka, 2023). Small-scale farmers and fisherfolks use visual surveys to gauge species richness, evenness and relative dominance (Nishi *et al.*, 2025).	
Spatial analysis: spatial mapping	The acreage of medicinal plant resources (e.g., for Traditional Chinese Medicine) was identified and classified to illustrate industry dependence on specific plant habitats and ecosystem productivity (Meng *et al.*, 2023). Geospatial mapping of seagrass beds, using satellite imagery and spatial models to quantify their global distribution, to assess the vulnerability of coastal fisheries to habitat loss, showed that rapid seagrass declines – critical nursery habitats for many fish species – can significantly reduce juvenile fish survival and stock sustainability, jeopardizing the long-term productivity of coastal fisheries (Waycott *et al.*, 2009).	Scientific uptake: Broadly used in environmental/ land-use studies; remote sensing widely accepted for spatial inventories. Reliability: High, given suitable satellite/imaging data and ground truthing. Resources: Data-intensive; software and technical expertise needed.
Spatial analysis: biophysical models	Vineyards depend on suitable climatic and soil conditions, and machine-learning models project shifting areas for grape cultivation in Europe, highlighting the wine sector's reliance on biodiversity-driven ecosystem processes (Moriondo *et al.*, 2013). Coastal flood models and coral reef maps measure how coral ecosystems protect insured coastal assets from storm surges with the potential to inform insurance industry risk models (Beck *et al.*, 2018).	Scientific uptake: Strong within climate change and agricultural modelling communities. Reliability: Dependent on model calibration and input data quality. Resources: Requires expertise in modelling software, climate/ ecological datasets.
Life cycle approaches	Dependency of rice production systems on water provisioning, as well as dependencies on carbon sequestration, water quality and air quality regulation (Liu *et al.*, 2020).	Scientific uptake: Proof-of-concept application in academic case studies, no wider uptake by business. Reliability: Highly dependent on quality and regional representativeness of input data, often not spatially explicit. Resources: Data intensive; requires interdisciplinary knowledge and incorporation of specialist modelling. No operationalization in life cycle assessment software.
Participatory monitoring and mapping methods		
Participatory mapping & co-assessment	Local fishing communities, as key IPLCs stakeholders, collaborated with researchers to map and assess fisheries, revealing how artisanal fishing businesses depend on healthy coastal and mangrove habitats (Sagoe *et al.*, 2021). In Tun Mustapha Park, IPLCs joined forces with a mariculture enterprise to co-map essential marine nature's contributions to people and demonstrate their shared reliance on healthy reefs and mangroves, guiding more inclusive and sustainable resource management in the region (Lim *et al.*, 2021).	Scientific uptake: Widely used in social sciences, increasing use in IPLCs research and practice. Reliability: High-context specificity, integration of knowledge systems can be complicated. Resources: Considerably resource-intensive to ensure ethical and non-extractive practices; requires mutual training and field travel.
Indigenous and local knowledge-based indicators and monitoring	The Athabasca Landing Métis Community partnered with the oil sands industry to design a community-based monitoring program that merges Indigenous knowledge (e.g., hunting and foraging traditions) with scientific tools (like geo-referenced photo mapping) to track biodiversity and environmental changes, providing early warnings and promoting sustainable resource use (O'Connor *et al.*, 2022).	Scientific uptake**:** Increasing use in community-based research and practice. Reliability: High-context specificity, integration of knowledge systems can be complicated. Resources: Considerably resource-intensive to ensure ethical and non-extractive practices; requires mutual training and field travel; data collection itself can be less costly.

Table 2 2

Approach and sub-method	Example of dependency	Scientific uptake, reliability & resource requirements
Participatory monitoring and mapping methods		
Indigenous and local knowledge-based indicators and monitoring	The Gitga'at First Nation co-developed a biodiversity monitoring program with external researchers that integrates Indigenous knowledge (e.g., local observations of fish, shellfish and marine mammals) with scientific methods to track ecosystem health, safeguarding vital subsistence and economic resources for communities and external stakeholders in tourism and fisheries (Thompson *et al.*, 2019).	
Rights-based & ethical biocultural evaluation	IPLCs in Colombia effectively applied a biocultural diversity framework to safeguard their knowledge systems through ethical, rights-based principles that respect traditional customs (Nemogá *et al.*, 2022).	Scientific uptake: Increasing use in community-based research and practice. Reliability: High-context specificity, integration of knowledge systems can be complicated. Resources: Considerably resource-intensive to ensure ethical and non-extractive practices; requires mutual training and field travel.
Monetary valuation methods		
Cost-based methods	Downstream farmers in South India depend for irrigation on clean upstream water provided by upstream biodiversity that underpins natural filtration; replacement costs (e.g., damaged pump and filtration systems) illustrate how industrial pollution can threaten farm productivity (V. R. Reddy & Behera, 2006).	Scientific uptake: Common in environmental economics for pollution control and resource management. Reliability: Straightforward if cost data are available; can oversimplify complex ecosystem functions resulting in higher uncertainties. Resources: Requires site-specific cost data and basic hydrological context.
Revealed preference	Real estate businesses rely on biodiversity to maintain property values: house prices increase in proximity to scenic landscapes and wildlife presence in forests and wetlands, shown by hedonic pricing analyses (Fois *et al.*, 2019). The value of Gold Coast recreational beach visits was estimated at $117 million per year (AUD) for tourists and 402 million per year (AUD) for residents, using the travel cost method (Zhang *et al.*, 2015).	Scientific uptake: Well-established in environmental economics, especially property value studies. Reliability: Low to moderate depending on data quality. Data-intensive (requires robust real market data). Resources: Statistical expertise, reliable real estate and biodiversity data.
Market price methods	Farmers in the Mississippi Basin depend on wetlands for nutrient regulation and water quality (reducing the need for costly fertilizers and mitigating runoff); market price models can reveal how wetland restoration and nitrogen credit trading affect agricultural commodity prices (Ribaudo *et al.*, 2005). Based on the production function method, the value of soil retention and pollination services to agricultural values at regional and national level represents 44 per cent of the value of production (Grammatikopoulou *et al.*, 2024)	Scientific uptake: Straightforward when a well-functioning market exists for a related good (e.g., farm. commodities). Reliability: High if causal pathways between biodiversity and market outcomes are established; may be confounded by subsidies or externalities. Resources: Data on prices, production volumes and ecosystem conditions and market dynamics (e.g., supply-and-demand models).
Stated preference methods	Ecotourism operators rely on healthy landscapes; contingent valuation or choice experiments reveal visitors' willingness to pay for biodiversity conservation (e.g., iconic species, pristine habitats) (TEEB, 2012). Different stated preference studies assess costumer preferences for changes in water supply and environmental services and their willingness to pay for these – such payments can help recover costs of restoration of ecosystems that provide water supply and quality (Willis & Sheldon, 2022).	Scientific uptake: Widely used in environmental economics for non-market valuation. Reliability: Depends on survey design and the realism of hypothetical scenarios; prone to bias if not carefully structured. Resources: Social science expertise, representative sampling of stakeholders, and clear scenario framing to capture perceived value of biodiversity.

Table 2 2

Approach and sub-method	Example of dependency	Scientific uptake, reliability & resource requirements
Monetary valuation methods		
Benefit transfer	Farmers in the Mississippi Alluvial Valley use previously estimated nitrogen mitigation values from similar regions to evaluate the benefits of adjusting fertilizer usage or retiring cropland (Jenkins *et al.*, 2010). This also provides businesses and policymakers with rapid, cost-effective insights into their dependence on services like water filtration and soil fertility.	Scientific uptake: A frequent, cost-effective approach in policy and corporate contexts when primary valuation is not feasible. Reliability: Varies with the similarity between the "study site" and "application site" and the robustness of original valuation data. Resources: Access to relevant external studies, plus careful calibration to local ecological, economic and cultural conditions.
Socio-cultural valuation methods		
Expert elicitation, Delphi & Q methods	Chemical manufacturing depends on adequate freshwater availability; a Delphi-type approach estimated potential production losses if water supply declines (Reddy *et al.*, 2015). Salmon aquaculture stakeholders in Tasmania were interviewed using a Q-method approach; findings suggest that they highly value seabed health and water quality to sustain the coastal ecosystem services that they rely on (Pethiyagoda *et al.*, 2024).	Scientific uptake: Moderate but increasing, especially for complex 'what-if' scenarios in corporate planning. Reliability: Can be high if experts are diverse and iteration is well-structured. Resources: Facilitation, expert networks and iterative survey tools required.
Participant observation	A large environmental sector company recognizes direct reliance on biodiversity (e.g., pollination, pest control) through an embedded researcher's on-site observations and staff interviews (Feger & Mermet, 2022). Participant observation in combination with other socio-cultural valuation methods reveals how botanical species in biodiverse regions like the Amazon, used in cosmetics, hold deep cultural significance for Indigenous communities (Iniesta-Arandia *et al.*, 2014).	Scientific uptake: Less common in corporate contexts, more frequent in anthropological or organizational research. Reliability: Depends on researcher's access and objectivity. Resources: Time-intensive, interpretation and analysis can be difficult.
Document analysis	Document analysis demonstrated that the enabling policy framework for hydropower in Nepal does not yet consistently and comprehensive include nature's contributions to people (Lohani Sitoula *et al.*, 2024). Document analysis revealed that conflicts arise over provisioning nature's contributions to people due to high competition, with power imbalances shaping the outcomes in forestry in Turkiye (Başkent, 2022).	Scientific uptake: Widely used in social sciences research. Reliability: Moderate to high. Data may be limited, and reliability depends on transparency in process and triangulation. Resources: Not very resource intensive.
Perception assessments	Results of 1,634 photograph-based interviews across Sweden, Latvia, Belarus and Russia captured how different people value agroforestry landscapes; agriculture and forestry enterprises managing land can integrate these diverse stakeholder values into decision-making (Elbakidze *et al.*, 2021).	Scientific uptake: Widely used in social sciences, increasing use in applications on nature's contributions to people. Reliability: Data quality hinges on sampling strategy and survey design. Resources: Moderately resource-intensive; requires interviewer training and possible field travel.
Narrative methods	Farming communities describe how wildlife (e.g., primates, ungulates) can damage crops, highlighting dependence on balanced local fauna and pest control (Hill, 1997). Interviews helped to understand how wine makers in Australia integrate nature's contributions to people, such as water quantity, into their management (Sandhu *et al.*, 2018). Interviews revealed the role of nature's contributions to people in China's forestry sector, finding that increased resource competition combined with increased frequency and unpredictability of natural hazards drive up dependency risks (Wan *et al.*, 2017). Interviews were used to determine the credit risk of the Australian beef cattle industry resulting from natural capital dependencies (Ascui & Cojoianu, 2019).	Scientific uptake: Widely used in social sciences. Reliability: Data quality hinges on sampling strategy and protocol design, and control of polarization and power imbalances when applied in groups. Resources: Moderately resource-intensive; requires possible field travel.

2.4 INTEGRATING METHODS, SCENARIOS AND METRICS

The use of the methods described in **Section 2.3** often requires further analysis through integrating and synthesizing methods, which allow for bringing together different dependency assessment approaches into a joint analysis framework to support decision-making. We describe such methods in **Section 2.4.1**. Scenario analysis, described in **Section 2.4.2**, can further support decision-making and strategy development for managing business dependencies on nature through anticipating future risks, pathway development and robust effectiveness assessment of interventions to manage dependencies. **Section 2.4.3** describes metrics and indicators that can be used in dependency assessment to support decision-making, and that can be used in the integrating and synthesizing methods of **Section 2.4.1**.

2.4.1 Integrated and synthesizing methods

Following the IPBES Values Assessment (IPBES, 2022), biodiversity dependency assessments would ideally combine different methods to express these dependencies and their meaning in terms of endpoints of interest to people. Method combination is inherent to the integrated environmental-economic models described in **Section 2.3.1**, which combine ecological and economic data and methods. Monetary and socio-cultural valuation methods can build on biophysical research to assess how changes in biodiversity relate to changes in other types of values meaningful to stakeholders and to changes in quality of life.

There are also methods and tools that combine values and indicators (derived through methods described in **Sections 2.3.1** to **2.3.5**) for a holistic assessment of biodiversity dependencies and interventions to address these, which we list here as integrated and synthesizing methods. Supported by frameworks such as the IPBES conceptual framework (Díaz *et al.*, 2015) and The Economics of Ecosystems and Biodiversity for Business (TEEB, 2012), they can use multiple criteria and interdisciplinary biophysical, economic and socio-cultural metrics. These methods help to integrate the multiple effects that interventions to address biodiversity dependencies can have and help to prioritize these. Key methods include: (a) multi-criteria decision analysis, (b) cost-benefit analysis and (c) natural capital assessment and accounting. These methods have high scientific uptake and adoption by businesses and financial institutions is growing. **Table 2.3** provides an overview.

(a) Multi-criteria decision analysis: Multi-criteria decision analysis tools help businesses evaluate options or prioritize actions when multiple biodiversity dependency factors are at play, by incorporating ecological, social, and economic criteria (Kiker *et al.*, 2005). By scoring and weighting different criteria, multi-criteria decision analysis provides a structured method to incorporate ecological metrics into industry decision-making to compare alternatives, such as sourcing locations or mitigation strategies (see Huang *et al.*, 2011).

(b) Cost-benefit analysis: Cost-benefit analysis compares the monetized benefits of maintaining or enhancing nature's contributions to people against the costs of conservation, restoration or alternative provisioning through built capital. It is widely used in project appraisal and environmental policy evaluation (Freeman III *et al.*, 2014; TEEB, 2012). In a business context, cost-benefit analysis can quantify the net economic gains from actions such as watershed restoration to secure industrial water supplies, habitat conservation to sustain pollination services, or investment in green infrastructure to reduce flood risks. When combined with ecological models, social cost-benefit analysis can capture both market and selected non-market benefits, enabling businesses to identify investments that generate positive returns for both the company and broader society. Limitations include the difficulty of monetizing cultural and relational values, sensitivity to discount rates and uncertainty in long-term ecological responses.

(c) Natural capital assessment & accounting: This approach quantifies biodiversity and nature's contributions to people in economic terms, integrating biodiversity into business accounting (Dasgupta, 2021; Natural Capital Coalition, 2016). Using biophysical and monetary data, the System of Environmental-Economic Accounting Ecosystem Accounting–Ecosystem Accounting (SEEA-EA) framework contains both physical and economic accounts, including an assessment of the state of biodiversity — i.e., ecosystem extent and condition — and flows of ecosystem services, linked to economic accounts, but relies on exchange (market prices and cost) values. These methods are translated into business accounting standards (Capitals Coalition, 2022) to help businesses assess nature-related risks and identify more sustainable extraction practices. Business-oriented frameworks also emphasize links to other types of interlinked capital (human, produced, etc) (TEEB, 2018).

Robustness and uptake: Integrated methods are robust, and cross-validate economic valuations, ecological data and socio-cultural methods, as well as participatory mapping and monitoring information. While integration is complex due to issues of commensurability (especially in cost-benefit analysis), scientific uptake is strong. Leading businesses are piloting these methods, as researchers continue to

Table 2 3 **Selected and additional examples of business dependencies on biodiversity across key methodological approaches.**

The table also presents associated references and assessment of scientific uptake, reliability and resource requirements.

Integrated and synthesizing methods		
Multi-criteria decision analysis (MCDA)	Fisheries' enterprises depend on healthy fish stocks; Analytic Hierarchy Process reveals how stakeholders in the Bay of Biscay, the English Channel and the North Sea, weigh ecological vs. economic objectives such as fish stock conservation, profitability and social stability and highlight biodiversity as a driver of profit sustainability (Mardle *et al.*, 2004). Participatory multi-criteria decision analysis involving industry players and stakeholders examined trade-offs between peat extraction businesses, climate regulation, water quality and biodiversity in Finnish peatlands, revealing direct dependencies of peat-based businesses on peatland ecosystems and guiding more sustainable resource use (Saarikoski *et al.*, 2019).	Scientific uptake: Widely used in environmental decision-making for complex trade-offs. Reliability: High if stakeholder representation and criteria weighting are transparent. Resources: Requires facilitation, data on multiple criteria and collaboration among stakeholders.
Cost-benefit analysis	Forest conservation in the Brazilian Amazon increases açaí palm pollination services, improving yields and generating a positive net present value for local producers and supply-chain partners, which could be used to inform a cost-benefit analysis exercise (Campbell *et al.*, 2023).	Scientific uptake: Well-established in environmental economics; growing in corporate natural capital assessments. Reliability: Strong where biophysical changes can be reliably linked to economic outcomes; sensitive to valuation assumptions. Resources: Requires interdisciplinary expertise in economics, ecology and valuation; moderate to high data demands.
Natural capital accounting	Natural capital accounting was used to determine the economic values of forest in Ethiopia using a welfare-economic framework that treats changes in forest stock as a form of capital accumulation or depreciation (Narita *et al.*, 2018). Monetary valuation of groundwater stocks was used to value aquifer depletion, demonstrating how natural capital accounting can guide resource-intensive industries — especially agriculture — to incorporate ecosystem costs into risk management and investment decisions (Fenichel *et al.*, 2016).	Scientific uptake: Gaining traction, endorsed by frameworks like the Natural Capital Protocol. Reliability: Depends on ecological and economic data quality; can be technically demanding. Resources: Interdisciplinary expertise (finance, ecology, accounting) usually needed.

refine them for improved decision support. As demand for comprehensive nature-related risk assessments grows, adoption is expected to rise (Addison *et al.*, 2020; WEF, 2020a).

2.4.2 Scenarios and counterfactuals

Scenarios support multi-stage decision-making by revealing dependencies and risks and expected effects of changes to natural capital from pressures, policies or business strategies. Using systems-thinking, they explore systemic risks to business. The IPBES Nature Futures Framework (IPBES, 2023) was specifically designed to support scenario development and provides an overview of existing scenario approaches. Here, "scenarios" refer to internally consistent, plausible descriptions of future conditions (e.g., biophysical, economic, and policy) used to explore "what-if" questions, test the robustness of strategies, identify thresholds or tipping points, or evaluate future impacts.

Scenarios can be qualitative (e.g., narratives co-developed with stakeholders), quantitative (model-based projections of land use, climate, or market conditions) or both. Ex-ante and ex-post impact assessments require baselines and counterfactuals to establish causality and attribution; establishing baseline conditions allows comparisons across sectors, land uses (e.g., Baral *et al.*, 2013) and management strategies aiding biodiversity-related decision-making. This enables business to better assess and manage risks by showing sensitivity of dependencies to shocks, trends and policy pathways (Cheung *et al.*, 2019; IPBES, 2023). For instance, Cheung *et al.* (2019) used participatory approaches to model wild fish provisioning, showing that high-seas fishing is unprofitable without further measures in fisheries and conservation. However, the use of scenario analysis and long-term outlooks is rare and mostly limited to short-term shock assessments rather than longer-term dynamics (see **Section 2.5.5**).

2.4.3 Metrics and indicators

Assessing dependencies requires multiple indicators and metrics for monitoring, evaluation and reporting. Under the Convention on Biological Diversity, a state-pressure-response-benefit framework was used to guide indicator development for biodiversity (Burgess *et al.*, 2024). While biodiversity impact indicators and metrics exist, a framework for monitoring and reporting on business dependencies on biodiversity and nature's contributions to people is largely absent. The Convention on Biological Diversity framework categorizes all business dependencies under the benefit category "ecosystem services". However, indicators such as business risk and response indicators, such as business action, should be considered (Addison *et al.*, 2020).

As shown in **Section 2.2.4**, assessing dependencies requires metrics for both environmental and organizational contexts – how much biodiversity is available for sustainable use and how much is used in production (Smith *et al.*, 2024). Methods described in **Section 2.3.1** generate various metrics covering these aspects. However, the few existing dependency indicators focus on benefits such as productivity, or risk related to magnitude of dependency.

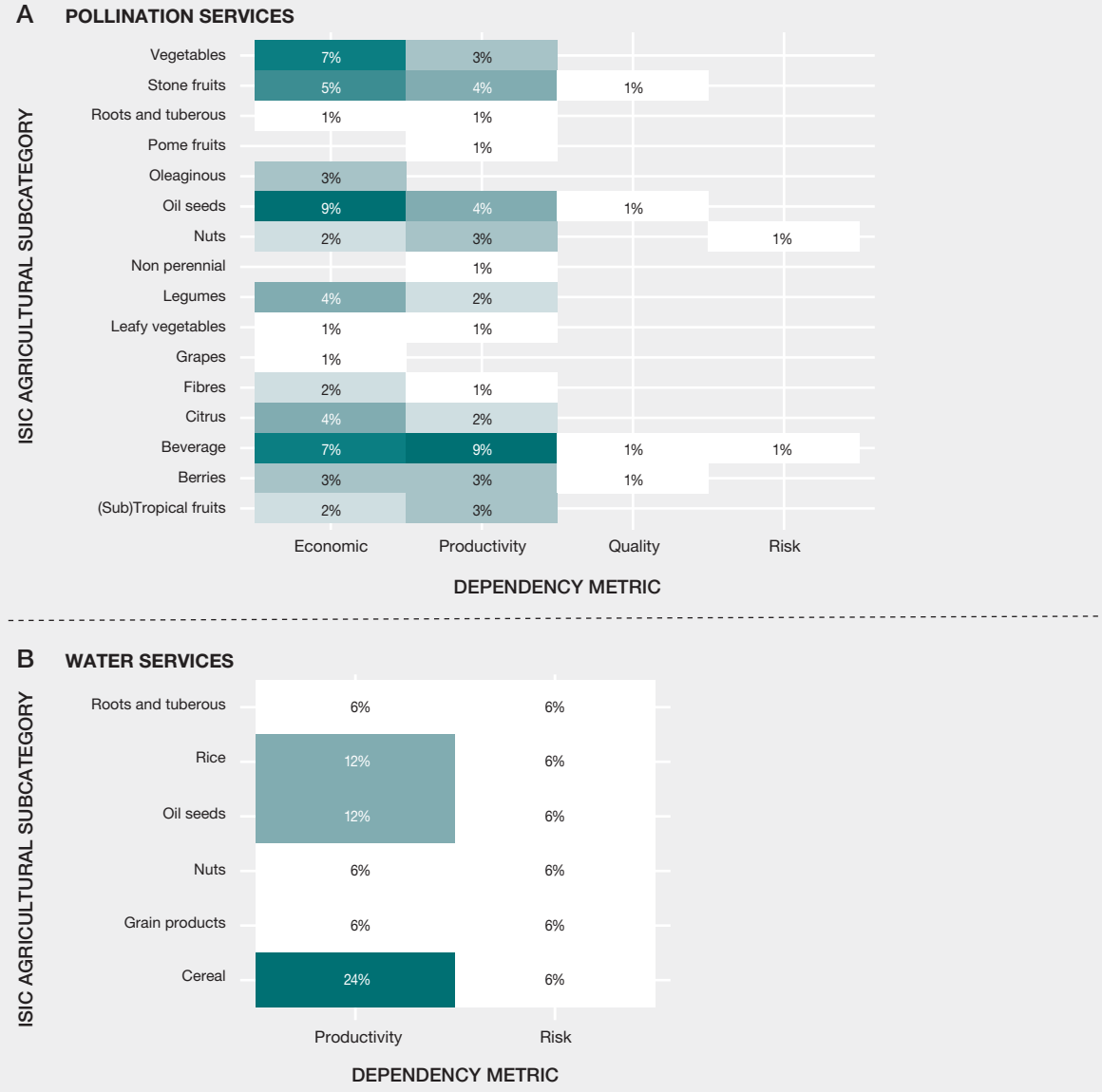


Figure 2 5 **The frequency of International Standard Industrial Classification subcategories studied for each metric used to measure the dependency.**

(A) pollination services and **(B)** water services.

Studies on dependencies and risks use various metrics and units, depending on methods and focus areas, such as natural capital stocks or flows of nature's contributions to people (demand/supply). Biophysical and ecological approaches are used most often and use quantitative productivity metrics such as fruit/crop yield or cattle yield in kilograms per hectare, volumes of water, or biodiversity metrics such as species richness/abundance, while qualitative metrics include product quality (e.g., of meat or fruit). Monetary valuation studies, second most used, report outcomes in local currency or international dollars, relating company output to biodiversity input. Integrated methods use both quantitative and qualitative units. Socio-cultural valuation methods also use both, from productivity increases to monetary values of increasing farm biodiversity to qualitative ratings of consumer preferences.

Indicators and metrics to monitor and report on dependencies remain unstandardized, but emerging regulatory pressure such as the European Union's Corporate Sustainability Reporting Directive is pushing towards more standardization in metrics and reporting standards (Giner & Luque-Vílchez, 2022). A review (Smith *et al.*, 2024) of 349 assessed indicators found only 54 (15 per cent) directly measure dependencies, 33 (9 per cent) are proxy measures, and only 8 indicators (2 per cent) capture financial consequences of lost ecosystem services. Knowledge gaps persist in metrics linking financial impacts to nature risks, and in indicators enabling comparisons across geographies and industries (Smith *et al.*, 2024). While biophysical indicators are common, socio-economic effects are less studied. This chapter's literature review highlights this issue, with no crosscutting indicators and metrics that integrate business and biodiversity for monitoring purposes.

Figure 2.5 is based on the summary of selected studies from the snowball search[6] exercise on water (A) and pollination (B). The snowball search exercise not only found that pollination dependencies were studied more often, but also that the pollination studies assessed a wider array of metrics, related to economic dependencies, production changes, quality changes and risk, compared to water-related dependencies which were expressed only in terms of productivity changes or risk.

6. A detailed explanation and comprehensive review of the process carried out for selecting the literature for this chapter can be found in the data management report http://doi.org/10.5281/zenodo.12790967

2.5 MAGNITUDES OF DEPENDENCIES AND ASSOCIATED RISKS

This section summarizes the academic evidence of the quantification of dependencies using a sub-sample of 151 articles selected from the snowball search,[6] and demonstrates that dependencies are high and widespread across global ecosystems.

2.5.1 Magnitudes of dependencies at the global and regional level

Businesses depend on biodiversity, including genetic diversity, species, ecological functions and services. It has been estimated that $44 to 58 trillion, or 50 to 55 per cent of global GDP, moderately or highly depend on ecosystem services (WEF & PWC, 2020, Retsa et al, 2020, PwC, 2023). For example, the agricultural sector heavily depends on pollination services, which contribute to about 30 per cent of global food production (Khalifa *et al.*, 2021). Biotic pollination improves fruit and seed quality or quantity of 87 global crops (Khalifa *et al.*, 2021), 70 per cent of 1330 tropical crops (Roubik & Food and Agriculture Organization of the United Nations, 1995) and 85 per cent of 264 European crops (Williams, 1994). Globally, pollinator-dependent crop areas grew 137 per cent from 1961 to 2016 (Aizen *et al.*, 2019). The annual market value of the 5-8 per cent of production that is directly linked with pollination services is estimated at $235 billion-$577 billion (in 2015 $) worldwide (IPBES *et al.*, 2016). Forests are another important source of inputs to production for timber, pharmaceutical and cosmetic industries. Over 80 per cent of registered medicines originate from plants or have been inspired by natural products (Bernardini *et al.*, 2018). Water is another critical input to business. Approximately 42 per cent of the global workforce operates in water-dependent sectors (Sjöstrand *et al.*, 2021; Unesco, 2016), such as construction, forestry, fisheries and manufacturing. These inputs are often assessed using water footprinting methods. These methods assess the virtual trade in water, for instance highlighting that the 54 African countries, grouped into five main regions, are net importers of 40,000 Bm^3 of virtual water from grain products from 2000 to 2020, mostly green water (79 per cent), especially in North Africa (Hirwa *et al.*, 2022).

The European Union's ecosystem service accounts include multiple ecosystem services, including water purification and recreation and value these at EUR 228 billion **(Figure 2.6)**, though these accounts cover only terrestrial ecosystems. Coastal and marine ecosystems provide essential services for businesses, including food, raw materials, water purification, carbon sequestration and recreation.

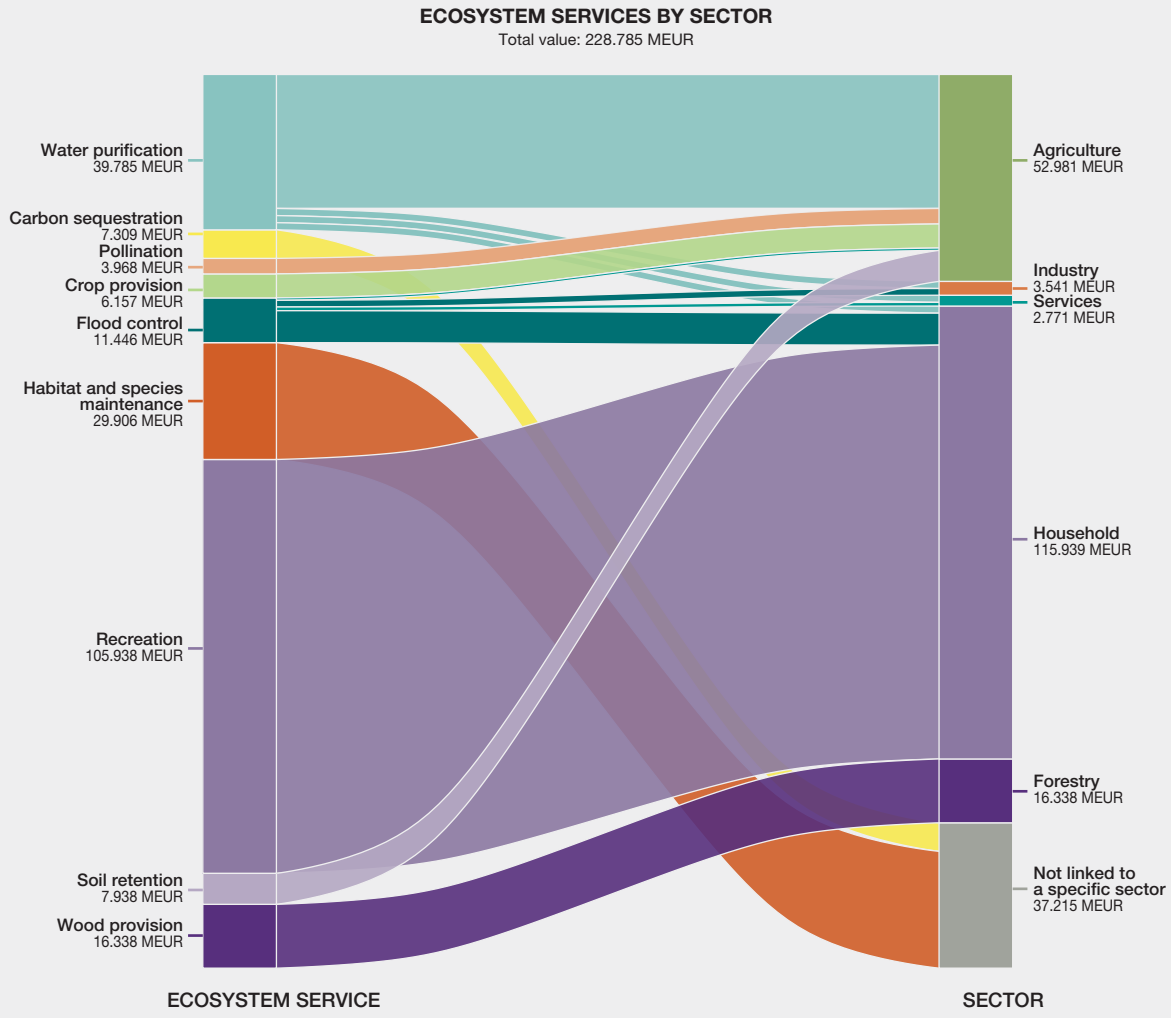


Figure 2 6 **Flows between ecosystem services and economic sectors in the European Union.**

Data for 2018, sourced from Joint Research Centre of the European Commission (n.d.), accessed in February of 2024.[7]

Direct ocean outputs, such as marine fisheries, mangroves, coral reefs and sea grass, were valued at $6.9 trillion in total gross value (Hoegh-Guldberg *et al.*, 2015). Aquaculture is crucial to global food systems, with fish supplying 17 per cent of animal-based protein and 6.5 per cent of total protein consumed worldwide (Troell *et al.*, 2014). Small-scale fishers contribute 40 per cent of global catches, supporting one in every 12 people's livelihoods (Basurto *et al.*, 2025) and contributing approximately $77.2 billion to the total economic value of global fisheries (Basurto *et al.*, 2025). Coral reefs provide $172 billion in value (OECD, 2022). Climate-related coral loss could cost tourism up to $2.89 billion by 2050 under different climate change scenarios (P.-Y. Chen *et al.*, 2015).

2.5.2 Magnitudes of sectoral dependencies at the level of States

Several studies highlight the varying dependence of economic sectors on biodiversity and nature's contributions to people, including clean water, pest control, pollination and food and feed supply. These are essential for industries such as agriculture, fisheries, pharmaceuticals and tourism **(Table 2.4)**. Dependencies

7. Details of the analysis are provided in the accompanying data management report: https://doi.org/10.5281/zenodo.17239488

vary significantly by region, sector and nature's contributions to people. The contribution of individual nature's contributions to people can make up from 2 to 8 per cent of a country's GDP, such as with fisheries in Senegal (see **Figure 2.7**) or shark-based tourism in Palau. Individual nature's contributions to people contribute billions to national economies, such as pest control services at $70 million, pollination services for agriculture at $12-34 billion and habitat provision supporting tourism at $22-39 billion.

Box 2 2 Microbes' contribution to businesses.

Microbial communities, or microbiomes, exist in every habitat on Earth and host tremendous genetic and metabolic diversity for industrial applications, especially in agriculture and energy. Digital sequence information (DSI) is extensively used in these sectors. Fungi and bacteria are essential in producing beer, wine, cheese, bread and other fermented foods mostly using DSI. Industries increasingly harness microbes in agricultural and industrial processes from fields to factories, with businesses developing products that embody natural microbial benefits to assist plants in acquiring nutrients or avoiding pathogens, thereby reducing the need for pesticides and fertilizers. The global microbial bioinoculant market exceeded $2.25 billion in 2023 (Fortune Business Insights, 2024).

Biofuel energy industries also rely on microbiomes. Ethanol production from corn or sugarcane, valued at $90 billion per year globally, relies on bacterial fermentation in bioreactors (Skyquest, 2024). Emerging biofuel and bioproduct strategies focus on a broader range of plant feedstocks (Himmel *et al.*, 2007), like switchgrass, miscanthus, or other grasses, which are less vulnerable to pests and climate extremes and can be grown on marginal lands, making them preferred over fertilizers and pesticides. Making use of the capacity to degrade organic matter, the biofuel industry is screening environmental microbes for genes and metabolic pathways (using DSI) that can convert resistant plant chemicals into fermentable sugars. Risks associated with introducing microbes into new ecosystems should be considered when evaluating opportunities.

Table 2 4 Examples of magnitudes from studies providing evidence at a national level.

Country and source	Sector	NCP	Magnitude	Unit
Italy (Guidetti *et al.*, 2014)	Fisheries	Biomass provisioning	Fisherfolks obtain an 18 times higher catch in MPAs vs. outside MPAs.	Ratio
Senegal (De Graaf & Garibaldi, 2014, see Figure 2.7)	Fisheries	Biomass provisioning	The total contribution of fisheries to the country's GDP is 1.7 per cent, while the post-harvest sector of fisheries, including processing and marketing (value chain), contributes 2.4 per cent.	Contribution to nations' GDP in percentage
United States of America (Losey & Vaughan, 2006)	Agriculture	Regulation of organisms detrimental to humans	Dung beetles reduce the habitat for cattle parasites by 19 per cent in the USA. Without these beetles, annual losses due to parasite infections are estimated at $70 million.	$
Brazil (Giannini *et al.*, 2015)	Agriculture	Pollination services	The total contribution of pollination services to the national agricultural product accounts for ~30 per cent (~ $12 billion).	$
United States of America (Jordan *et al.*, 2021)	Agriculture	Pollination services	$34 billion in 2012; 20 per cent of counties produce 80 per cent of total economic value attributable to insect pollinators.	$
Australia (Cook *et al.*, 2007)	Agriculture	Pollination services	Maintaining a honeybee population free of parasitic infestations (i.e., Varroa mite) represents a benefit of $.4–38.8 million per year for a total of 25 crops.	$/year
Palau (Vianna *et al.*, 2012)	Arts, entertainment and recreation	Physical and psychological experiences	The shark diving industry generates $18 million annually, accounting for 8 per cent of the country's GDP.	$

Table 2 4

Country and source	Sector	NCP	Magnitude	Unit
United States of America (Erin Carver, 2019)	Recreation and tourism	Physical and psychological experiences	Birders in an established birding economy like the USA are estimated to spend ~ $39 billion annually on birding related expenses, generating ~ $16 billion in tax revenue and ~ $96 billion in total industry output.	$
United States of America (Losey & Vaughan, 2006)	Recreation and tourism	Physical and psychological experiences	Insects are crucial for the diets of small game and birds (important for hunting and birdwatching), with their total value estimated at around $21.8 billion.	$
Costa Rica (Barbier & Aylward, 1996)	Manufacturing (pharmaceutical and biotechnology industry)	Medicinal, biochemical and genetic resources	Net private returns of pharmaceutical prospecting in Costa Rica are estimated at $4.8 million.	$(1990)
Australia (Australian Bureau of Statistics, 2022)	Electricity, gas steam and air conditioning supply	Water quantity and flow regulation	Electricity and gas supply in Australia in the years 2021-22 used approximately 49,802 gigalitres (GL) of self-extracted surface water, 50 GL of self-extracted groundwater and 151 GL of distributed water. Total water use, the sum of self-extracted water use, distributed water use, reuse water use and wastewater collected, was approximately 50,009 GL.	Gigalitres

The contribution of fisheries to African countries' GDP is estimated at $24 billion, equivalent to 1.26 per cent of GDP (De Graaf & Garibaldi, 2014) **(Figure 2.7)**.

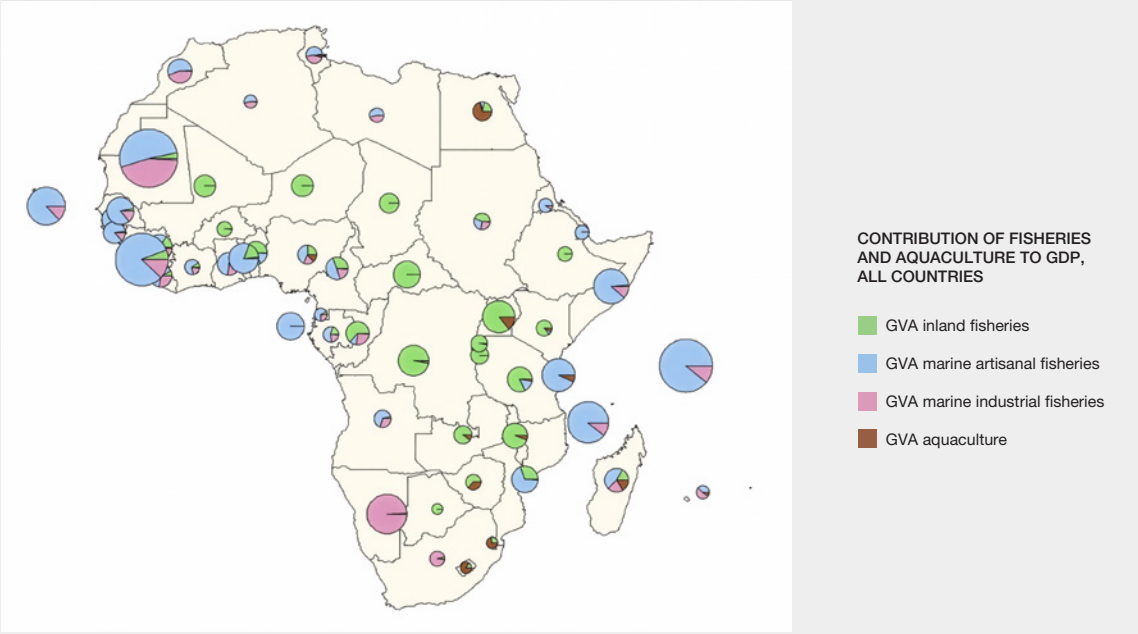


Figure 2 7 **Contribution to GDP by fishing sub-sector by gross value added (GVA).**

The size of the pie signifies the overall contribution of the fisheries sector to GDP. The highest contribution is from marine artisanal fishing contributing 1.82 percent of total GDP. Aquaculture contributes the least. Figure borrowed from De Graaf & Garibaldi (2014).

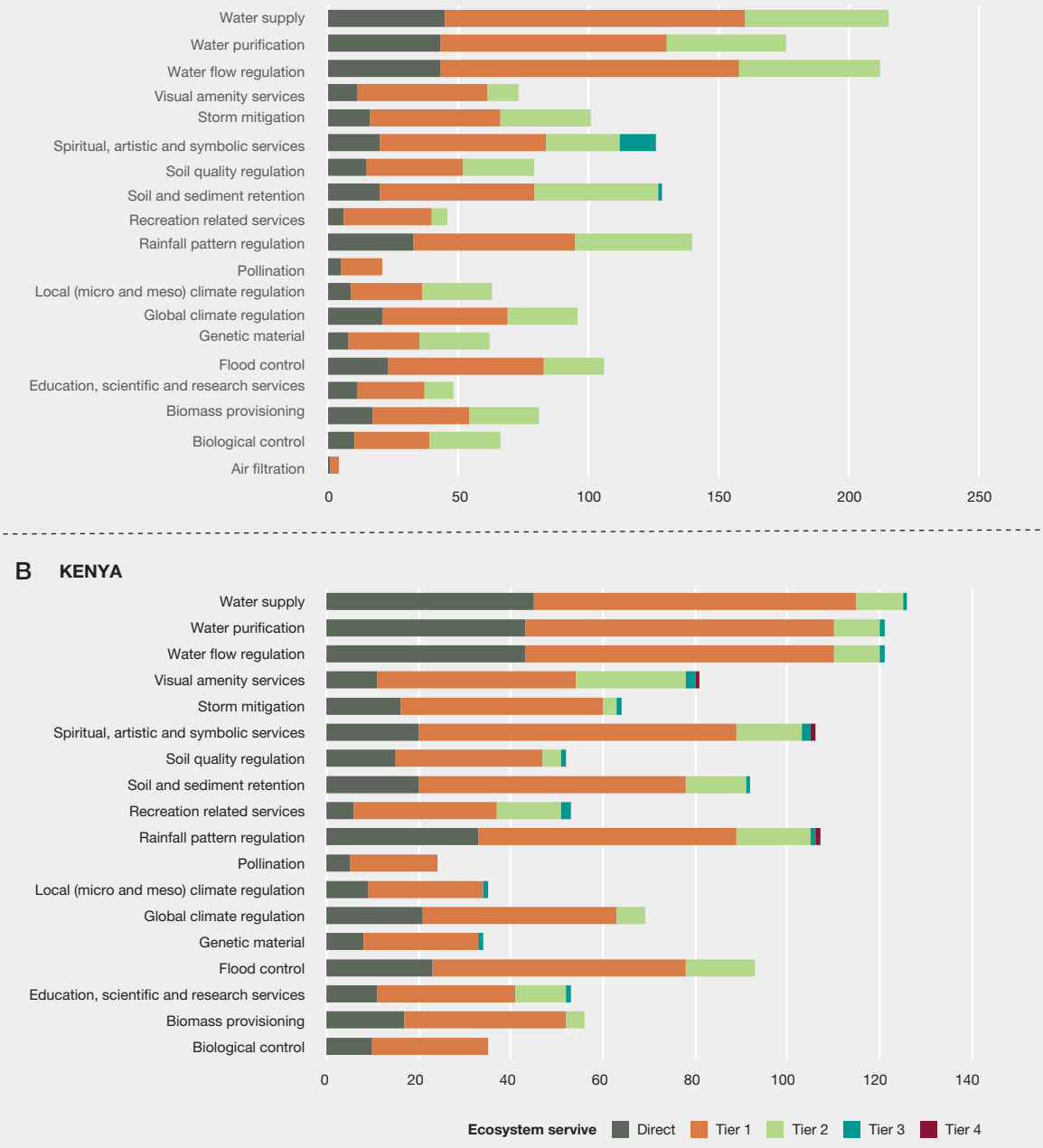


Figure 2 8 **Comparison of ecosystem service dependencies of the national economies of Brazil and Kenya.**

The comparison uses the REX 3 multi-regional input-output database combined with the ENCORE database (ENCORE, n.d.). The bars reflect the number of times that an ecosystem service is listed as a "High" or "Very High" dependency of an economic activity. Note the different scales on the axis for Brazil and Kenya. Details of the analysis are provided in the accompanying data management report (https://doi.org/10.5281/zenodo.17239489).

National economies differ in their dependence on biodiversity, with non-material benefits being more important for some economies than regulating and material benefits. Using a multi-regional input-output (MRIO) tier (i.e., value chain) analysis with Resolved EXIOBASE version 3 (REX3) and ENCORE databases (ENCORE, n.d.), we traced operational and value chain dependencies on nature for Kenya and Brazil. This shows not only which ecosystem services are essential to the economy, but also how those dependencies are embedded in complex, multi-tiered

supply chains **(Figure 2.8)**. Both economies rely directly on ecosystem services, but Brazil's industries and export-driven sectors depend more on higher-tier links, making it vulnerable to international shocks. Kenya's resource-based economy is highly exposed to natural capital disruptions (in land and water), aggravated by the limited economic diversification. The analysis also highlights tourism's importance in Kenya, where spiritual, artistic and symbolic services and visual amenity services play a key role.

While ENCORE (ENCORE, n.d.) is widely used in dependency assessments for its strengths, any results should be evaluated with its limitations in mind. ENCORE provides the currently most comprehensive dataset on potential dependencies for all economic sectors. It is widely adopted in business practices and recommended by multiple corporate reporting initiatives. It uses qualitative, expert-based scoring for assessing potential dependencies per ISIC sector. However, as is common for business-focused tools, the scores are difficult to verify. The scores do not provide insight in the quantitative magnitude of dependencies on biodiversity and should be compared to the actual availability of resources and context-specific state of biodiversity if the aim is to assess risks. The scores do not consider differences in dependencies on biodiversity between different countries or locations. Overall, the database has not been academically peer-reviewed; 45 per cent of references are scientific literature, 28 per cent are grey literature, 6 per cent are corporate reports, and 21 per cent are websites, some of which are generic public sources or commercial pages; and relies considerably on a small number of sources: 20 sources account for 50 per cent of ecosystem service – ISIC sector combinations.

2.5.3 Dependencies in national financial systems

Several central banks have assessed the economic value underpinned by nature's contributions to people in their respective national financial systems. Overall, between 36 per cent and 98 per cent of portfolios of the central banks with existing assessments are highly or very highly dependent on ecosystem services, depending on the sectoral composition of portfolios and the weight of individual sectors in each portfolio. The top dependencies are for Lithuania (98 per cent), European Union (75 per cent) and Mexico (61 per cent). These studies all rely on the ENCORE database, and some studies also link with the EXIOBASE (an environmentally extended multi-regional input-output database) to assess dependencies embedded in trade **(Table 2.5)**.[8] The largest dependencies are recorded for water-related services (surface water, groundwater, water flow maintenance), climate regulation, flood and storm protection, mass stabilization and erosion control. These dependencies can translate into both physical risks and transition risks (van Toor *et al.*, 2020).

8. Details of the analysis are provided in the accompanying data management report: https://doi.org/10.5281/zenodo.17239488

Table 2 5 **Summary of central bank studies on business dependencies on nature's contributions to people.**

Numbers represent available rankings, from 1 (highest, darker) to 5 (lowest, lighter). Note: ENCORE ranks ecosystem services dependencies on a 5-point scale of very-low/low/medium/high/very-high (ENCORE, n.d.); the table includes (very) high dependencies.

	Surface water	Climate regulation	Groundwater	Flood and storm protection	Mass stabilization and erosion control	Water flow maintenance	Share highly dependent on ≥1 ecosystem service	Portfolio	ISIC sectors (top dependencies, from highest to lowest)
Kingdom of the Netherlands (van Toor *et al.*, 2020)	1	2	3	4	5		36 per cent	Loans, securities	L H C10, C11 F B
France (Hadji-Lazaro *et al.*, 2024; Svartzman *et al.*, 2021)	1	5	2	4	3		42 per cent	Securities	A01 C10 F36 F37

Table 2 5

	Surface water	Climate regulation	Groundwater	Flood and storm protection	Mass stabilization and erosion control	Water flow maintenance	Share highly dependent on ≥1 ecosystem service	Portfolio	ISIC sectors (top dependencies, from highest to lowest)
Brazil (Calice *et al.*, 2021)	1	3	2	4	5		46 per cent	NFC loans	D C10 F G A01
Malaysia (World Bank & Bank Negara Malaysia (BNM), 2022a)	1	2	3	4	5		54 per cent	Commercial loans	L F G A01 C10
United Kingdom	1	4		2	3	5	52 per cent	Loans, securities	D A01 Q C20 A02
Georgia (Nikuradze & Tvalodze, 2023; UNEP-WCMC, 2024)	1	4	2	3	5		46 per cent	Commercial loans	F G L I A01
Mexico (Martinez-Jaramillo *et al.*, 2023)	1	3	2	4		5	61 per cent	NFC loans	A F L G C
European Union (Boldrini *et al.*, 2023)	Not stated						75 per cent	NFC loans	Not stated
Lithuania (Borges & Laurinaitytė, 2023)	1	5	2	3	4		98 per cent	Commercial loans	Not stated

Top sectors in terms of dependencies across studies (ISIC section [ISIC Divisions, if noted]):

A. Agriculture, forestry and fishing
B. Mining and quarrying
C. Manufacturing [of food products; of beverages; of chemicals and chemical products]
D. Electricity, gas, steam and air conditioning supply
E. Water supply; sewerage, waste management and remediation activities
F. Construction
G. Wholesale and retail trade; repair of motor vehicles and motorcycles
H. Transportation and storage
I. Accommodation and food service activities [Accommodation]
L. Real estate activities
Q. Public administration and defence; compulsory social security

2.5.4 Magnitude of dependencies at the subnational level

Most subnational assessments of sector dependencies provide key insights for business operations. **Table 2.6** summarizes selected studies from the literature, covering multiple countries and nature's contributions to people. These studies mainly focus on the agricultural sector, followed by arts, entertainment and recreation. Dependencies are measured through various metrics including economic value, productivity (volume and employment), quality and risk. Some studies integrate multiple methods to measure nature's contributions to people. For example, Tremlett *et al.* (2021) combine field experiments, stakeholder surveys and economic valuation to quantify pollination dependence. Only few studies incorporate uncertainty analysis, which is crucial for understanding long-term management effects, for instance by providing confidence intervals, using sensitivity analysis, or comparing results across different input data sources (e.g., López-Cubillos *et al.*, 2021).

Table 2 6 **Overview of studies at subnational level of the dependencies of economic activities on nature's contributions to people.**

Together with the metrics and a summary of the study results and methods used.

Nature's contributions to people		Metric & frequency	Examples
A01-03: Agricultural sector			
Material	**Pollination (N = 38)**	Economic value N = 25	Summary: Pollination services by bats were estimated at $2,500/ha in pitaya crops by boosting both fruit yield and size, accounting for approximately 40 per cent of the total income for producers in a region of Mexico (Tremlett *et al.*, 2021). Methods: Location-based observations of pollinator exclusion experiments, market pricing and value chain analysis.
		Productivity N = 22	Summary: Wild bee pollination positively impacted the quality and quantity of blueberry production, through an increase in seed set, fruit mass and fruit set. Not controlling for baseline yields, pollen limitation reduced yields (kg/ha) and associated revenue ($/ha) by between 1 and 36 per cent per farm in the USA (Nicholson & Ricketts, 2019). Methods: Location-based observations. Pollination supplementation experiments, pollinator observations and yield estimates.
		Quality N = 9	Summary: In Israel, the addition of bumblebees in Gala-cultivar apple orchards increased the mean number of seeds per fruit by 80 per cent, which also generally reflected a greater fruit size (Sapir *et al.*, 2017). Methods: Location-based observations. Bee colony treatments, pollinator activity observations and seed and fruit size measurements.
		Risk N = 9	Summary: In Costa Rica, with a complete clearance of habitat important for pollinators, coffee yield could suffer a 23 per cent drop, while preserving forests for pollinators could boost average yield by 6 per cent compared to the baseline scenario (López-Cubillos *et al.*, 2021). Methods: Ecological modelling & geospatial mapping. Spatial explicit optimization model using geospatial mapping of forest area important for pollinators combined with coffee land suitability.
	Water quantity (N = 16)	Productivity N = 13	Summary: The highest blue and green water requirements of three main grain crops (rice, wheat and corn) in eight regions of China (PRC) for rice, wheat and corn, were found in South-central China (2.45 m^3/kg), South-Central China (2.16 m^3/kg) and Northwest China (1.22 m^3/kg), respectively (Y. B. Wang *et al.*, 2014). Methods: Biophysical approaches. water foot printing, effective precipitation and the actual water use method (volume by field water consumption and irrigated water loss).
		Risk N = 8	Summary: Six different cropping patterns and water supply scenarios are generated to predict the effects of cropping adjustments on groundwater sustainability of the North China Plain. Irrigation requirements need to be limited to 187 mm/a to sustain current groundwater levels; 34 per cent of the land should be left fallow every year or all cropland should be left fallow every 3 years to sustain current agricultural practices, groundwater sustainability, food supply, water use efficiency and soil fertility recovery (Ren *et al.*, 2021). Methods: Ecological Modelling & Geospatial Mapping. Decision Support for Agro-technology Transfer (DSSAT) crop- and regression model; it simulates crop growth and agricultural water use, using weather, soil, crop cultivar and management practises as inputs.

Table 2 6

Nature's contributions to people		Metric & frequency	Examples
A01-03: Agricultural sector			
Material	**Food and feed (N = 1)**	Productivity N = 1	Summary: Lamb and wool production in Argentina appropriate 11 per cent of total net primary productivity (NPP), highlighting its dependence on ecosystem productivity. Human appropriation of net primary productivity (HANPP) is lower in ecotones and wetlands but higher in intensively managed northwest and central regions. Its negative correlation with plant biodiversity and carbon balance suggests a trade-off between provisioning services and ecosystem health (Peri *et al.*, 2022). Methods: Ecological modelling & geospatial mapping. HANPP; simple linear regression.
	Regulation of organisms detrimental to humans (N=2)	Productivity N = 2	Summary: Over multiple spatial scales, landscape-level crop diversification increased biological control of aphids in winter wheat fields in Germany. In fields with high landscape-level crop diversity, biological control was 8 to 33 per cent higher than in fields with low landscape-level crop diversity, with main effects observed on scales less than 500 metres (Redlich *et al.*, 2018). Methods: natural enemy exclusion experiment.
	Medicinal, biochemical and genetic resources (N=1)	Economic value N = 1	Summary: Basmati rice landraces outperformed modern varieties like Sabitri and China-4 in gross and net margins, with a 17 per cent net marketing margin compared to Sabitri's 10 per cent in Nepal. While coarse-grained landraces like Mutmur thrive in marginal conditions, they fetch lower prices, but households growing both types had 3.3 extra months of rice self-sufficiency (Gauchan *et al.*, 2005). Methods: Participatory market systems analysis and baseline survey of farm and household characteristics, perceptions of traits and access to resources (primarily qualitative).
	Material and assistance (N=1)	Productivity N = 1	Summary: Landscape composition (land cover in 20km radius around main cities of municipalities) accounted for 25, 77 and 64 per cent of the total employment in the agriculture subsector and 33, 67 and 23 per cent of employment in the animal production and forestry subsector for Coastal Patagonia, the main irrigated valley (Valley of Rio Negro) and Andean Patagonia, respectively, in Argentina (Laterra *et al.*, 2021). Methods: Generalised additive models and multiple regression analysis.
R90-93: Arts, entertainment and recreation			
Non-Material	**Physical and psychological experiences (N=1)**	Quality N = 1	Summary: In the Libo Carst in South China, 26 landscapes were identified as aesthetic value carriers and ranked by experts based on aesthetic value scores, complemented with existence values (e.g., intrinsic value of its characteristics such as geological unique features) and potential value (e.g., the cultural aspects of a site) (Xiong *et al.*, 2023). Methods: evaluation scores built from a combination of online text big data analysis, expert landscape beauty evaluation and ArcGIS spatial analysis.
	Habitat creation and maintenance (N=2)	Productivity N = 1	Summary: Landscape composition (land cover in 20km radius around main cities of municipalities) explained 34, 50 and 78 per cent of variation in employment in tourism across Coastal Patagonia, irrigated valley (Valley of Rio Negro), and Andean Patagonia respectively. The number of employments explained by landscape composition per each employment in the tourism subsector was 1.29, 1.9 and 2.96 for Coastal Patagonia, the main irrigated valley (Valley of Rio Negro), and Andean Patagonia respectively (Laterra *et al.*, 2021). Methods: Generalised additive models and multiple regression analysis.
		Quality and economic value N = 1	Summary: Tourists varied in their cognition of four rare species (Giant Panda, Golden Monkey, Crested Ibis and Takin) in protected areas of the Qinling region in China. Tourists are willing to pay 26 per cent more on an annual basis above the entrance ticket for the Giant Panda and Golden Monkey (36 RMB), and less for the Crested Ibis and Takin (26 RMB) (Yang *et al.*, 2022). Methods: Contingent valuation method; perception survey.

2.5.5 Magnitude of business risks from dependencies

Multiple studies assess macro-level risks from biodiversity loss, showing variation across sectors and countries under different scenarios. These what-if scenarios vary in scope, with more recent studies adding new components and moving from physical risks to more systemic risks (e.g., Johnson *et al.*, 2021), however, none of the studies fully quantifies the systemic risks of biodiversity loss.

Table 2.7 summarizes findings linking biodiversity loss to economic value declines using scenario-based models. Recent studies include all ecosystem services in ENCORE (Ranger *et al.*, 2023, 2024), while earlier research focuses on select nature's contributions to people or undifferentiating impacts. Loss of biodiversity poses risks to businesses across all scales with some countries having better adaptation capabilities than others. For example, pollination loss could reduce global GDP by 1 to 3 per cent, depending on the model. Some States, like the Kingdom of the Netherlands, may increase agricultural output substituting production with higher reliance on pollination (Prodani *et al.*, 2023), but lower-income countries would struggle to reduce poverty when pollination, timber and fishery services are lost (Johnson *et al.*, 2021).

Deterioration of other biodiversity also poses risks. Losing disease control services due to antimicrobial resistance could reduce GDP of the United Kingdom by 12 per cent, surpassing COVID-19 losses (Ranger *et al.*, 2024). Loss of nature's contributions to people could destabilize finances by increasing non-performing loans (up to 2.75x increase in financial losses in the European Union, 4x in some countries and by 9 percentage points in Brazil) (Calice *et al.*, 2021).

Table 27 **Summary of results from studies on risks to the economy from loss of nature's contributions to people.**

Nature's contributions to people	Core finding
Fisheries	High seas (areas beyond national jurisdiction) fisheries will not be economically viable under future climate change without measures to enhance the sustainability of fisheries, such as marine protected areas (Cheung *et al.*, 2019)[10]
	With sound management reforms, global fisheries can yield value of $53 billion annually (Cheung *et al.*, 2019)
Pollination	Decline: Global short-run losses: $127 – 152 billion (2004 price levels Bauer & Sue Wing, 2016)
	Decline: Global long-run losses: $574 – 1,318 billion (2017 price levels) (Lippert *et al.*, 2021)
	Decline: -1 per cent global GDP (Ranger *et al.*, 2023)
	Collapse: Kingdom of the Netherlands: +38 per cent agricultural prices, +23 per cent agricultural output, limited effect on GDP (Prodani *et al.*, 2023)
Timber + Fisheries + Pollination	Partial collapse: -2.3 per cent GDP, -10 per cent for poorest countries (Johnson *et al.*, 2021)
	Brazil: +9 per cent points rise in non-performing loans (Calice *et al.*, 2021), based on Johnson *et al.* (2021)
Water quantity and quality	Global: -7-9 per cent GDP (Ranger *et al.*, 2023)
Pest and disease control	United Kingdom: -12 per cent GDP (antimicrobial resistance scenario) (Ranger *et al.*, 2024)
All ecosystem services in scope	European Union: +2.5 to 2.75 times financial losses. Up to 4 times losses for Germany, Lithuania (Boldrini *et al.*, 2023)
	Malaysia: 16-44 per cent of financial portfolio affected under most significant ecosystem services reduction scenarios (World Bank & Bank Negara Malaysia (BNM), 2022b)
	United Kingdom: -6 per cent GDP (Ranger *et al.*, 2024)
	Global: Effects of decline in all ENCORE ecosystem services has been assessed in Ranger *et al.* (2024) and (2023)

9. Note that while this study focuses on marine protected areas in particular, it does not explore the full range of potential policy options and does not aim to prescribe specific policies for fisheries management.

Despite widespread statements about biodiversity dependencies underpinning GDP, firm-level scientific evidence linking biodiversity and company performance is scarce (Karolyi & Tobin-de la Puente, 2023). Few academic studies examine nature-related dependencies in company performance, while most focus on impacts (Akey & Appel, 2021; Flammer *et al.*, 2023; Garel *et al.*, 2023; Hsu *et al.*, 2023; Xin *et al.*, 2023).

Businesses anticipate biodiversity risks using qualitative survey data (Giglio *et al.*, 2023, Wagner, 2023) and quantitative financial market data (Hoepner *et al.*, 2023; Giglio *et al.*, 2024; Coqueret & Giroux, 2023), but are unprepared to manage them. A global survey of 48 financial businesses managing $33 trillion in assets found only 25 per cent identified nature-related risks, with 68 per cent still assessing them. Additionally, 36 per cent introduced nature-related risk management only in the last 2 years. Key barriers include availability of data, reliable models and scenarios (Paisley & Nelson, 2024).

Self-reported business data confirms this gap. The 2024 World Benchmaking Alliance Nature Benchmark reviewed 816 businesses across 21 sectors, finding just 6 businesses in the sample (0.7 per cent of total) assessed dependencies. A review of Fortune 500 disclosures of 100 businesses found similar results (Trim & Jones, 2025). In 2018, an estimated 1,759 listed businesses with biodiversity policies (29 per cent of the top 85 per cent listed businesses by value) represented $51.1 trillion in total enterprise value (Carvalho *et al.*, 2023a). Water-risk disclosure is more established: of 2,934 businesses disclosing to CDP Water in 2021 (a quarter of global market cap), 41 per cent reported water stress/scarcity risks, 27 per cent flood regulation, 17 per cent water flow maintenance, 8 per cent water quality and 7 per cent disaster risk reduction (CDP, 2021).

2.6 IMPLICATIONS FOR SOCIETY

This section outlines the relevance of the academic methods from **Sections 2.3** and **2.4** in guiding societal actors toward sustainable business-biodiversity interactions. While sustainable action also requires stakeholder engagement, collaborative frameworks (L. H. Huang *et al.*, 2024), and analyses of roles and relationships of governments, businesses, consumers and civil society (Carvalho *et al.*, 2023b; Reale *et al.*, 2019), this section focuses on the use dependency assessment methods.

2.6.1 Implications for governments and policymakers

Integrating biodiversity into economic reporting enables policymakers to guide corporate activities towards sustainability (Booth *et al.*, 2024), develop evidence-based and targeted regulations, design economic incentives, and enhance corporate transparency and accountability (Ingram *et al.*, 2024; Mohr & Thissen, 2022). National natural capital accounting frameworks, combining biophysical and monetary valuation methods, help quantify business dependencies on natural resources (Grunewald *et al.*, 2024). While over 90 States have piloted natural capital accounting initiatives, and specifically the System of Environmental-Economic Accounting Ecosystem Accounting – Ecosystem Accounting (SEEA-EA) framework (United Nations Statistics Division, 2023), most remain in early stages.

Global environmental-economic models inform national strategies for global commitments under the Convention on Biological Diversity (including mainstreaming of biodiversity in economic sectors) and the Paris Agreement, identifying areas where ecosystem restoration can mitigate risks. More detailed valuation methods and behavioural experiments help identify distributive impacts and design public policy instruments that incentivize sustainable behaviour by businesses or households. Integrated methods can help develop economic strategies that consider the plural values in society. To ensure business accountability, biophysical methods like remote sensing or field-based measurements are crucial for monitoring natural capital stocks and flows, while corporate document analysis aids transparency but is insufficient for evaluating compliance. Biophysical models are also used to identify changes in critically endangered species and habitats, motivating further public investment into conservation and restoration (Retsa *et al.*, 2020), seed banks, genetic information and so on.

2.6.2 Implications for businesses and financial institutions

Businesses can integrate biodiversity into their models and implement sustainable biodiversity strategies by assessing nature-related dependencies, impacts, and risks (Jones & Wynn, 2024). Effective evaluation requires combining ecological and financial datasets (Mohr & Thissen, 2022) to identify exposure, hazard, vulnerability, and opportunities to mitigate risks through reducing impacts or investing in restoration, collaborating with communities, or consumer engagement. However, current risk assessment methods have notable limitations and constraints (Smith *et al.*, 2024).

Financial institutions increasingly acknowledge nature-related risks and are implementing disclosures for risk management and regulatory compliance (Barning *et al.*,

2024). Biophysical methods help materiality screens of dependency risks based on operational, legal, financial and reputational criteria (Mohr & Thissen, 2022). While major sectors (agriculture, forestry, extractives, etc.) have adopted biophysical approaches (Addison & Bull, 2018; WEF, 2020b), they mostly assess impacts rather than dependencies. Businesses use the ENCORE database (see **Table 2.4**) for risk screening, though it lacks the capacity to quantify dependency risks. The Finance Sector Deforestation Action initiative, representing $8.9 trillion in assets, assessed deforestation risks, focusing on identifying high-risk regions, sectors and priority forest-risk commodities to understand their overall risk profile, including their physical risk, financial risk and transition risk. They set targets to eliminate deforestation risks from agricultural commodity investments and lending by 2025, with full phase-out by 2030 (Institutional Investors Group on Climate Change (IIGCC), 2024).

Corporate adoption of nature-related financial risk assessments (TNFD, 2023b) and natural capital assessments (Natural Capital Coalition, 2016; WEF, 2020b) is growing, with businesses using monetary valuation to quantify ecosystem value and anticipate liabilities tied to natural resource depletion. However, these applications have so far assessed impact values, as seen in the Kering (2018) Environmental Profit & Loss (EP&L) accounts. Some marketing reports use stated preference methods to evaluate demand for products with eco-labels or sustainable certifications, highlighting markets where sustainable levels of use (dependencies) can be profitable (Bar Am *et al.*, 2023; PricewaterhouseCoopers (PwC), 2024). Key knowledge gaps remain in how business and finance can apply non-market valuation to justify investment in natural capital and how to adapt their internal decision-making criteria (e.g., minimum return-on-investment, investment size, or payback period requirements). If conditions changed such that non-marketed values would be valued by the market, and paid for by consumers or otherwise, this could render sustainable practices (more) profitable.

Socio-cultural valuation is emerging as businesses seek support of communities for a licence to operate. Global frameworks, such as the Kunming-Montreal Global Biodiversity Framework, emphasize rights-based approaches (Convention on Biological Diversity (CBD), 2022). Industries such as mining, forestry and bioprospecting are beginning to integrate Indigenous and local knowledge into their corporate social responsibility and free, prior and informed consent compliance (Cariño & Colchester, 2010) (See **Section 2.7**).

Integrated approaches are increasingly recognized in corporate reporting (TNFD, 2023b). For example, Dow Chemical Company partnered with The Nature Conservancy to address future water risks in Texas, using natural capital valuation and multi-criteria analysis to identify cost-effective, nature-based solutions (Reddy *et al.*, 2015). Despite considerable technical, legal and political hurdles, the assessment demonstrated public benefits that opened opportunities for multi-stakeholder collaboration.

2.6.3 Implications for civil society organizations

Multiple methods support civil society and non-governmental organizations promote sustainable business practices. Conservation-oriented non-governmental organizations use biodiversity metrics to track changes in ecosystem health and identify areas at risk. Such assessments help recognize critical tipping points in ecosystems, guiding them in prioritizing conservation efforts (IPBES, 2019d; World Wide Fund for Nature (WWF), 2024).

Biodiversity assessments can highlight overlaps between critical ecosystems and development zones, providing civil society organizations with scientific evidence to advocate for nature-inclusive policies. For example, global scenario analyses show where conserving 30 per cent of the planet by 2030 could most benefit climate, jobs and health (McKinsey & Company, 2020). In China, ecological footprint studies reveal that footprints tripled from 1978 to 2013, while ecological carrying capacity grew only slightly, leading to greater ecological insecurity (Z. Wang *et al.*, 2018).

Participatory assessment strengthens evaluations by incorporating civil society organization and community input. Local community engagement in Colombia shaped strategies aligning cultural heritage with biodiversity goals (Echeverri *et al.*, 2025). In China's Yongding River Corridor, modelling and community surveys identified green infrastructure solutions (Wong *et al.*, 2018). In Portugal, stakeholder engagement was used to articulate diverse values and defined sustainable interventions for tourism and recreation dependent areas (Lopes & Videira, 2016).

By quantifying economic benefits of nature's contributions to people, civil society organizations can support payments for ecological services schemes, incentivizing biodiversity-friendly practices (Nelson *et al.*, 2009; Neugarten *et al.*, 2018). Stated preference studies show that tourists are willing to pay premiums for sustainably managed coral reef areas, creating business opportunities for conservation organizations in collaboration with tourism and recreation businesses.

2.6.4 Implications for consumers

Consumer representatives can use various methods to inform governments and businesses about consumer preferences for sustainable products and ethical strategies to influence consumer behaviour. Valuation methods assessing economic and socio-cultural values help raise awareness of the importance of biodiversity and origin of the products and drive behavioural change (BCG, 2021), strengthening consumer-nature connections. For example, stated preference methods gauge consumer willingness to pay for improved water service quality (Kim *et al.*, 2021), biodiversity conservation in tourism (Gross *et al.*, 2023; Surendran & Sekar, 2010; P.-W. Wang & Jia, 2012), forests' cultural ecosystem services (Acharya *et al.*, 2021; W.-J. Chen *et al.*, 2022) and sustainable supermarket products (Gatti *et al.*, 2022; Tokuoka *et al.*, 2024). These studies show how understanding biodiversity dependencies enables consumers to make greener choices and support eco-friendly businesses.

2.7 IMPLICATIONS OF BUSINESS DEPENDENCIES ON BIODIVERSITY FOR INDIGENOUS PEOPLES AND LOCAL COMMUNITIES

Business dependencies intersect with rights over lands, territories, waters and resources of IPLCs, as well as their Indigenous and local knowledge, which supports their cultural values, identity and livelihoods. This section explores the interrelationships between IPLCs and biodiversity, the role of Indigenous and local knowledge in how businesses assess their dependencies on biodiversity, and IPLCs' businesses.

2.7.1 Interrelationships between Indigenous Peoples and local communities and biodiversity

Increasing environmental and biodiversity risks, and regulatory and disclosure frameworks, have prompted businesses to consider how biodiversity supports businesses at an operational level and throughout the value chain (Dasgupta, 2021). However, this understanding is largely framed through an instrumental logic, where biodiversity is valued for its contributions to people such as pollination, water purification, climate regulation or supply of raw materials. The concept of 'business dependencies' on biodiversity sometimes suggests a two-dimensional relationship, the conversion of biodiversity to manufactured and financial capital (Gómez-Baggethun *et al.*, 2010) and the impacts of businesses on biodiversity. More recently, there has been a push to consider the multidimensional relationship between the broader nature and humans including businesses. IPLCs view biodiversity from a relational perspective, through an interconnected bond described as a 'mutual interrelationship' with nature (IPBES *et al.*, 2023). The relationship with nature is multidimensional and shaped by principles of care, obligation and interdependence, where both humans and nature have responsibilities toward each other (Díaz *et al.*, 2018; Irvine *et al.*, 2019). This symbiotic worldview encourages IPLCs to safeguard biodiversity while deriving sustenance, reflecting a deeply spiritual connection and a philosophy of reciprocity (Cloud & Redvers, 2023; Mazzocchi, 2020). This reflects contrasting views between relational worldviews of a mutual interrelationship with nature and instrumental worldviews that promote the exploitation and degradation of nature (IPBES, 2024).

This epistemic divergence presents a growing challenge for businesses seeking to assess and manage their nature-related dependencies. Standard corporate approaches to biodiversity are characterized by environmental accounting, risk disclosure and ecosystem service valuation, which overlooks the ontological and ethical dimensions of biodiversity as understood by IPLCs (Tadaki *et al.*, 2017; Turnhout *et al.*, 2013). When nature is framed solely in terms of its instrumental values as natural capital to be measured and managed, businesses may overlook how their dependencies on biodiversity may conflict with or undermine the values, rights and relationships that IPLCs have with biodiversity. This divergence contrasts with corporate efforts to assess their nature-related dependencies, leading to blind spots in risk assessments, stakeholder engagement and the design of sustainability strategies. Without grappling with these plural ways of knowing and relating to biodiversity, businesses risk reinforcing epistemic and procedural injustices when they measure and address their dependencies on biodiversity. Moving beyond instrumental valuation and embracing more pluralistic, inclusive approaches to biodiversity involves recognizing the rights and self-determination of IPLCs, creating spaces for equitable knowledge co-production and embedding relational values into corporate governance systems (IPBES *et al.*, 2022; Pascual *et al.*, 2023).

The Organisation for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises (OECD MNE Guidelines) and the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (IFC Performance Standards) are widely viewed as important international standards for guiding responsible transnational business conduct (Seck, 2016). Yet, the rights of Indigenous Peoples to free, prior and informed consent (FPIC) are not always

adequately recognized and sometimes misinterpreted. Moreover, there is a need for national and local standards that recognizes the rights of IPLCs. Businesses should engage IPLCs and secure the agreement of local communities to establish operations at a site or make significant changes to existing operations to correct wrongdoing and meet communities' expectations.

2.7.2 Role of Indigenous and local knowledge in how businesses assess their dependencies on biodiversity

Indigenous and local knowledge encompasses governance systems, customary laws and ecological knowledge including food, medicine and ecosystem management (Sahoo *et al.*, 2022). Indigenous and local knowledge develops from generations of observation and interaction with the natural world, shaping Indigenous identities and responsibilities toward the environment (Jessen *et al.*, 2022; Pierotti & Wildcat, 2000). This knowledge includes nuanced understandings of species behaviour, ecological variability, and socio-environmental feedback, often extending beyond the temporal and spatial resolution of conventional ecological monitoring. For instance, the Yolngu people in Australia have detailed knowledge of seasonal cycles to manage water and food resources (Prober *et al.*, 2011). IPLCs possess expertise in weather forecasting, managing forests and preserving water sources (Abas *et al.*, 2022). Indigenous and local knowledge can therefore play a big role in biophysical quantifications or socio-cultural and economic valuation assessments of business dependencies on biodiversity.

Indigenous and local knowledge offers valuable insights for ecosystem management (Mistry *et al.*, 2016; Reyes-García *et al.*, 2016; Tengö *et al.*, 2017). Indigenous-managed lands often experience lower rates of biodiversity loss and lands located within tropical protected areas often maintain high levels of forest integrity (Dawson *et al.*, 2021; IPBES, 2022; Sze *et al.*, 2024). This knowledge is important in business response to assess and minimize risk to biodiversity along the value chain. Efforts to bridge Indigenous and local knowledge with scientific knowledge enhances conservation practices, such as in northern Australia where traditional knowledge has been integrated into local watershed management (Robinson *et al.*, 2016). Under the Convention on Biological Diversity, Indigenous and local knowledge has been applied in natural resource management, integrated into conservation planning, and implemented in sustainable use initiatives (Parks & Tsioumani, 2023).

While emerging nature-related standards and frameworks aim to assess and disclose dependencies, they remain largely grounded in biophysical and economic metrics. This can result in narrow assessments that fail to capture the full complexity of human–nature relationships, particularly in landscapes managed or inhabited by IPLCs. Indigenous and local knowledge can inform ecological models, improve temporal sensitivity to environmental shifts, and inform culturally relevant indicators of ecosystem health (Berkes, 2018; Tengö *et al.*, 2014). Participatory mapping and monitoring to assess biodiversity dependencies includes participatory mapping, community-led monitoring, rights-based approaches, oral histories and seasonal indicators (Robinson *et al.*, 2016; Tengö *et al.*, 2021). Collaboration and partnerships between businesses and IPLCs can document, preserve and leverage valuable knowledge and resources to build resilience across sectors through comprehensive risk assessments, co-designed monitoring systems and benefit-sharing mechanisms.

2.7.3 Indigenous Peoples and local communities' businesses

Indigenous businesses often operate business models with generational business strategies, sharing of resources amongst communities and as stewards of biodiversity. For example, in northern Canada, the Inuvialuit operate sustainable fisheries that support local communities and protect Arctic char populations (Tallman *et al.*, 2019). Indigenous businesses create community benefits, as they seek to preserve their culture and rights to self-determination (Peredo & Anderson, 2006; Dana, 2015). Therefore, Indigenous businesses may use Indigenous methods with indicators that could include social aspects such as cultural events or number of youths or elders supported. In New Zealand, Maori businesses emphasize benefits for the entire community rather than individual profit (Mrabure, 2019). Since benefits are communal, in many instances, accountability is also communal and there are continuous risk assessments to the community. Traditional practices are often associated with sustainable activities through IPLCs' attachment to their ancestral lands and social cooperation (Peredo & Anderson, 2006). Many Indigenous businesses therefore have a social focus (**Table 2.8**, see **Chapter 5** for more information). However, some business sectors such as agriculture, forestry, mining and energy depend on biodiversity for direct physical inputs, thereby competing for resources with IPLCs.

Businesses' dependencies on biodiversity can conflict with Indigenous Peoples rights, relationships and their interrelationships with biodiversity. Industrial development expansion threatens 60 per cent of Indigenous lands globally and one-quarter of Indigenous territories are under high pressure for resource exploitation (Kennedy *et al.*, 2023). Demand for minerals vital to the energy transition has escalated these risks, with mining projects

Table 2 8 **Indigenous Peoples' and local communities' businesses with an emphasis on mutual interrelationships with biodiversity.**

Country	IPLCs' business description	Ecological focus	Social focus
Colombia	Tree nursery businesses owned by IPLCs support reforestation, recover rare plant species and preserve biodiversity (IPBES *et al.*, 2023).	Seed preservation businesses have developed to safeguard genetic resources that are increasingly valuable due to scarcity.	Plant species can be exchanged or sold for money. Access to rare plant species that have important cultural elements supports IPLCs in re-discovering their traditional foods and origins.
Indonesia	Planet Indonesia, a nonprofit organization, assists IPLCs in West Kalimantan in community-led governance of ecosystems through village partnerships (Planet Indonesia, 2024).	One of the organization's partnerships in Gunung Nyiut led to improved conservation outcomes and reduced deforestation rates.	Using a rights-based approach, their efforts focus on securing communities' formal legal tenure and rights over lands and resources, as well as financial inclusion and regenerative livelihoods from small-scale fisheries, agriculture and ecotourism.
Kenya	The Samburu community collaborates with the Sarara Foundation on conservation and ecotourism within Namunyak Conservancy. It combines pastoral farming, ecotourism and wildlife conservation. Revenue generated from tourism, lodging, and conservation fees funds ecosystem protection, water development, education and healthcare for the community (Sarara / The Sarara Foundation, n.d.).	This business has contributed to the survival of endangered species like the Grévy's zebra and the Reticulated giraffe, as well other species such as zebras, hyenas, kudus, lions and leopards.	Empowerment of female entrepreneurs who sell goat milk to the Reteti Elephant Sanctuary, fostering local economic opportunities. A recognition of Indigenous communities' land rights through obtaining title deeds for the Sarara and Sapashe communities.

frequently overlapping Indigenous territories (Owen, Kemp, Harris, *et al.*, 2022; Owen, Kemp, Lechner, *et al.*, 2022). For example, 80 per cent of lithium projects are located on Indigenous lands, and water scarcity in these regions compounds the risks of pollution (International Renewable Energy Agency (IRENA) & International Labour Organization (ILO), 2024; Lèbre *et al.*, 2020). These activities may restrict IPLCs' access to sacred sites, land and water, or disrupt their traditional land management practices that have evolved over generations (see **Chapter 3** for more information).

Climate change further exacerbates challenges for IPLCs, disrupting traditional food systems, agriculture and cultural values (Jarillo & Crivelli, 2024; Reyes-García *et al.*, 2023). Island communities are some of the most vulnerable to climate change; including rising sea levels that threaten water supplies and food system, respiratory illnesses and mental health effects (Keener *et al.*, 2021). These impacts disrupt cultural practices and threaten the economic, social, and spiritual well-being of IPLCs (Ksenofontov & Petrov, 2024; Pearson *et al.*, 2023; Yletyinen *et al.*, 2022).

2.8 TRADE-OFFS AND SYNERGIES IN DEPENDENCIES

Businesses that rely on biodiversity and nature's contributions to people often face complex decisions that involve balancing trade-offs and fostering synergies between economic goals and social and environmental sustainability (see also **Chapters 3** and **6)**. These trade-offs and synergies are a feature of the conditions of the system within which business operates. Recognizing these dynamics is crucial to identify suitable actions.

Synergies and trade-offs involve questions around the fair allocation of scarce resources (related to equitable development as a societal goal). Trade-offs occur when a decision or action to enhance or maximize one aspect for economic growth may decrease or compromise biodiversity and nature's contributions to people or impact IPLCs and other communities. For businesses, this often involves balancing short-term economic gains with long-term sustainability, including risks of biodiversity loss and impacts on the business itself, nature and external stakeholders (Howe *et al.*, 2014). Synergies refer to interactions where multiple benefits are derived simultaneously from biodiversity and nature's contributions to people; these can result from

business actions to restore ecosystems (Brancalion *et al.*, 2022; Mohr & Metcalf, 2018). Synergies can arise because of dependencies in "production spheres", e.g., when nature's contributions to people are bundled (Spake *et al.*, 2017) or interdependent such as in the water-energy-food-biodiversity nexus (Doelman *et al.*, 2022). Joint investment in multifunctional landscapes (Medina-Roldán *et al.*, 2024), or in non-consumptive use of public goods may also create business synergies. Synergies can also arise because of shared objectives, e.g., shared (interdependent) needs, dependencies or objectives of different stakeholders, for example in case of social enterprises, or shared resources (Katic *et al.*, 2023)**.** **Table 2.9** provides a typology of trade-offs and their synergy equivalents.

Accounting for the different types of trade-offs and synergies is essential for understanding and managing risk to business, where financial performance and broader environmental and social impacts are integrated into corporate decision-making. By recognizing and quantifying these trade-offs, businesses can better align their operations with sustainability goals and enhance their resilience to environmental and social risks. Understanding shared objectives or needs requires assessments to consider the diverse values and worldviews of all actors involved (IPBES, 2022). These can be mapped against different business objectives to identify areas of synergies and interdependencies.

Synergies in dependencies suggest that investing in nature's contributions to people can benefit multiple businesses and societal actors simultaneously. This creates opportunities for businesses to collaborate on sustainable management, secure supply chains, reduce risk and improve business operations (Ya He & Cranston, 2014) and at the same time support dependencies of other non-business actors. Partnerships can foster collective agreements to manage dependencies equitably, benefiting non-business actors. For instance, restoration can provide direct benefits and positive return on investment to farmers and thereby create a business case for purely private investment (López-Cubillos *et al.*, 2023), but this is not the case everywhere; for example, in California, managing natural habitats for pollinators created no net private benefits to individual landowners, but neighbouring landowners benefited from the services provided by mobile pollinators (Lonsdorf *et al.*, 2020). In such cases, payment for ecosystem services

Table 2 9 **Typology of trade-offs and synergies among businesses, society and biodiversity.**

Trade-offs within the business	Synergies within the business
Risk of biodiversity loss that affects the business itself, such as removing natural habitat essential for pollination services (e.g., López-Cubillos *et al.*, 2021).	Opportunities for improving biodiversity or nature's contributions to people that generate profitability for the business, such as the restoration of natural habitat that improves pollinators' abundance and the services they provide, which leads to an increase in yields or quality (e.g., López-Cubillos *et al.*, 2023).
Trade-offs with other businesses	**Synergies with other businesses**
Trade-offs among sectors that occur when other businesses demand nature's contributions to people located in the same landscape. Rival nature's contributions to people occur when one user reduces the availability of such services for other users (Metzger *et al.*, 2021).	Synergies that occur when multiple businesses benefit from an improvement in nature's contributions to people within the same landscape or production process. For instance, within the same value chain, or in case of non-consumptive use, such as better air quality.
Trade-offs between increasing business profitability and civil society and IPLCs	**Synergies between increasing business profitability and civil society and IPLCs**
Trade-offs that occur when businesses overexploit natural resources that are important for civil society. Examples include using water resources for agricultural commodities through restricting access for IPLCs (e.g., Larsimont, 2022) or the opening of international fishing markets that generate profits to men but displace women (Porter *et al.*, 2008).	Business profitability and dependency should also generate positive impacts on civil society and IPLCs by supporting their reliance on biodiversity and nature's contributions to people.
Trade-offs between increasing business profitability and biodiversity and nature	**Synergies between increasing business profitability and biodiversity and nature**
Trade-offs with climate mitigation and biodiversity (e.g., Grass *et al.*, 2020), biosecurity risks related to trade and land competition between business/economic use and the environment.	Creating positive effects on biodiversity.

schemes can be a viable option (Lonsdorf *et al.*, 2020), if needed combined with carbon payments (d'Albertas *et al.*, 2024). Increasingly businesses, including social enterprises, adopt objectives beyond profit maximization related to social and environmental goals, including issues of equity and justice (Green *et al.*, 2017).

Multiple methods can be used to identify synergies and trade-offs (see **Table 2.10**). Studies at larger spatial scales often use production possibility frontier analysis and tend to identify synergetic opportunities (Damania *et al.*, 2023) (see also **Section 2.6.2**). Such studies often focus aggregate indicators of resource efficiency and GDP or economic output but ignore distributional effects and wider well-being impacts. More detailed studies on the impacts of interventions often find trade-offs, as they are more likely to consider distributional impacts across actors as well as non-monetary impacts (Schaafsma *et al.*, 2021; Schreckenberg *et al.*, 2018). For example, shifting to more efficient agriculture through technological innovation may well improve resource efficiency and agricultural revenues, but is unlikely to benefit resource-poor smallholder farmers who may be outcompeted. Marine

Table 2 10 **Examples of trade-offs and synergies with different methodological approaches.**

Trade-off / synergy type	Summary	Sectors	Methods	Nature's contributions to people	References
Trade-offs within the business	Forest industries, construction and publishing rely on sustained supplies of timber and wood fibre, but can alter forest structure.	Forestry/ construction	(Bio)-physical and ecological	Timber	Kallesoe *et al.* (2012) and Lähtinen *et al.* (2016)
Trade-offs with other businesses	Fishing unsustainably may negatively impact tourism and angling recreational activities.	Fisheries, mining and recreation	Life cycle assessment	Water services, food production and cultural services	Blanco *et al.* (2018)
Trade-offs with civil society and IPLCs	Water pollution caused by eucalyptus plantations in Ecuador resulted in the death of livestock of smallholders.	Industrial tree plantation, smallholder farmers	Participatory and socio-cultural methods and monetary valuation	Water services	Gerber *et al.* (2009)
Trade-offs with nature's contributions to people	Irrigating crops (e.g., rice and corn) in the USA can increase profits but also increase agricultural runoff and degrade surface water quality.	Soybean, corn, rice, wheat and cotton sectors.	Monetary valuation and efficiency frontiers	Food production and water services	Kovacs *et al.* (2017)
Synergies within the business	Conserving and restoring forest patches near coffee farms in Costa Rica can enhance populations of pest-controlling birds and pollinating wild bees, increasing yields and farmers' profitability.	Agriculture (coffee)	(a) Ecological and (b) efficiency frontier analysis	Pollination and pest control services	(a) Karp *et al.* (2013), (b) López-Cubillos *et al.* (2023)
Synergies with other businesses	Managing forest for timber production, yield water used for hydropower in Sierra Nevada.	Timber and energy	Economic valuation	Water supply	Guo *et al.* (2023)
Synergies with civil society, and Indigenous Peoples and local communities	Ecotourism enhances the diversification of household income, by creating employment, boosting small businesses and improve social welfare in six southern African countries.	Tourism, agriculture and small businesses	Socio-cultural valuation methods	Tourism and cultural heritage	Snyman (2014)
Synergies with biodiversity and climate change	Forest conservation in the Brazilian amazon improves biodiversity, enhances carbon storage and maximizes açaí palm pollination services.	Agriculture, forestry, carbon storage	Biophysical spatial modelling and cost benefit analysis	Carbon mitigation; soil erosion control; habitat creation and maintenance	Campbell *et al.* (2023)

protected areas may benefit the tourism industry because divers often prefer areas with higher fish density and biomass (Morse *et al.*, 2024), however, excluding local fishermen can lead to food insecurity and displacement (Kamat, 2014). Assessing power imbalances in supply chains or across sectors and spatial scales can help to understand why trade-offs occur or where opportunities for synergies are missed (Martín-López *et al.*, 2019).

However, very few examples of studies demonstrate how individual businesses can create positive societal impacts in how they manage their dependencies on nature's contributions to people, let alone including compound climate change effects. One example is a study on an international brewery, which examined the extent to which agronomic advice given by corporate farm extension workers would help smallholders (suppliers) to increase income, improve resource efficiency (water, fertilizer, energy) and reduce greenhouse gas emissions, and at the same time secure barley production for the beer company (Bowe & Der Horst, 2015). It is important to note that the same practice can have different outcomes across different geographies. For example, some businesses, with agronomic advice, aim to enhance social and environmental sustainability in farming practices by planting trees (Bianco, 2020). Producers in Colombia reported positive outcomes from such verification, including increased prices and improved market access and technical support (Rubio-Jovel, 2024). Conversely, producers in Costa Rica noted that the verification favoured only a few producers and hurt cooperatives, despite the program's positive effects on water conservation (Rubio-Jovel *et al.*, 2024).

2.9 CLOSING AND KNOWLEDGE GAPS

The review in this chapter demonstrates that while the existence of nature-related business dependencies and risks is well established, evidence for quantified dependencies for individual businesses' operations and value chains is scarce. Nonetheless, the evidence is sufficiently robust for a call for individual business action despite remaining uncertainties (Retsa *et al.*, 2020).

Studies on dependency from our review showed a very skewed distribution with most studies in Americas, Europe and Asia. African and Oceania studies are lacking (see **Figure 2.9**).

A significant knowledge gap remains in the evidence for dependencies for multiple sectors. Existing studies focus on agriculture, forestry and fishing (about 60 per cent) and about 3 per cent on water supply, sewerage, waste management and remediation, and arts, entertainment and recreation, each. There were no studies on, for example, wholesale and retail trade or transportation and storage. In addition, studies on the agricultural sector mostly analysed pollination effects on crop yield, ignoring other key services such as soil quality or pest control. Most importantly, few studies account for feedback loops in business dependencies that negatively impact biodiversity and reduce its ability to provide benefits. An example is how farming practices affect pollination services and how pollination decline in turn negatively impacts famers' income. Global, long-term scenarios for biodiversity exist (e.g., Pereira *et*

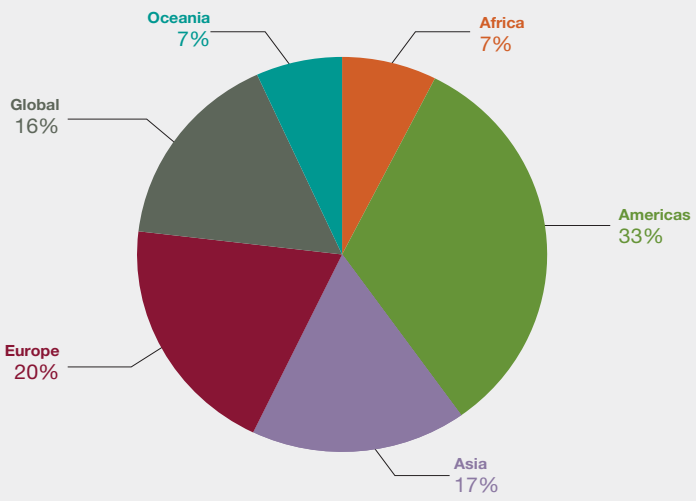


Figure 2 9 **Percentage of studies on dependency per region based on snowball search carried out in this assessment.**

al., 2010) but are not linked to nature-related business risks (Svartzman *et al.*, 2023).

Several knowledge gaps remain in approaches to understand the dependencies of businesses on nature's contributions to people and the associated magnitude and risk or the trade-offs that exist due to such dependencies. This includes the limited application of diverse methods for understanding dependencies and trade-offs, and the failure to understand, and account for, the implications for IPLC. Dependences which extend beyond species to their genetic resources such as the use of DSI by businesses for economic gain remain unknown and are key to the implementation of initiatives such as the Cali Fund (Orozco & Scholz, 2025). These gaps, plus the lack of long-term, longitudinal studies, limit understanding of sustainable business reliance on biodiversity. Addressing these issues requires better data collection, cross-disciplinary collaboration and inclusion of diverse knowledge systems. These knowledge gaps have been populated in **Table 2.11**.

Table 2 11 **Knowledge gaps.**

Context/Section	Knowledge gap
Methods and data (2.3)	Biophysical and ecological approaches are widely used but often lack sufficient data — especially in remote areas and for under-studied species—limiting accurate nature's contributions to people measurement and predictive models.
Methods (2.3)	Socio-cultural methods, while valuable, are not used often and hard to standardize and scale for business use and benchmarking.
Typology of dependency (2.2)	Existing tools allow measuring certain nature's contributions to people in certain locations, but large knowledge gaps and data constraints remain in quantifying spatial and temporally explicit dependencies. This means that methods to better disentangle the contributions of natural, produced, social and human capital to a production process and related analyses need to become more spatially and temporally detailed.
Methods and IPLCs (2.3 and 2.6)	IPLCs knowledge is rarely integrated into formal analyses due to limited ethical and effective mechanisms.
Methods (integration) (2.3)	Integrated methods like natural capital accounting face challenges in merging diverse data and balancing ecological, economic and social trade-offs.
Methods and data (2.3)	Available academic methods are only partially reflected in private sector tools, and these tools and associated data are fragmented and sometimes inaccessible.
Business reporting (2.4)	Lack of consistent, self-reported data and information on dependencies and risks by individual businesses.
Business reporting (2.4)	Standardized business-relevant indicators and metrics for assessing nature-related dependencies and risks are absent.
Scenarios (2.4)	Consistent and established scenario data and modelling approaches for nature-related risks, not only for shocks but also for long-term futures, are missing or not applied consistently and comprehensively to identify sustainable business strategies. The IPBES Nature Futures Framework may provide a useful starting point.
Scientific studies on business dependencies (2.4)	Dependencies at the level of individual businesses are studied for only a limited subset of sectors and most of the assessments are related to economic valuation or productivity, there is a significant lack regarding quality and risk of the dependency. Socio-cultural valuation methods tend to focus on understanding the valuation of nature's contributions to people in order to integrate the value of nature into public sector decision-making. Few studies are conducted in the context of businesses' dependencies on biodiversity and if so, the sectors are skewed towards agriculture, forestry and tourism.
Magnitude of dependency (2.4)	Lack of a comprehensive peer-reviewed database on the dependence of economic sectors on nature's contributions to people. To date, the only such database (ENCORE, n.d.) is not peer-reviewed, highlighting a significant disconnect between market requirements and scientific knowledge. Very few studies evaluate the sustainability of business use of nature's contributions to people that they depend on, because dependency analyses fail to include stock and pressure/trend analyses.
Implications of business dependencies on nature for Indigenous Peoples and local communities (2.7)	As few businesses are aware of their dependencies on biodiversity, there is even less awareness within the private sector of how business dependencies on biodiversity affects IPLCs.

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Chapter 3

HOW DOES BUSINESS IMPACT BIODIVERSITY?[1]

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Chapter **3**

HOW DOES BUSINESS IMPACT BIODIVERSITY?

EXECUTIVE SUMMARY

1 **The activities of businesses and financial institutions have had significant impacts on biodiversity and nature's contributions to people, through a variety of pathways across the full value chain of businesses *(well established)* {3.1, 3.2, 3.3, 3.4, 3.5}.** Understanding business impacts on biodiversity and nature's contributions to people is needed to guide decision-making by businesses, financial institutions, governments, consumers and civil society to manage these impacts and their associated risks and opportunities, and to promote accountability and transparency (*well established*) {3.5, 3.6}.

2 **Business activities impact biodiversity and nature's contributions to people by contributing to the drivers of biodiversity change and affecting the state of nature *(well established)* {3.2}.** Businesses have direct, value chain and indirect impacts on biodiversity. Business activities, in combination with other societal activities, also have cumulative impacts. While the impacts of business activities on biodiversity have been overwhelmingly negative, they can in some cases be positive relative to the current state of biodiversity. Positive impacts will need to become frequent and substantial to halt and reverse biodiversity loss to meet the goals of the Kunming-Montreal Global Biodiversity Framework. Business impacts on nature's contributions to people are complex, increasing the production of certain material contributions, such agricultural products, while reducing regulating and non-material contributions.

3 **All businesses have impacts on biodiversity and nature's contributions to people linked to their activities and value chains. The magnitude and form of a business's impact vary based on the type, scale (spatial and temporal), magnitude, frequency and location of their activities *(well established)* {3.2}.** Impacts result from businesses' physical activities, such as using raw materials and energy to produce goods, and non-physical activities, such as influencing consumer demand for goods and services.

4 **Business impacts on biodiversity affect everyone, but Indigenous Peoples and local communities, women, children and the rural poor are among those particularly susceptible to harms *(well established)* {3.2, 3.5}.** The effects of business impacts on biodiversity on these and other vulnerable groups can be positive or negative, although the preponderance of impacts to date have been negative *(well established)* {3.2, 3.5}. These vulnerable groups are especially susceptible to negative impacts from businesses in part because of their direct interrelationships with nature and their reliance on common-pool resources.

5 **A diversity of methods for identifying impacts of businesses on biodiversity and nature's contributions to people is available, both within the scientific literature and for practical applications *(well established)* {3.3}. No single method or metric can capture all dimensions of impact *(well established)* {3.2, 3.3}.** Different methods focus on different components of biodiversity (e.g., ecosystems, species) or different aspects of nature's contributions to people (e.g., regulation of climate, regulation of freshwater quality), or use proxy indicators (e.g., emissions, resource use). Some methods rely on location-based observations of nature, while others use modelling. Approaches produce a mix of qualitative and quantitative measures. Methods differ in their ability to capture variation in impacts by location, within sectors and across the value chain.

6 **Existing methods have not yet produced a comprehensive and comparable attribution of impacts across all sectors or businesses *(well established)* {3.3, 3.4}. However, current analyses point to agriculture, forestry and fishing as sectors with large negative impacts on biodiversity, particularly given contributions to land use change *(established but incomplete)* {3.4}. The highest quantified impacts come from sectors that produce materials and energy in response to demand from other sectors and consumers, and ultimately all sectors contribute to these impacts through their value chains *(established but incomplete)* {3.2, 3.4}.** Other sectors found to have relatively high impacts on biodiversity and materiality across multiple studies include energy (electricity, gas, steam and air conditioning supply sector), construction, mining and quarrying, transportation and storage, and manufacturing. In terms of nature's contributions to people, sectors such as agriculture, forestry and fishing have increased certain material contributions from nature (such as food and timber) but have had negative impacts on other nature's contributions to people, such as regulating contributions.

7 **Comparable global estimates of sector-level impacts on biodiversity and nature's contributions to people are hindered by inaccessible data on the location and magnitude of business activities, a lack of traceability of material flows and impacts through value chains, and the use of different metrics produced by incompatible methods *(well established)* {3.4}. Voluntary self-disclosure by businesses has not yet yielded enough data to support such analyses. Other key knowledge gaps at the sector level include impacts on nature's contributions to people across sectors, as well as the potential for positive impacts on biodiversity relative to current conditions, both of which could be relatively high for agriculture, forestry and fishing compared to other sectors *(established but incomplete)* {3.4}.** Improving estimates of business- and sector-level impacts on biodiversity and nature's contributions to people requires filling gaps in data on the location and type of business activities, improving traceability of impacts across value chains and implementing comparable proxies where drivers are understood across sectors.

8 **Businesses face nature-related risks and opportunities resulting both from their impacts and their dependencies on biodiversity and nature's contributions to people *(well established)* {3.5}.** Risks can arise from a business's impacts on resources on which it depends, such as unsustainable harvest; from business impacts that occur separate from its dependencies, such as from pollution or land conversion; or from activities of actors outside the business's value chain, such as government regulation. Risks can be categorized as physical, transition or systemic risks. Businesses may also find nature-related opportunities to offer new products and services; to secure or enhance the biodiversity on which they depend; to differentiate themselves in the marketplace; to face fewer regulatory pressures; and to manage liability by reducing negative impacts or contributing to positive impacts on biodiversity. The way businesses choose to manage their impacts and dependencies significantly influences their risk and opportunity landscape.

9 **The impacts of the informal economy on biodiversity and nature's contributions to people are substantial and important to recognize but understudied *(established but incomplete)* {3.4}.** The informal economy may be included in assessments of business impacts that focus on activities detectable from satellite imagery, such as mining, agriculture and logging. Other informal activities, such as wild plant harvest, are more difficult to assess through these methods. The interface between the informal economy and formal economy is important to consider, given flows of materials between them and the size of the informal economy. Indigenous Peoples and local communities have both a high participation rate in the informal economy and a susceptibility to harms from the negative impacts of the informal economy on biodiversity and nature's contributions to people.

10 **Actions to improve the ability to systematically and comparably quantify business impacts on biodiversity and nature's contributions to people would enable more effective policy and management to reduce or reverse the loss of biodiversity *(well established)* {3.6}.** To date, the limited quantitative comparable estimates of both the tangible and intangible impacts on biodiversity from different businesses and sectors have a range of implications for decision-making by businesses, financial institutions, consumers, governments and civil society. The multiple pathways by which business activities affect biodiversity and nature's contributions to people have made it challenging to adopt consistent methodologies for quantifying the impacts – and hence multiple methodologies and metrics are currently being applied. While there is no one-size-fits-all measurement approach across sectors, comparable and systematic approaches are needed while considering local issues. The development of scenarios, understanding trade-offs, including distributional impacts, and more widespread use of tools and measurements would help inform different stakeholders on making appropriate decisions and action to enable transformative change.

3.1 INTRODUCTION

Global acceleration of unsustainable economic activity over the past century is driving a loss of biodiversity and undermining Earth's life support systems (IPBES, 2019b). The activities of businesses and financial institutions have collectively had significant negative impacts on biodiversity and nature's contributions to people through a variety of pathways across the full value chain of businesses (Bruyninckx *et al.,* 2024; Dasgupta, 2021; IPBES, 2019a). At the same time, impacts of businesses vary greatly in terms of their intensity, duration, magnitude, frequency and reversibility, as a factor of business activity type, location and other properties. Impacts of businesses on biodiversity and nature's contributions to people can also have profound effects on Indigenous Peoples and local communities (IPLCs) and other vulnerable groups with significant direct interrelationships with biodiversity and on Indigenous and local knowledge that is typically intertwined with local ecosystems and biodiversity. An understanding of the type, magnitude and extent of businesses' and financial institutions' impacts is key to informing decisions by consumers, investors, business leaders and policy makers. While impacts can already be managed without comprehensive measurement, the ability to accurately measure these impacts and attribute them to specific business activities is critical to promoting transparency, accountability and action.

Chapter 3 assesses business impact types and pathways and describes the methods available for measuring them. It builds on the definitions of businesses and sectors established in **Chapter 1** and the assessment of business dependencies in **Chapter 2**. This chapter sets the foundation for an assessment of the suitability of approaches for levels of business decision-making to assess impacts and dependencies **(Chapter 4)** and of options for action that follow both for businesses **(Chapter 5)** and for governments, the financial system and other actors **(Chapter 6)**.

This chapter is organized as follows:

Section 3.2 presents a framework for understanding the pathways by which businesses impact biodiversity and nature's contributions to people, and a typology of impact types. This typology includes direct, value chain, indirect and cumulative impacts.

Section 3.3 reviews available approaches and tools for measuring businesses' impacts on biodiversity and nature's contributions to people, highlighting shared features and key differences across options.

Section 3.4 synthesizes and evaluates the current state of knowledge of impacts by sector based on existing methods for measuring impact.

Section 3.5 examines the connections between business impacts and dependencies on biodiversity and nature's contributions to people, as well as links to business risks and opportunities.

Section 3.6 assesses the implications of business impacts – and the current state of the ability to measure these impacts – on biodiversity and nature's contributions to people on decision-making by governments, businesses, the financial system and other actors (including civil society, consumers and IPLCs.

Throughout the chapter, each section discusses connections to IPLCs and other vulnerable groups. Finally, the chapter identifies key gaps in knowledge, data and methodologies **(Annex 3.2)**, highlighting needs for data collection and data sharing and opportunities for new research and collaboration efforts.

3.2 PATHWAYS AND TYPOLOGY OF IMPACTS

3.2.1 Pathways by which businesses impact biodiversity

Businesses impact biodiversity and nature's contributions to people through changes in land and sea use, direct exploitation of organisms, climate change, pollution and the introduction of invasive alien species, among other drivers **(Figure 3.1)** (IPBES, 2019a). Business activities contribute to driving biodiversity change through, for example, deforestation for industrial agricultural activities, land-use change from mining or infrastructure development such as roads, dams and waterways, degradation due to resource extraction such as timber harvesting and the spread of invasive alien species through transportation and shipping. There is not yet a consistent terminology for referring to these drivers of biodiversity change. The IPBES Global Assessment of Biodiversity and Ecosystem Services (IPBES, 2019a) refers to these as the most important 'direct drivers of biodiversity loss'. The drivers of biodiversity change correspond to 'pressures' within the Driver, Pressure, State, Impact, Response (DPSIR) framework used in the environmental assessment field and adopted by the Science-Based Targets Network (Science Based Targets Network, 2023). Finally, they are also referred to as "impact drivers" by groups including the Taskforce on Nature-related Financial Disclosures (TNFD, 2023) and the Capitals Coalition (Natural Capital Coalition, 2016).

Drivers of biodiversity change are affected by socioeconomic trends, which include changes in demographic and sociocultural characteristics, economic

and technological developments, evolving institutional and governance systems and issues like conflicts and epidemics (IPBES, 2019a) **(Figure 3.1)**. The IPBES Global Assessment (IPBES, 2019a) refers to these as "indirect drivers" of biodiversity change. The IPBES Transformative Change Assessment further identifies underlying causes of biodiversity change, including disconnection from and domination over biodiversity and people, concentration of power and wealth and prioritization of short-term individual and material gains (IPBES, 2024). Business activities are both shaped by and contribute to these socioeconomic trends and their underlying causes, often in complex and unpredictable ways. Business activities may influence political and economic systems at all scales, such as through swaying government policies via lobbying, through philanthropic contributions to conservation organizations, or by influencing consumer preferences and affecting the supply-demand dynamics of products and services. For instance, marketing and sales activities can stimulate consumerism (Abela, 2006) and reshape a society's sociocultural makeup. Similarly, activities in the supply-chain domain, especially those involving distributed natural resource supply networks, can lead to community conflicts (Deberdt & Billon, 2021; Hofmann *et al.,* 2018; Murcia *et al.,* 2021) and the spread of zoonotic diseases (Tumelty *et al.,* 2023). Business practices in human resource management can influence local demographics (Zhang *et al.,* 2019), while stakeholder management strategies, particularly through lobbying, can alter institutions and governance systems (Clapp, 2021; Madsen & Ulhøi, 2001; Savell *et al.,* 2014). While these linkages are conceptually well-supported, quantifying their extent and the subsequent impact on biodiversity is difficult.

Understanding the impacts of operations and supply chain activities on drivers of biodiversity change tends to be more straightforward than for activities such as marketing and finance (Ghadge *et al.,* 2020; Howard-Grenville *et al.,* 2014). Examples of this are the connections between operations and supply chain activities and drivers like climate change or the introduction of invasive alien species (Borgelt *et al.,* 2024; Hulme *et al.,* 2018). These activities are also more clearly linked to land and sea use changes and the exploitation of organisms – areas where extensive assessment and modelling efforts have been conducted, particularly in sectors such as agriculture, forestry and infrastructure development (Kasraian *et al.,* 2016; Lambin *et al.,* 2000; Lambin & Meyfroidt, 2011; Lark *et al.,* 2017). Meanwhile, the effects of financial activities (Pástor *et al.,* 2022; Vörösmarty *et al.,* 2018) and marketing practices (Galeazzo *et al.,* 2014; Klassen & Vachon, 2003; Moran & Kanemoto, 2016; Ottman, 2017) on biodiversity loss are receiving growing attention. However, the understanding of impacts remains largely conceptual and they are not yet as systematically measured or understood.

The magnitude and form of a business's impact vary based on the type, scale (spatial and temporal), magnitude, frequency and location of its business activities. Business activities can affect all components of biodiversity, from genes to species to communities to ecosystems (Panwar *et al.,* 2023). The same business activity will have varying consequences for biodiversity and ecosystem functioning depending on the ecosystem and climate zone where impacts occur (Benítez-López *et al.,* 2010; Bobbink *et al.,* 2010; Li & Jiang, 2021; Mantyka-Pringle *et al.,* 2011). Business activities can also impact all forms of nature's contributions to people, including material, regulating and non-material benefits. Business impacts on nature's contributions to people also include intergenerational impacts (Hayward *et al.,* 2022). The impacts of business activities on nature's contributions to people often occur as a result of their negative impacts on biodiversity. For example, nutrient pollution from agricultural and industrial activity around the Black Sea led to a hypoxic zone and fish die-off in the 1970s and 80s, during which period the $2 billion commercial fishery declined by 90 percent (Rabotyagov *et al.,* 2014). However, businesses can also have impacts on nature's contributions to people without an associated loss of biodiversity. This can occur when a business reduces people's ability to access nature's contributions to people, such as through implementation of conservation measures meant to protect biodiversity that restrict access to land for wild plant harvest and other activities (Bidaud *et al.,* 2017).

Overall, the impacts of business activities on the state of biodiversity and nature's contributions to people through drivers of biodiversity change have been overwhelmingly negative. This is evidenced by the global decline in biodiversity and its diminished capacity to provide sustained contributions to people (IPBES, 2019a). When business activities enhance biodiversity and nature's contributions to people relative to current levels, these impacts may be considered positive **(Figure 3.2)**. Such instances of positive impacts are currently rare. Many claims of positive outcomes are more accurately described as reductions in negative impacts rather than genuine positive contributions relative to a reference state **(Section 3.2.3)**.

3.2.2 Typology of business impacts on biodiversity and nature's contributions to people: direct, value chain, indirect and cumulative

The multi-faceted properties of business impacts – across space, time, the value chain and business activity type – have led to varied categorizations and terminology. Sometimes, the literature distinguishes business impacts on biodiversity based on whether the business organization's

boundaries are defined narrowly or broadly: the former are known as business-level impacts, while the latter are referred to as value chain level impacts (Crenna *et al.,* 2020; Maier *et al.,* 2019; Panwar, 2023). Some impacts occur locally – that is, close to the site of business operations — and others occur remotely due to the activities of others in the value chain. Business impacts on biodiversity are often examined only in relation to the production processes involved in creating a product. However, they may also be assessed across the product's entire life (Damiani *et al.,* 2023; Wolff *et al.,* 2017).

By examining both the pathways by which an individual business contributes to the loss of biodiversity and nature's contributions to people, along with the scope of analysis, a primary typology of impacts emerges as direct, value chain and indirect impacts **(Figure 3.1).** All impacts of a particular business ultimately result from that business's effects on the drivers of biodiversity change; what differentiates them is the degree to which that effect is directly under the business's control. A business's direct impacts result from operational business activities like mining and drilling for resources, clearing forests or other vegetation, farming, manufacturing, transporting and selling goods. A business's value chain impacts result from the impacts of its upstream or downstream value chain on drivers of biodiversity change. Indirect impacts result from activities that were spurred by that business's actions but fall beyond its direct operations or value chain. For example, development of a mine often leads to in-migration to the surrounding area,

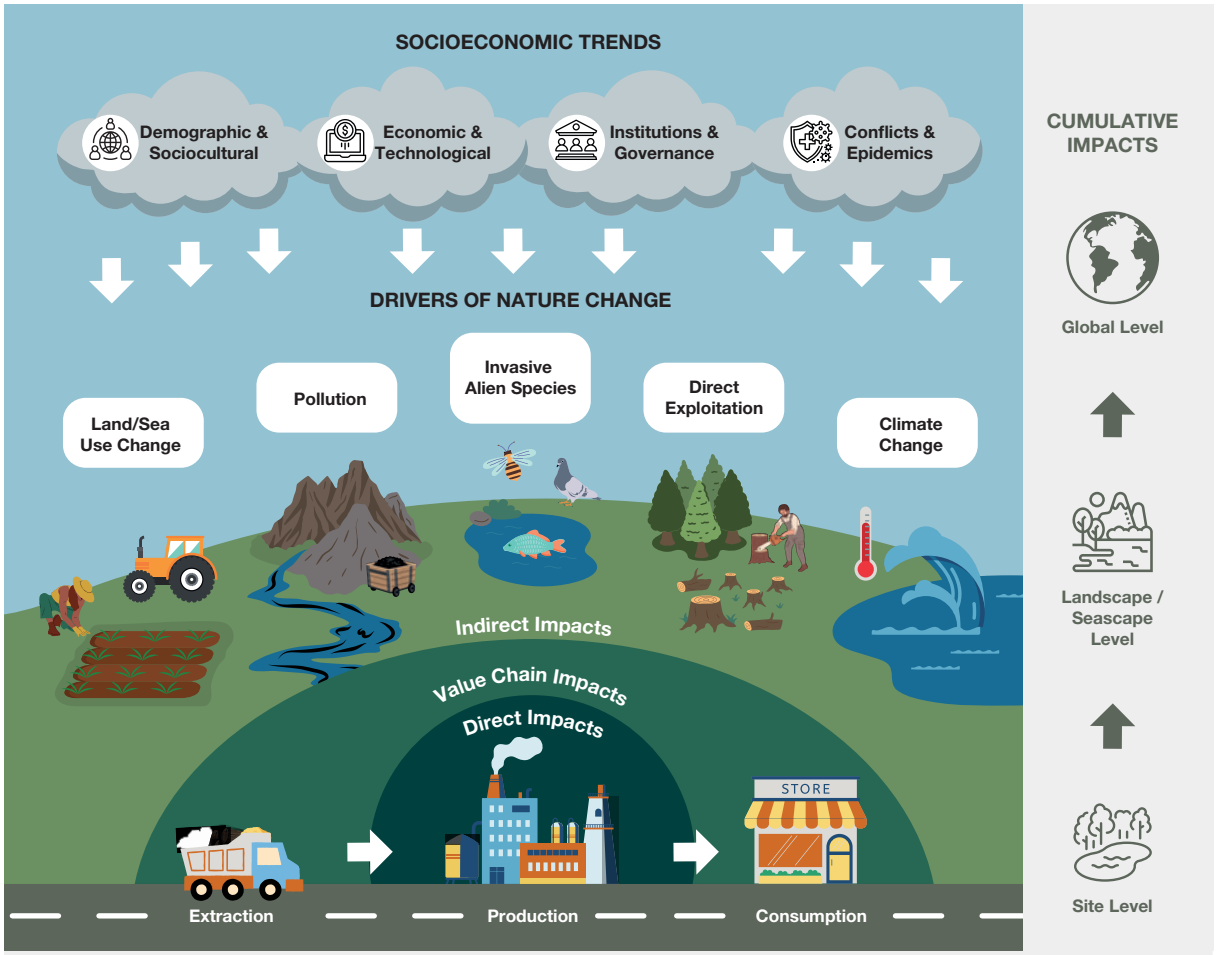


Figure 3 1 **Typology and pathways of business impacts on biodiversity and nature's contributions to people.**

Businesses have direct, value chain, indirect and cumulative impacts on biodiversity and nature's contributions to people through their impacts on drivers of biodiversity change and socioeconomic trends. Direct impacts stem from the operational activities of a business, while value chain impacts result from the activities within its upstream or downstream value chain. Indirect impacts result from activities that were spurred by that business's actions but fall beyond its direct operations or value chain, such as population growth, land clearing and the expansion of infrastructure surrounding a new mine or road. Cumulative impacts result from the aggregate effects of businesses and other actors at a site, landscape or seascape, or globally.

with expansion of transportation and energy infrastructure (Giljum *et al.,* 2022). These impacts are indirect from the perspective of the mine operator but have real consequences for biodiversity and nature's contributions to people that are linked to the mine's operations.

The accumulation of impacts and their interactions in a location over time give rise to a crucial secondary form of impact known as cumulative impacts (sometimes referred to as "aggregate impacts") (IPBES, 2023; Wassénius *et al.,* 2024; Whitehead *et al.,* 2017). Cumulative impacts occur when the impacts of multiple businesses and other actors in an area have additive or interactive effects that are greater than would be expected from their individual activities occurring in isolation. Considering such cumulative impacts is essential for fully assessing a business's impacts on biodiversity and nature's contributions to people.

The level and scope of analysis are critical when analyzing the impacts of business activities on biodiversity and nature's contributions to people **(Figure 3.1)**. A narrow analysis considers only business- or operations-level activities and their associated impacts. A broader analysis includes value chain-level activities and impacts. Corporate reporting practices often overlook this more comprehensive approach due to challenges with data availability and the complexity of methods, yet it is vital for developing effective corporate strategies to achieve global biodiversity targets (Panwar, 2023). Notably, business size – whether measured by the number of employees or revenue – is not a definitive factor in determining business impacts on biodiversity. While larger businesses may in general have greater impacts on biodiversity, business size alone is not a sufficient proxy for quantifying a business's impacts or comparing impacts among businesses.

3.2.3 Positive impacts of business activities on biodiversity

While business activities typically have negative impacts on biodiversity, there are instances where they can have a positive impact relative to the current state of biodiversity. A clearly defined baseline and consistent identification and measurement of impacts are necessary to differentiate reductions in negative impacts on biodiversity and nature's contributions to people from those with a positive impact on their state **(Figure 3.2)**. For instance, certain agriculture and forestry practices can genuinely enhance biodiversity compared to current levels, thus qualifying as positive impacts (e.g., Torralba *et al.,* 2016). However, if a business adopts waste reduction strategies that alleviate the drive for further land use change, this only reduces its negative impact, rather than constituting a positive impact on the state of biodiversity relative to current conditions.

Recent surges in corporate claims to achieving no net loss or net positive impacts on biodiversity (De Silva *et al.,* 2019) and proliferation of the term "regenerative" in corporate sustainability literature (Feger & Mermet, 2022; Hahn & Tampe, 2021; Konietzko *et al.,* 2023; Muñoz & Branzei, 2021) therefore warrant a clear distinction between actions that reduce negative impacts and those that are positive. When measured against a baseline of an "intact," "pristine," or otherwise unimpacted reference state, the impacts of business activities on biodiversity will be nearly exclusively negative. In addition, combining positive and negative impacts into a measure of "net" impacts risks masking important negative impacts, given the location specificity of impacts to biodiversity and nature's contributions to people. Claims of no net loss or net positive impacts therefore warrant careful attention to the underlying negative and positive components.

3.2.4 Intersection of impacts with Indigenous Peoples and local communities and other vulnerable groups

The losses of biodiversity and nature's contributions to people affect everyone, but the burden of these losses is disproportionately borne by IPLCs and other vulnerable groups. Business activities impact biodiversity and nature's contributions to people in ways that negatively affect IPLCs through diverse and complex pathways connected to their strong and direct interrelationship with biodiversity (Kennedy *et al.,* 2023). Often, these impacts manifest through reduced wildlife populations, water disruption and contamination of water and food sources, ultimately leading to food and water insecurity, cultural and livelihood disruptions and harm to cultural and spiritual practices. Women and girls are particularly vulnerable to these changes and may experience increased work burden, loss of income, decreased health, and increased exposure to gender-based violence as a result (Awumbila & Momsen, 1995; Booker *et al.,* 2022, 2022; Treviño & Murillo-Sandoval, 2021). Children, especially in rural areas and less-developed communities, are also at heightened risk for health impacts (Herrera *et al.,* 2017; Rasolofoson *et al.,* 2018, 2020). Individuals who oppose the environmental impacts associated with business activities have faced violence and assassination, particularly associated with conflicts around resource extraction, land use and water management (Scheidel *et al.,* 2020). Such violence disproportionately affects – but is not limited to – Indigenous Peoples (Scheidel *et al.,* 2020).

Paradoxically, these effects often arise from business involvement in climate transition strategies, such as mineral extraction for electric vehicle production, plantation schemes to support carbon offset projects or biodiversity offset

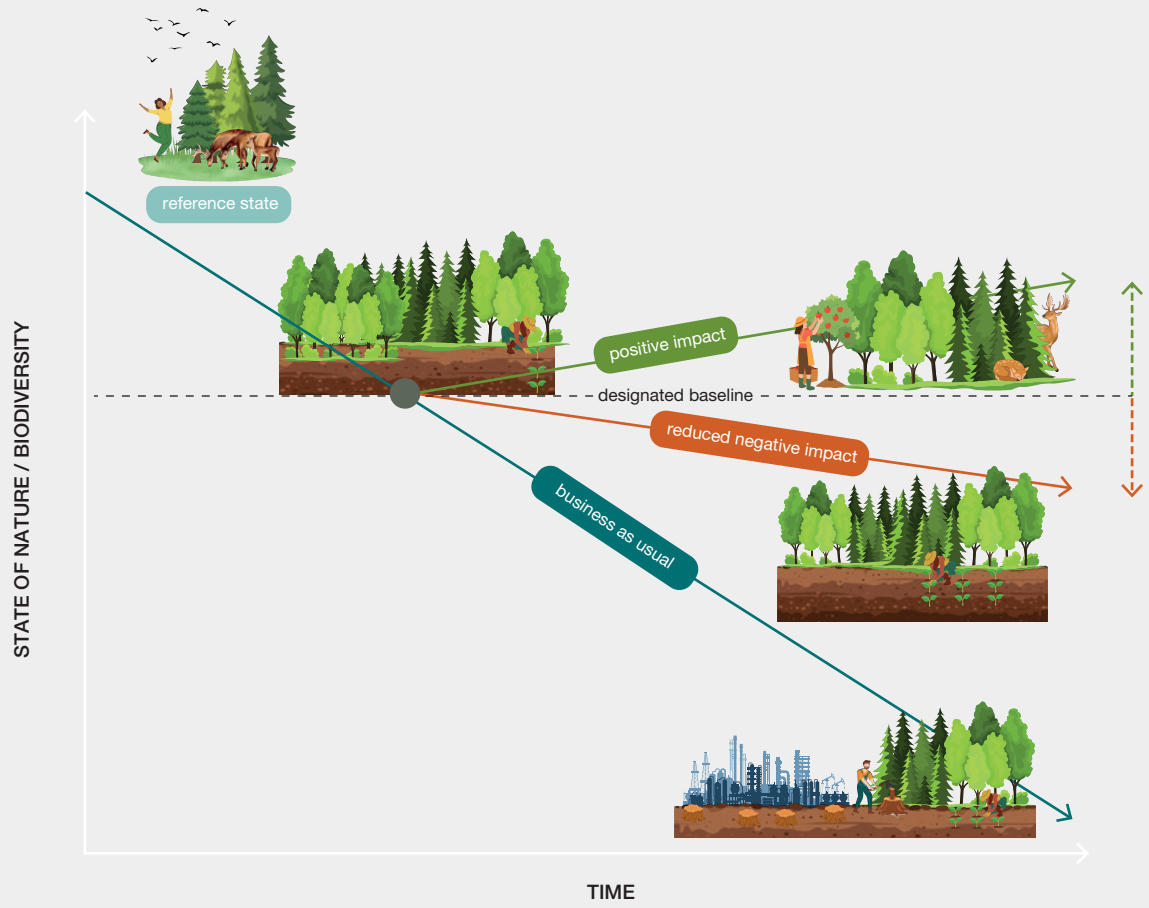


Figure 3 2 **Differentiating positive and negative impacts of business activities on biodiversity.**

Whether the impacts of business activities on biodiversity can be considered positive or negative depends on the baseline conditions against which these impacts are measured (grey dot and dashed line). Activities such as restoration of ecosystems or agricultural practices that enhance biodiversity can have positive impacts (green arrow) that improve the state of biodiversity relative to a baseline of current conditions. Activities that lead to more efficient land use or reduced waste production can lessen the ongoing negative impacts of business activities (orange arrow), leading to improved outcomes relative to a business-as-usual scenario (blue arrow) but without improving the state of biodiversity relative to a baseline of current conditions. When considered against a relatively unimpacted reference state, the impacts of business activities on biodiversity will nearly always be negative.

programs (Bidaud *et al.,* 2017; Owen *et al.,* 2022). This phenomenon, known as the green-green dilemma (Voigt *et al.,* 2019), is emerging as a key social justice issue in climate transition strategies, as nearly 69 per cent of existing or planned critical mineral projects worldwide are located on or near IPLC lands (Stark, 2024).

Interweaving Indigenous and local knowledge with scientific practices and decision-making could provide actionable strategies to safeguard IPLCs from the negative biodiversity impacts of businesses. However, the way this incorporation is sought could itself undermine Indigenous knowledge systems (Gazing Wolf *et al.,* 2024). Corporate-led efforts to respect and learn from IPLCs are also increasing. However, due caution is warranted, as these initiatives can become tools of appropriation. Financial institutions can play a crucial role in protecting IPLCs from business impacts on biodiversity especially by requiring project planners to meaningfully engage IPLCs in project planning and implementation with their free, prior and informed consent (Sperl, 2024).

3.3 HOW IMPACTS ARE IDENTIFIED

3.3.1 Approaches to impact measurement

A large variety of approaches have been developed to identify and measure business impacts (or proxies for impact) on biodiversity and nature's contributions to people. These approaches can be classified according to the same typology of approaches used to measure dependencies (see **Chapter 2**). These approaches can be grouped into five broad categories: biophysical approaches, economic-ecological modelling, participatory mapping and monitoring methods, socio-cultural valuation and monetary valuation **(Table 3.1)**. Biophysical approaches can be further divided into three sub-categories, given differences in their implications for informing decision-making by businesses and others: location-based observations, spatial analysis and modelling and life cycle approaches **(Table 3.1)**. See **Chapter 4** for a more detailed evaluation of these impact measurement approaches and their suitability for informing different decision contexts.

3.3.2 Impact measurement tools available to businesses and investors and their underlying assessment approaches

Approaches for measuring and estimating impacts of business activities on biodiversity and nature's contributions to people **(Table 3.1)** are often combined into tools offering to help businesses, investors and other stakeholders assess impacts of businesses, including their investments. To understand what these tools do, the actual measurement methods and metrics used and how well they deliver on their ambitions, 28 approaches available at the time of this IPBES assessment's initiation were reviewed (January 2024). This chapter refers to all these approaches as tools throughout **Sections 3.3.2** and **3.3.3**, although some offer a framework for assessment, rather than a specific methodology; yet are marketed as 'tools' to the business community.[2] Tools included in the review state an aim to explicitly help businesses and financial institutions measure and report on their impacts on biodiversity or nature's contributions to people.

The selection of tools was based on an initial review of available tools online, starting from the collection of tools listed in the Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions by the EU Business and Biodiversity Platform (Lammerant, 2021) and those listed in the Taskforce on Nature-related Financial Disclosures tool catalogue (TNFD, 2025). These lists were cross-checked against tools assessed in recent academic papers (Damiani *et al.,* 2023; Zhu *et al.,* 2024), and additional tools covered by these publications were added. The 28 tools included in the final review represent a broad range of tools available to the business and investment community for assessing impacts to biodiversity and nature's contributions to people at the time of writing this assessment but are not a comprehensive list. A detailed analysis of individual tools lies beyond the scope of this chapter. The purpose of the review is rather to assess the range of tools, provide an overview of the most commonly used approaches or combinations of approaches (see **Table 3.1**) on which they are based, and briefly discuss the opportunities and pitfalls that these practices give rise to. The review is not intended as a comprehensive list, as the rapid evolution in the space of biodiversity impact assessment of business and finance would quickly make such a list outdated.

3.3.2.1 General trends

Tools were assessed across three dimensions: approach category (following **Table 3.1**), data used and type of output metric. Tools included those focused on providing assessments of biodiversity-related risks to businesses or investments and those assessing impact. A detailed description of each tool, its methodology, the organization(s) behind its development, and intended users and suggested use (by developers) is available in the data management report.[2] This analysis allowed authors to identify patterns regarding the specific dimensions of biodiversity impacts that each approach captured but also patterns in scientific traceability of the methodologies and approaches employed by tools.

Most tools (25 of 28) reviewed aim to provide some form of biodiversity-related impact assessment, while the remainder has a stronger focus on providing biodiversity-related risk assessments. The latter take a business-centric perspective on risk and analyses generally focus on understanding company or investor exposure to biodiversity impacts through their practices or through their supply chains. Risks can include those arising from high business dependencies on biodiversity, but also through reputational, regulatory or market risks related to the use of natural resources (see **Section 3.5**). As such, their primary concern is not with quantifying impacts on biodiversity from biodiversity loss *per se* but rather assessing how these impacts translate into business risk.

Tools vary in the number of drivers or pressures they considered in their analysis. Almost all tools include and are based on terrestrial drivers while freshwater and marine

2. Data management report referring to a review of biodiversity assessment approaches http://doi.org/10.5281/zenodo.12790886

Table 3 1 **Overview of commonly used approaches for measuring impacts of business activities on biodiversity and nature's contributions to people**

Adapted from **Table 2.2** in **Chapter 2**, with illustrative examples of their application from the scientific literature. Note that the approach categories are not mutually exclusive and example applications may integrate methods from across multiple approach categories.

Approaches	Example applications
Biophysical approaches	
Location-based observations	Field sampling used to measure the abundance and diversity of birds, plants, insects and spiders across crop fields of varying sizes in Canada (Fahrig *et al.*, 2015). Satellite imagery used to quantify the direct and indirect impacts of industrial mines on deforestation across the tropics (Giljum *et al.*, 2022).
Spatial analysis and modelling	Different potential power line routes overlaid with environmental and social data layers to measure the routes' impacts on ecologically sensitive and socially complex areas in South Africa (Warner & Diab, 2002). Global modelling of nature's contributions to people and biodiversity combined with asset locations to quantify the direct impacts of corporate assets from over 2,000 businesses (Mandle *et al.*, 2024a).
Life cycle approaches	Life cycle assessment and environmentally extended multi-regional input-output models combined to estimate biodiversity impacts across a global set of 3,000 businesses (Kulionis *et al.*, 2024). Life cycle assessment integrated with spatial modelling to assess the impacts of alternative feedstock sources for bioplastics from the United States of America and Brazil on biodiversity and nature's contributions to people (Chaplin-Kramer *et al.*, 2017).
Economic-ecological modelling	
	Nested multi-regional input-output (MRIO) models used to quantify the impacts of beef production on threatened animal species in Australia through local and global supply chains (Malik *et al.,* 2022).
Participatory mapping and monitoring methods	
	Participatory mapping identified potential impacts of offshore wind farms to local fisheries and marine biodiversity in Brazil (Xavier *et al.*, 2023). Community monitors and scientists collaborated to assess water pollution and its impacts downstream of a coal mine in Zimbabwe (Ruppen *et al.*, 2021).
Socio-cultural valuation	
	Choice experiment focus groups used to elicit ecosystem service and biodiversity values associated with different scenarios of shrimp aquaculture development and mangrove conservation in Vietnam (McDonough *et al.*, 2014). The impacts of petroleum exploitation and agriculture on biodiversity and economically and medicinally useful plants in a forest reserve were documented using perception assessment in Nigeria (Udoma-Michaels *et al.*, 2019).
Monetary valuation	
	Hedonic pricing used to value increases in property values, driven by reductions in local air pollutants and particulate matter from coal-to-gas conversion of power plants in China (Mei *et al.*, 2021). Calculated net present value of public and private benefits of coastal protection and other ecosystem services from conservation of marshes surrounding a manufacturing facility in the U.S. (Reddy *et al.,* 2015).

drivers are less prevalent. Similarly, extinction risk and invasive alien species are inconsistently covered. These findings align with results from recent research on similar sets of biodiversity assessment tools (Strange *et al.,* 2024; Zhu *et al.,* 2024). Using only land as an analytical entry point to assess impact is problematic considering the inherent complexity of biodiversity and the importance of and threats to freshwater and marine biodiversity. Recently, methods have developed to include a greater number of drivers or pressures and integrate them with global extinction risk (Verones *et al.,* 2020).

Most tools have individual businesses as their primary target audience (17 out of 28) and are intended to be used

across various sectors (including agriculture, resource extraction and investments)[3]. Many remaining tools are designed for specific users or sectors and thus have a narrower range of applicability. These tools often have a high degree of scientific traceability, clearly articulated steps and good alignment between stated ambitions and outputs of the approach. Despite this, their specificity and more narrow scope mean they may be less versatile across different contexts, less scalable in their current form and currently not suitable for assessing and comparing businesses globally.

3.3.2.2 Methodological approaches applied

Most tools reviewed rely on a mix of approaches all falling under the broader category of 'biophysical approaches' outlined in **Table 3.1**. Variations of life cycle assessments are the most recurring methodology (10 out of 28) and are prominently represented by biodiversity footprinting tools (9 out of 10). These footprinting methodologies consistently use a combination of life cycle assessments and multi-regional input-output analysis (MRIO) to calculate biodiversity impacts. This has been referred to as 'beyond life cycle assessments' because they add additional methodological components or economic-ecological modelling onto the overall life cycle assessment (Damiani *et al.,* 2023). The biodiversity footprinting tools reviewed have many commonalities. Most can use business-specific data on pressures (drivers of biodiversity change such as land use, water, greenhouse gas emissions or pollution, depending on which life cycle assessment methodology is used). However, the review shows that because of the lack of business-specific asset level data, biodiversity impact assessments commonly use financial data in the form of business revenue reported at the headquarter level. These data are then connected to a multi-regional input-output table to map links to other sectors and estimate the consumption of resources and the emissions associated with each product or revenue stream (often referred to by the tools as 'capturing scope 3'). Such use of revenue data, coupled with multi-regional input-output tables means that estimates of environmental pressures are not spatially explicit. Therefore, while biodiversity footprinting methods could produce results for different locations, as currently used they differ significantly from tools using 'spatial analysis and modelling' **(Table 3.1)** in their inability to deliver meaningful, location-specific information.

Environmental pressures estimated using multi-regional input-output tables are subsequently used as input into a life cycle assessment model. An underlying life cycle assessment method commonly used by reviewed tools is ReCiPe (Huijbregts *et al.,* 2017). More recently developed life cycle approaches for biodiversity footprinting, including LC-IMPAC, cover global extinction risk as well as terrestrial, freshwater and marine pressures, but are not currently employed in the tools examined. Another model commonly used by existing tools is the global biodiversity model for policy support (referred to with the acronym "GLOBIO") (Schipper *et al.,* 2020). This is not a life cycle assessment but is commonly used to derive characterization factors for this analytical step to allow for an estimate of impact in the form of mean species abundance or potentially disappeared fraction of species.

Many footprinting tools rely on the same datasets. The most recurring pre-compiled datasets used by footprinting tools are EXIOBASE (an environmentally extended multi-regional input-output database) and Ecoinvent (life cycle assessment database). Some footprinting tools rely on 'in-house' models or datasets and others require that tool users select which drivers of biodiversity impacts are considered on a case-by-case basis. Others require the user to choose which valuation methods to use. This means the robustness of expected outputs for a particular tool will depend on choices made by the user.

The second most common approach categories used by the tools reviewed are 'location-based observations' and 'spatial analysis and modelling' **(Table 3.1)**, represented by nine tools each. Tools using location-based observations often use land use and habitat as proxies for biodiversity or ecosystem services. Others use indicators against which to assess the operations or estimates of business-specific pressures, such as waste, land, water and other resource use. All rely in some way on business-specific information and thus reduce the issues of sector-generic outputs seen with footprinting tools, which cannot reliably inform actions of individual businesses.

Tools based on spatial analysis and modelling range from frameworks that combine biodiversity, ecosystem condition and natural capital accounting to support decision-making, map changes in ecosystems and how these likely affect the provision and value of ecosystem services or map likely biodiversity impact by overlaying business asset locations with various spatial datasets. Some of the tools in this category, including STAR (Species Threat Abatement and Restoration metric) and IBAT (Integrated Biodiversity Assessment Tool), rely on data extracted from the International Union for Conservation of Nature Red List of Threatened Species. Others, like InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) rely on a combination of biophysical models, land use/land cover (LULC) data and other input data, and ecosystem service production functions from peer-reviewed ecological and economic research. The GLOBIO model, which features strongly in footprinting tools, is also employed in purely

3. Data management report referring to a review of biodiversity assessment approaches http://doi.org/10.5281/zenodo.12790886

spatial analysis to provide impact appraisals of expected location-based activities.

The inclusion of monetary valuation, socio-cultural valuation and participatory mapping and monitoring approaches is limited across the tools reviewed. Only one tool (InVEST) includes monetary valuation approaches. InVEST can provide valuation of some impacts on biodiversity and nature's contributions to people by translating the biophysical outputs of ecosystem service models (e.g., quantity of water purified, coastlines protected, or carbon sequestered) into economic or social values. None of the tools reviewed explicitly incorporate socio-cultural valuation or perspectives of IPLCs, and none differentiate impacts on other vulnerable groups such as the urban or rural poor. However, some aspects of IPLC perspectives and differential social impacts can be incorporated into tools that rely on user-provided information. Several tools on the market also cannot be neatly classified into the approach categories covered in this report but instead tend more toward analysis of action strategies and corporate policy, monitoring compliance against standards and managing reputational risk.

The current landscape of tools available to businesses, investors and other actors for estimating business impacts on biodiversity is diverse. Biophysical approaches and economic-ecological modelling are the dominant methods in the set of tools reviewed, while participatory mapping and monitoring methods and socio-cultural valuation are not represented at all, and only one tool incudes any aspect of monetary valuation. This highlights a divergence in focus between methodologies developed by science for understanding and assessing biodiversity and the methodologies business-oriented tools have thus far incorporated.

3.3.3 Challenges, limitations and potential issues of concern

Across the tools examined, a limited number of drivers or pressures tend to be included, as most tools reviewed assess only land-based impact. There is also limited diversity in the underlying models and datasets used to estimate impacts which means that any concerns or limitations relating to these data sources represent an inherent weakness that is replicated across all biodiversity assessment tools using them.

Tools reviewed here also display significant variability in the degree to which the scientific traceability of methods and assumptions is possible to discern. Some tools are very transparent and clear in their articulation of methodological steps and anchor their baselines clearly in public policy. Others have limited public documentation or are poorly referenced.[4] Broadly speaking, the tools produced by consultancies are more ambiguous in their methodological framework, less rigorously documented and are therefore more difficult to understand and evaluate. These tools often neglect to make explicit the causal connection between the driver they use to assess impact (most often land use change) and biodiversity. Insufficient public documentation also makes it hard to assess the validity of thresholds and indicators chosen and precludes evaluation of how capable the methodology is in delivering on the objectives of the tool. Tools also differ in the baselines they set, and these baselines are often not traceable to a scientific assessment or based on transparent scientific assumptions. Instead, the baseline is often understood to be the first occasion of measurements by a business, or the current state of biodiversity before some intervention.

A key concern pertaining specifically to biodiversity footprinting tools is that, as noted above, their current application often precludes spatially explicit impact assessments due to use of revenue data as inputs, reliance on sector averages and national level trade data. This is a major limitation given that the biodiversity impact of any specific business activity varies greatly based on its location across ecosystems and climate zones (see **Section 3.2.1**). Asset-level information on environmental pressures is therefore a necessary input for footprinting tools and outputs to inform business-specific mitigation goals and development of strategic action plans. Furthermore, the limited sector differentiation in environmentally extended input–output analysis (EEMRIO), and the fact that no positive impact information is currently available in these input-output tables, also means that biodiversity footprinting tools relying on MRIO analysis make identification of business-specific positive biodiversity impacts, and thus business opportunities, unattainable at present.

Against this background, it is noteworthy that tools geared at investors tend to be footprinting methods that do not rely on location-based observations. Several non-footprinting tools targeted at investors do employ some form of spatial analysis by providing opportunities to identify likely impacts and risks by overlaying spatial data with known locations. However, if operation-specific information of portfolio businesses is lacking and MRIO analysis is used to infer sector impacts, the same limitations apply as with footprinting tools.

The reviewed set of tools are also limited in their ability to effectively account for cumulative impacts. Cumulative impacts include direct and indirect impacts, past, present and future, resulting from the actions of all actors, not just the target organization or project assessed. Cumulative

4. Data management report referring to a review of biodiversity assessment approaches http://doi.org/10.5281/zenodo.12790886

impacts may arise from the actions of both public and private agents. This makes it difficult to assess in the context of a particular business. However, such impacts could be assessed at the landscape, watershed, local government, state/provincial or national levels, as part of broader non-organizational specific assessments.

This review of biodiversity assessment tools currently available highlights the need for a set of principles and best practices that all tools should adhere to in order to enable users to measure impacts in a way that can effectively accurately guide actions. These may first and foremost include transparent documentation, including clear scientific traceability and transparency regarding datasets and models used. It is important for tools to make explicit their assumptions about attribution and causality used to infer impact from the drivers or pressures they use to estimate impact. Tools should strive to ensure that there is alignment between the methodologies they employ, the output metric provided and the objectives of the tool. Limitations pertaining to lack of spatially explicit outputs (i.e., sector-generic outputs) for many tools are good examples. The Partnership for Biodiversity Accounting Financials elaborate an extended list of best practices for biodiversity footprinting tools specifically (PBAF, 2024). This can help users ascertain if the tool is best suited for screening potential impacts based on generic classifications of economic activity or for evaluating outcomes. The differences between these purposes and the ability of varying methods to support them are further developed in **Chapter 4**, **Section 4.4**.

When applying these tools, best practices include using asset-level information on location, emissions and resource use from direct operations if disclosed or captured by a business. Emissions and resource use can also be modelled from disclosures of comparable businesses or sectors, but then with added uncertainty of estimated values and with the added drawback of not being able to differentiate impact between businesses in a given sector. Evidence does not support the use of revenue data as a strong input to biodiversity footprinting.

3.4 IMPACTS OF BUSINESS SECTORS ON BIODIVERSITY AND NATURE'S CONTRIBUTIONS TO PEOPLE

3.4.1 Best estimates for the impacts of business sectors on biodiversity and nature's contributions to people

No authoritative estimate currently exists that provides a quantification of the impacts of businesses on biodiversity and nature's contributions to people comparably across a comprehensive range of different sectors and using generally agreed upon metrics. Instead, there are a range of estimates of impacts associated with one or more industrial sectors, based on a variety of the methodologies outlined in **Section 3.3**. Such approaches typically focus on impacts on species, ecological communities and habitats, or measurement of drivers or pressures. They commonly use a combination of life cycle impact assessment and multi-regional input-output analysis or are derived from the International Union for Conservation of Nature Red List of Threatened Species data (IUCN, 2025) and other key global biodiversity datasets. Life cycle approaches aim to capture impacts across the value chain, whereas other approaches capture only the direct impacts of a sector. Relevant metrics in these cases include 'species/year', 'potentially disappeared fraction of species', 'mean species abundance' and metrics such as those based on the International Union for Conservation of Nature Red List of Threatened Species (Mair *et al.,* 2021). The associated data – along with multiple additional datasets, e.g., Projecting Responses of Ecological Diversity in Changing Terrestrial Systems referred to with the acronym "PREDICTS" (Hudson et al., 2014) and landcover data – also provide the basis for risk and materiality tools such as ENCORE. The unit of analysis is typically sectoral or regional (i.e., by geography) and not at the level of individual businesses. It should not be assumed that only big businesses are relevant, or even dominant in terms of impacts. However, a number of the studies focus on the world's larger businesses, e.g., based on the Morgan Stanley Capital International (MSCI) World Index, or Global Fortune 100 (Zu Ermgassen *et al.,* 2022).

Although there are a growing number of methods, approaches and tools for measuring the impacts of businesses on biodiversity **(Section 3.3)**, these have not yet produced a definitive basis for comparison across all, or even most, sectors. Nonetheless, existing estimates provide an understanding of the likely relative impacts compared across those sectors with the greatest impacts

on biodiversity and nature's contributions to people.[5] **Figure 3.3** provides an overview of the outcomes of some such known estimates. These estimates were identified based on a search of the scientific and grey literature for estimates based on the methodologies outlined in **Section 3.3**, with requirements for inclusion being that (a) estimates were quantitative, (b) two or more defined sectors were judged using a comparable methodology and (c) the results were accessible.

Overall, the comparison across sectors in **Figure 3.3** provides support for the widely held view that sectors are not equally responsible for biodiversity loss. Existing quantitative studies consistently identify the agriculture, forestry and fishing sector (which includes all agricultural commodities) as a key driver of biodiversity loss, with studies assessing impacts focusing primarily on agriculture and forestry, and sometimes aquaculture. Energy (the electricity, gas, steam and air conditioning supply sector, although studies primarily assess electricity, oil and gas), construction, mining and quarrying, transportation and storage, and manufacturing are often highlighted as high impact sectors as well. There are important nuances and limitations to these assessments, such as the degree to which attribution for biodiversity impacts can be considered to rest fully with primary industries that support other sectors throughout the value chain, which are discussed further below.

3.4.1.1 Sector-level estimates from existing tools and methodologies

In **Figure 3.3**, estimates are split into those focusing on negative impacts to biodiversity and on materiality. Each category is discussed in more detail in turn.

The agriculture, forestry and fisheries sector is consistently identified as one of the sectors having the highest negative impact on biodiversity across many estimates. This is logical, given the spatial extent of agricultural activities and the contribution of land use change to species threat (Maxwell *et al.,* 2016), as well as the sensitivity of some indicators to spatial pressures. For example, mean species abundance is a function of human pressures including land use, fragmentation and hunting, alongside three other pressures; see Kok *et al.* (2014). Manufacturing and utilities (energy and water) also have a relatively high impact on biodiversity across estimates, including across multiple biodiversity footprinting approaches (e.g., Finance for Biodiversity Foundation, 2024), which considers four different biodiversity footprinting approaches: the Biodiversity Impact Analytics powered by the Global Biodiversity Score (BIA-GBS) tool; the Corporate Biodiversity Footprint tool; the Biodiversity Footprint Financial Institutions tool; and the Global Impact Database tool; see **Section 3.3** and **Figure 3.3**). It is equally important to consider the gaps in these assessments: none comprehensively includes all sectors in the International Standard Industrial Classification (ISIC), leaving considerable areas for further evaluation **(Figure 3.3)**.

Similarly, for impacts based on the International Union for Conservation of Nature Red List of Threatened Species, agricultural activities and hunting again represent the largest impacts, followed by others associated with substantial impacts on biodiversity such as energy and the construction sector (Irwin *et al.,* 2022; Mair *et al.,* 2021; Maxwell *et al.,* 2016). Red List data are mature, well-established and useful for many applications, representing one of the larger global biodiversity datasets available and enabling analyses based on the STAR metric **(Section 3.3)**. However, Red List data are not taxonomically complete and species assessments can lag substantially behind actual trends. Efforts are underway to broaden International Union for Conservation of Nature Red List of Threatened Species coverage across taxonomic groups and biomes to reduce such knowledge gaps. These include Red List assessments of all reptiles (Cox *et al.,* 2022) and freshwater fishes, decapod crustaceans and odonata (Sayer *et al.,* 2025). Some high impact sectors are currently under-represented as pressures contributing to the Red List. For example, the impacts of sand mining on threatened species has been a gap on the Red List (Torres *et al.,* 2022). The existence of such sectoral 'unknown unknowns' is important to consider more generally when interpreting sector-level estimates of biodiversity impacts.

An important consideration across the above estimates based on different methodologies is the issue of scope. For instance, life cycle impact assessment approaches consider both direct impacts and supply chain impacts and in some cases those across the full value chain. Conversely, the estimates based on Red List data (including the STAR metric) consider primary direct threats from the perspective of the relevant species, attributing threads to the primary industries (e.g., agriculture, extractive sectors) and not considering the sectoral end-users of the commodities produced by the primary industries. Addressing this, Irwin *et al.* (2022) linked STAR to the EORA multi-regional input-output database to estimate sectoral contributions towards extinction risk embodied in international trade flows (see the summarized results also in **Figure 3.3**). Another consideration is that leading approaches for estimating impacts on biodiversity and nature's contributions to people for different sectors, as outlined above, are focused on negative impacts. The Red List focuses only on species threat. Life cycle assessment approaches focus on reduction in biodiversity, which means when applied to agriculture, these would consider how pressures from

5. Data management report referring to the review of cross-sector biodiversity impact estimates http://doi.org/10.5281/zenodo.17238915



Figure 3 3 **Relative sector-level impacts from studies providing cross-sector estimates of impacts on biodiversity.**

Studies were selected according to inclusion criteria in the main text and re-categorized against the International Standard Industrial Classification of All Economic Activities (United Nations, 2008). Each source of analysis is given one column; the colour scheme provides a qualitative illustration of the relative impact or materiality by sector as extracted from that analysis. Darker shades indicate higher estimated impact within a study; white indicates sectors that were not assessed. Sectors are listed according to their weight across studies (high = 3, intermediate = 2, low= 1, not assessed = 0). Sources **(A)** AGCS (2018); **(B)** Irwin *et al.* (2022); **(C)** Finance for Biodiversity Foundation (2022); **(D)** Sun *et al.* (2022); **(E)** UN Environment Programme *et al.* (2020); **(F)** Maxwell *et al.* (2016); **(G)** CDC Biodiversité (2021a, 2021b, 2022b, 2022a, 2023c, 2023a, 2023b); **(H)** Mair *et al.* (2021); **(I)** CBD (2014); **(J)** Salafsky *et al.* (2025); **(K)** Natural Capital Finance Alliance & UN Environment World Conservation Monitoring Centre (2018).

agriculture reduce global biodiversity, but not capture any gains achieved within production landscapes. While it is clear that the agriculture, forestry and fishing sector have major negative impacts on biodiversity, existing studies have not captured to what extent this sector provides opportunities for biodiversity gain relative to current conditions and crucially, how that relates to opportunities in other sectors.

Similar sectors identified as having high impact are also identified as having high materiality. Materiality in this context follows the definition of the Taskforce on Nature-related Financial Disclosures (TNFD, 2023): how 'dependencies and impacts on biodiversity create risks and opportunities for an organization's financial position and prospects' (financial materiality, based on the International Financial Reporting Standards definition) and in terms of the 'information needs of stakeholders focused on impacts' (impact materiality, based on the Global Reporting Initiative definition). ENCORE (ENCORE, n.d.), a widely used tool for understanding materiality to businesses, rates materiality from low to very high across a range of sectors. Agriculture, forestry and fishing again rank most highly in terms of materiality (NCFA & WCMC, 2018). These are followed by the energy and water supply sectors and, to a lesser extent, mining and quarrying.

3.4.1.2 Other sector-level proxies for impact

Sector-level estimates of drivers of biodiversity change – such as land and sea use, direct exploitation of organisms, climate change, pollution and the introduction of invasive alien species – can also provide an indication of biodiversity impacts (e.g., Kulionis *et al.,* 2024). It is important to emphasize that these are either drivers or pressures, and can be useful proxies for biodiversity impact, but cannot be used to directly measure a change in the state of biodiversity or nature's contributions to people. For example, energy, transport, industry (production of materials such as metals, chemicals and cement) and agriculture/forestry are broadly responsible for greenhouse gas emissions as a driver of biodiversity loss (e.g., Lamb *et al.,* 2021). In turn, this supports the conclusions based on biodiversity metrics above. In some life cycle assessment analyses, greenhouse gas emissions have been seen to be closely correlated with biodiversity impacts – however, this tight correlation is only the case for a very specific set of economic activities and also may largely be due to limits in data availability related to the links between business activities and the other four main drivers of biodiversity change (e.g., Bull *et al.,* 2022).

Sector contributions to land use change provide another proxy for biodiversity impacts. Spatial area alone (e.g., of different habitat types, land uses) is not a good representation of biodiversity value, but – especially given the importance of land use change as a contributor to biodiversity loss – spatial analyses can provide indispensable proxies. As part of this, it is worth noting the increasingly influential role that Earth observation approaches are playing in tracking biodiversity impacts and dependencies, and the potential they have going forward, for example in relation to the Essential Biodiversity Variables (Skidmore *et al.,* 2021). With sufficient access to sectoral value chain data and further development of appropriate biodiversity proxies, the potential applications of spatial analyses based on Earth observation approaches are considerable. Such spatial approaches run the risk of overweighting the impacts of agriculture and forestry, with urbanization, construction and civil infrastructure also presenting major global land uses (FAO, 2022). Simple spatial approaches also have some important caveats, not least that some sectors have substantial impacts with disproportionately small spatial footprints, such as the oil and gas or mining sectors, and major linear infrastructure. It can also be difficult to attribute land use change to certain sectors, such as finance and insurance.

3.4.2 Gap analysis

Information from existing assessments of sector-level business impact on biodiversity **(Figure 3.3)** demonstrates that multi-sector analyses are far from comprehensive. Having consistent analyses across all sectors will require filling gaps for certain sectors. This could also involve using multiple metrics to estimate impacts, to account for differences in scope, emphasis and methodology.

In addition, there is a notable gap in sector-level assessments of impacts on nature's contributions to people. Despite numerous assessments of the impacts of policies and scenarios on nature's contributions to people (e.g., Chaplin-Kramer *et al.,* 2019; Pereira *et al.,* 2024) business impacts on nature's contributions to people are less frequently assessed, whether at the level of individual business activities or sectors (but see Chaplin-Kramer *et al.,* 2017; Mandle *et al.,* 2024), and such assessments have not yet produced estimates that allow for a global comparison across sectors. Those sectors that might be prioritized for future research could include those with largest environmental impacts or those most critical to global value chains.

These knowledge gaps arise from several factors. First, business reporting of impacts does not sufficiently disclose impacts in value chains, whether highly material to the organization (e.g., in terms of physical or transition risks), or less material to the business but important to biodiversity. In turn, data from businesses and sectors

cannot at present give an accurate assessment of the scale and magnitude of biodiversity impacts, beyond broad generalized patterns shown above. Second, many measures used to assess biodiversity (see **Section 3.3**) – and drivers of biodiversity loss – are best understood in relative rather than absolute terms. Eventually it will be necessary to move more consistently towards measurement of absolute impacts and dependencies (i.e., change in the state of biodiversity against a fixed baseline). This would not only facilitate wider benchmarking of impacts across sectors but would also be consistent with the concept of seeking biodiversity recovery in absolute terms as per the Kunming-Montreal Global Biodiversity Framework. Finally, many business disclosures are centred around drivers of biodiversity change, not the state of biodiversity itself and are not generally connected to theories of change that connect the drivers or pressures to change in the state of biodiversity. This is not inherently inappropriate, given the multidimensional nature of biodiversity and nature's contributions to people and therefore the multiplicity of ways in which they can be assessed. However, sector-specific standardized disclosures, combined with georeferencing, could generate the data needed for estimates of sector-level biodiversity and impacts on nature's contributions to people.

Overall, existing methods, approaches and tools currently provide the ability to measure the relative impacts of business on biodiversity and nature's contributions to people. The challenge now is to extend existing analyses comprehensively across all sectors, at scales from individual businesses to sectors and beyond and to evaluate impacts on nature's contributions to people from businesses more extensively. Global spatial datasets exist on land uses for agriculture, mining, forestry, built infrastructure and other key sectors, which could be combined with biodiversity data to estimate impacts (although access to both sectoral and environmental datasets in terms of restrictions and the cost for licensing data, for some organizations, is an important emerging issue). In turn, these could be combined with input-output models to enable further estimates of the proportional distribution of impacts along value chains. An important element of all such analyses would be to capture assumptions made and associated uncertainties in estimating relative impacts, both within and between different methods applied. Nonetheless, knowledge gaps cannot be an excuse for inaction, as it is already clear that some specific sectors are major drivers of biodiversity loss due to their land use needs or physical resource requirements. This concern calls for fair and transparent reporting that addresses remaining gaps in reporting about the impacts of businesses on biodiversity.

3.4.3 Sector-level information on positive impacts of businesses on biodiversity and nature's contributions to people

Efforts towards the Kunming-Montreal Global Biodiversity Framework's 2030 mission to put in place actions to halt and reverse biodiversity loss must begin with mitigation of the negative impacts discussed above. However, existing assessments generally do not incorporate estimates of positive impacts that business activities might have on biodiversity or nature's contributions to people. Positive impacts could include restoration actions (e.g., sustainable sourcing strategies, directly or via investment in biodiversity credits), restorative business models (e.g., agricultural practices that increase biodiversity or carbon sequestration), or as a result of nature-based enterprises for which biodiversity is a core focus (e.g., ecotourism). Biodiversity commitments have increasingly become a major aspect of corporate sustainability programmes (Lamont *et al.,* 2023; zu Ermgassen *et al.,* 2022a).

Positive impacts from businesses on biodiversity might include biodiversity enhanced or restored in production landscapes or landscapes managed for defense purposes (Qin *et al.,* 2024). Some sectors may build business models around nature conservation and restoration, such as ecotourism and other recreational activities. Other businesses can reduce pressures on biodiversity through their core business, such as renewables businesses diverting energy use away from hydrocarbons (Sonter *et al.,* 2024) or agricultural commodities diverting consumption away from animal products (Poore & Nemecek, 2018). A key issue is, however, the choice of baseline (Maron *et al.,* 2018). For instance, renewable energy production may reduce biodiversity impacts in contrast to other forms of energy production but will still have some biodiversity impacts, so the choice of baseline determines whether the outcome of transitioning to renewable sources can be considered positive or less negative for biodiversity (Sonter *et al.,* 2024).

In the case of nature's contributions to people, the IPBES Global Assessment showed that business activities have increased material contributions that produce marketed goods, as evidenced by the increases in agricultural production, fish harvesting, bioenergy production and the harvest of other natural materials over the past 50 years (Brauman *et al.,* 2019). However, given global declines in the other 14 categories of nature's contributions to people assessed, these increases in certain material contributions are associated with losses of regulating and non-material contributions, such as pollination, pest regulation and soil quality. Regulating services are in decline partly as they are not typically priced or factored into economic activities and

are more challenging to measure than natural capital stocks. Another priority is to improve their measurement.

Positive impacts of businesses on biodiversity and nature's contributions to people are not typically captured in any systematic way and impacts of this type are currently small in comparison to the negative impacts of business activities (UNEP, 2023). However, given both the potential and the necessity in relation to global policy of achieving positive impacts from businesses, these deserve more detailed consideration. One example of a means for capturing the full range of negative and positive impacts associated with businesses and biodiversity is provided by the Mitigation and Conservation Hierarchy (Milner-Gulland *et al.,* 2021), relevant to structuring a nature positive economy as envisioned under the Kunming-Montreal Global Biodiversity Framework. Positive impacts will need to be understood and assessed alongside negative impacts to support a transition to an economy that delivers positive outcomes for biodiversity and nature's contributions to people (Leclère *et al.,* 2020; zu Ermgassen *et al.,* 2022a).

3.4.4 The informal economy and illegal activities

The biodiversity impacts of the informal economy and illegal activities are substantial. The informal economy includes economic activities that are not regulated by the government, often lacking formal contracts, worker protections or taxation, such as small-scale farming, artisanal fishing, traditional crafts, street vending and other small-scale enterprises. Although the extent of informal and illegal mining is uncertain and varies by commodity and by geography (Maus & Werner, 2024), these activities have contributed to deforestation and to heavy metal pollution such as mercury and lead in soil, water and fish, harming the health of people relying on those resources (Caballero Espejo *et al.,* 2018; Martinez *et al.,* 2018; Ofosu *et al.,* 2020). Deforestation and forest degradation from charcoal production has received much attention, especially in Africa, although the magnitude of impacts have been debated (Branch *et al.,* 2022; Chidumayo & Gumbo, 2013). Many studies (reviewed in Ticktin, 2004) show that harvest of non-timber forest products, which may occur as part of informal economic activities, can affect ecological processes at many levels, from individual and population to community and ecosystem, with effects mediated by environmental conditions and management practices. IPLCs often engage in informal economic activities due to a combination of social, economic, cultural and regulatory factors, including exclusion from formal institutions (Williams *et al.,* 2015). IPLCs also are susceptible to harms from the negative impacts of the informal economy and illegal activities on biodiversity and nature's contributions to people, given their close interrelationship with biodiversity.

The extent to which the impacts of the informal economy or illegal activities are included in global sector-level estimates discussed previously in this section or captured by the approaches and tools described in **Section 3.3** will depend on the methods used. The interface between the formal and informal economy and illegal activities is important to consider, given flows of materials between them. The informal economy's impacts are not easily traced or quantified through official statistics and data due to their informal status. The same is true for many illegal activities. Methods that rely on remote sensing for measuring the impact of activities, such as agriculture, mining or logging, can capture the impact of some informal or illegal activities but may not distinguish them from activities that are part of the formal economy.

3.5 CONNECTIONS TO DEPENDENCIES, RISKS AND OPPORTUNITIES

In addition to businesses' impacts on biodiversity, businesses depend on a wide range of nature's contributions to people for their operations (see **Chapter 2**). These impacts and dependencies are interlinked, and the way businesses choose to manage their impacts and dependencies influences their risk and opportunity landscape. Mismanagement of dependencies can lead to significant negative impacts on both biodiversity and nature's contributions to people and on the business itself. On the other hand, effective management of business dependencies on nature's contributions to people can lead to a range of positive impacts. Furthermore, business impacts can affect their own dependencies, creating a feedback loop that can either enhance or undermine a business's sustainability and operational resilience. By understanding these pathways, businesses can take action to mitigate risks, enhance their resilience and pursue new opportunities.

3.5.1 Relationship between business impacts and dependencies on biodiversity and nature's contributions to people

While business dependencies on biodiversity are vital for their operations, if operations lead to environmental degradation and biodiversity loss, they may result in risks that make the business vulnerable. Such activities may lead to biodiversity loss with consequences for resilience of ecosystems and lead to changes in nature's contributions to people, with consequences for society. This is because businesses use natural resources, produce or consume

products, own and manage areas of land, or finance other activities which have direct and indirect impacts on biodiversity. Businesses that rely on natural resources such as timber, fish, water and minerals may face scarcity due to over-exploitation, deforestation, overfishing and climate change. Industries such as forestry, pharmaceuticals, cosmetics and fisheries depend directly on biodiversity and also affect biodiversity through direct exploitation, habitat loss and pollution, ultimately affecting IPLCs (Mäkelä, 2017). For businesses that depend on nature's contributions to people such as pollination, water purification and soil fertility, whether directly or through their value chains, degradation of these benefits can lead to consequences including decreased agricultural productivity, higher water treatment costs, higher costs of inputs and lower overall efficiency. In the Dutch economy for example, over 45 per cent of the biodiversity losses related to business supply chains occur upstream of the direct suppliers (Wilting & Van Oorschot, 2017).

3.5.2 Nature-related business risks

Biodiversity loss has the potential to create business risks. This is the case whether these losses arise from a business's impacts on resources it depends on such as unsustainable harvest; business impacts that occur separate from its dependencies, such as from pollution or land conversion; or losses resulting from activities outside the business's value chain. A recent analysis showed that in the Dutch economy, 36 per cent (€504 billion) in investments held by Dutch financial institutions are highly or very highly dependent on one or more ecosystem services (Retsa *et al.,* 2020).

Potential threats posed to businesses that arise from their or wider society's dependencies and impacts on biodiversity are referred to as nature-related risks (see **Chapter 1**). Such risks can be categorized as physical risks, transition risks and systemic risks.

Nature-related physical risks are risks associated with a change in the state of nature or biodiversity on which a business depends or is impacted by. These risks are usually location specific and can be acute or chronic. Acute physical risks occur as the result of specific, short-term events related to a change in the state of nature or biodiversity, such as crop pest invasions, flooding or wildfires. Pest and pathogen invasions are globally responsible for 40 per cent loss in crop yield and the disruption of species composition and structure of forest ecosystems that may affect businesses (Montgomery *et al.,* 2023). For example, in 2020, the desert locust invaded the eastern African region putting at risk the economies of six nations and over 20 million people who faced severe acute food insecurity (FAO), 2020). Since locust outbreaks often follow floods and cyclones, such invasions may accelerate due to climate change (UNEP, 2021). This type of acute risk is therefore a significant threat to businesses that focus on cultivating, producing, or managing a single type of crop, plant species, or livestock. Among the acute nature-related risks, flooding is the costliest causing over €70 billion of economic losses globally in 2021 alone, and directly impacting households and businesses through the destruction of their assets (reviewed in Endendijk *et al.,* 2024)). Flooding also has indirect ripple effects for society by destroying infrastructure and interrupting business processes and financial markets.

Chronic physical risks are related to gradual changes to the state of biodiversity. For example, invasive alien species may cause chronic risks through disruption of ecosystems. The Asian carp pose significant threat to commercial and recreational fisheries of the Great Lakes of North America (Stern & Upton, 2017). In contexts of water scarcity and/or competing water uses, access to fresh water can be a challenge. Inadequate mine water management involving high withdrawal, low rates of water reuse and discharge of contaminated water can heavily impact local water resources availabile to other businesses, as well as to IPLCs and other vulnerable groups (Lèbre *et al.,* 2020).

Nature-related transition risks are the financial and strategic challenges that organizations face when not adapting to triggers prompted by changes related to policy, technological changes, shifts in consumer or investor sentiment and disruptive business model innovation (TNFD, 2023). Transition risk can be further subdivided into policy risk, market risk, technology risk, reputational risk and liability risk. Changes in the policy environment may arise from the creation of new policies or enforcement of existing policies to create positive influence or mitigate negative impacts on biodiversity. Businesses may face higher costs to comply with new policies, such as requiring investments in cleaner technologies, sustainable practices or reporting frameworks. Increasing regulatory pressures may impose significant additional costs on businesses, such as carbon taxes (Becker *et al.,* 2013; Chen *et al.,* 2022). Perhaps most directly, businesses face market risk when loss of biodiversity or nature's contributions to people affects their ability to produce and sell goods and services, such as through disruption of supply chains and increasing costs of operations. This loss could be a result of a business's impacts on a resource on which it depends, such as unsustainable harvest or extraction, or it could result from the negative impacts of other actors. Businesses may also face market risk if customer or investor preferences shift in favour of products or brands perceived to have a more positive or less negative impact on biodiversity. Reputational risk includes social license to operate and brand value. Businesses with negative impacts on biodiversity or nature's contributions to people risk the erosion of goodwill from conscientious consumers who are increasingly demanding

sustainable practices. Liability risks for businesses arise from factors such as increased regulation and litigation. Governments are increasingly imposing regulations related to biodiversity, potentially leading to additional costs for non-compliant businesses. Non-compliance can result in fines, litigation and reputational damage.

Systemic risks are risks to a business that arise from the breakdown of the entire system and include ecosystem stability risks and financial stability risks. Climate change, land degradation and pollution are systemic risks destabilizing ecosystems and disrupting business operations. Events such as extreme weather, pandemics and geopolitical shocks further strain natural systems and reveal the vulnerabilities of businesses that rely on them (Dasgupta, 2021). Financial instability – from market volatility and debt crises to geopolitical turmoil – also heightens these risks. During fiscal stress, some businesses may cut back on sustainability investments or exploit natural resources more heavily to protect short-term profits (UNEP *et al.,* 2021). This behaviour can speed up biodiversity loss and ecosystem degradation, threatening long-term financial stability by undermining nature's contributions to people that many sectors depend on. Incorporating ecological risk into financial decision-making is therefore vital to break this harmful cycle.

3.5.3 Nature-related business opportunities

Nature-related business opportunities arise from opportunities to develop new products and services, as well as from management of impacts, dependencies and risks. Businesses have the potential to gain a competitive edge by addressing biodiversity loss through integrating sustainable use into their core strategies, driving innovation in products, services and business models. Investments in protection, restoration and sustainable land management can provide cost-effective alternatives to grey infrastructure, while also improving ecosystem resilience (Grima *et al.,* 2020; Vicarelli *et al.,* 2024). Where new regulations or voluntary commitments lead businesses to track their impacts on biodiversity, this can open up new business opportunities to meet the demand for monitoring and reporting, such as utilizing technology to monitor and manage biodiversity impacts through satellite imaging, artificial intelligence or blockchain for supply chain transparency.

Some nature-related business opportunities represent the flip side of nature-related transition risks. For an example of a market opportunity, businesses supporting biodiversity that develop innovative products and services could attract environmentally conscious consumers and tap into emerging markets. There are reputational opportunities, such as the potential for businesses to improve their value proposition and brand by responding to the growing public demand for products that minimize harms or have a positive impact on biodiversity, hence fostering consumer loyalty. Businesses that comply with regulations or anticipate forthcoming regulation can avoid litigation and minimize regulatory costs. Finally, biodiversity-focused businesses may find it easier to secure capital or have access to new sources of funds due to their good environmental performance.

3.5.4 Intersection of impacts, dependencies, risks and opportunities for businesses with Indigenous Peoples and local communities

Nature-related risks faced by businesses are multifaceted and are intrinsically linked to their dependencies and impacts on ecosystems, as discussed above. These interlinkages can also have a significant impact on IPLCs and their businesses, which are often deeply connected to biodiversity (Sarkki *et al.,* 2023).

When businesses harm biodiversity – whether from overexploitation of natural resources on which a business depends or through impacts such as pollution or deforestation – IPLCs who also depend on that biodiversity may lose access to traditional economic activities and experience harms to livelihoods and well-being. For example, many agricultural practices harm ecosystems and affect society at various scales, including IPLCs affected by pesticides in drinking water, loss of land for traditional food production, food security concerns and reduced resilience to climate change (Laxman & Ansari, 2023; Liu *et al.,* 2013; Parks & Tsioumani, 2023).

Business activities aimed at managing nature-related risks and minimizing or reversing impacts on biodiversity can also affect IPLCs. For example, as previously discussed in **Section 3.2**, biodiversity offsets meant to mitigate a business's impacts on biodiversity can prevent local communities from accessing that land and biodiversity (Bidaud *et al.,* 2017). However, there are opportunities for businesses to mitigate the impact of their core business activities by working with local communities in ways that enhance biodiversity and livelihoods, such as by supporting more sustainable grazing practices (Ruckelshaus *et al.,* 2019).

Collaborations between IPLCs and businesses and interweaving of Indigenous and local knowledge with business practices present an opportunity for addressing business dependencies, impacts, risks and opportunities in line with a more just and sustainable future. For example, revitalization of Indigenous agricultural systems, such as

agroforestry, holds the potential to improve food security, enhance biodiversity and strengthen the well-being of Indigenous communities (Kurashima *et al.,* 2019).

The intersection of business impacts, dependencies and risks poses a complex and multifaceted challenge that requires holistic solutions and sustainable practices informed by both social and natural sciences and with specific considerations for Indigenous and local knowledge (Hill *et al.,* 2020).

3.6 IMPLICATIONS OF BUSINESS IMPACTS FOR DECISION-MAKING

Businesses' impacts on biodiversity and nature's contributions to people are multidimensional, whereby multiple pathways drive changes in the state of biodiversity **(Figure 3.1)**, different impact typologies are used **(Section 3.2)**, numerous tools and metrics are available **(Sections 3.3** and **3.4)** and the inter-relations between impacts, dependences and risks may vary between value chains **(Section 3.5)**. This complex set of circumstances creates a range of potential implications, which vary across different groups of stakeholders and rights holders.

These inherent challenges make it hard to provide a robust, comparable and quantitative assessment of the impacts of businesses and different business sectors on biodiversity and nature's contributions to people. This then potentially limits the ability to design and implement interventions needed by different stakeholders to effectively reverse the negative impacts and manage business activities required to achieve the 2050 Vision for Biodiversity. Based on the literature review and the key findings from this assessment, implications for each stakeholder group are discussed and summarized in **Table 3.2**.

3.6.1 Implications for governments

Governments, from local to national, are responsible for introducing and implementing appropriate and effective policies and regulations to address the drivers and pressures that impact the state of biodiversity resulting from business activities (Ferraro & Failler, 2024), as summarized in **Table 3.2**. Governments also face the need to balance economic and social outcomes with sustainable development and the integration of the three objectives of the Convention on Biological Diversity and the goals and targets of the Kunming-Montreal Global Biodiversity Framework into national plans and sectoral policies. Governance quality is an important determinant of biodiversity loss, deforestation rates, protected area effectiveness and poaching (Barnes *et al.,* 2016; Burn *et al.,* 2011; Smith *et al.,* 2003; Umemiya *et al.,* 2010). Policy and governance tasks are challenging given the complexity and multiple pathways in which business activities contribute towards the drivers of biodiversity loss.

To be effective in addressing the impacts of businesses, the integration of business impact measurement and metrics across branches of government could be advanced to systematically capture knowledge regarding pressures on biodiversity from business activities, and to contribute to policy coherence (Fopa Tchinda & Talbot, 2024). Similarly, policy experiments that trial different systems of incentives or monitoring approaches (e.g., Bowles & Carlin, 2021) could generate practical experiences akin to real-world learning laboratories with higher likelihood for transforming the sector and associated stakeholders (Schlüter *et al.,* 2023).

3.6.2 Implications for businesses

Appropriate mechanisms are needed for measurement and to incentivize businesses to make improvements to current modes of operation. Evidence points to significant knowledge gaps, implying that businesses are not implementing such actions (as summarized by Caro-Gonzalez *et al.,* 2021).

Businesses need reliable and accurate data, particularly related to operations, and tools to better understand their impacts **(Section 3.4)** and to understand the linkages between impacts, dependencies, risk and opportunities **(Section 3.5)** (Carvalho *et al.,* 2023). Both are critical to be able to set quantifiable incremental targets and implement adaptive management actions to drive transformative change (Addison *et al.,* 2018; Bull *et al.,* 2014; De Silva *et al.,* 2019). Failure of businesses to measure and assess these impacts and dependencies also potentially undermines their ability to assess the resilience of their business models and strategies to manage biodiversity and impacts on nature's contributions to people, and their subsequent ability to deliver goods, services and financial returns. This failure will limit the capacity to operate within the boundaries of goals and targets of global frameworks (Kopnina *et al.,* 2024), while respecting the rights and inter-relationships with IPLCs (IPBES *et al.,* 2023).

A key tool by which businesses assess their biodiversity impacts and to a lesser extent dependencies, is through environmental and social impact assessments. However, environmental and social impact assessments alone cannot resolve global challenges of biodiversity loss and deterioration of ecosystem services. Typically, substantive trade-offs arise where negative impacts on biodiversity remain at the end of the environmental and social impact

Table 3 2 **Summary of the implication of business impacts on biodiversity for different stakeholder and rights holder groups.**

Implications are derived from various sources summarised in the text.

	Governments	Businesses	Financial institutions	Civil society and consumers	Indigenous Peoples and local communities
Value and relationship with biodiversity	Transactional: impact & dependence	Transactional: impact & dependence	Transactional: impact & dependence	Cultural and transactional: dependence	Mutual interrelationship
Impact on stakeholders from business pressures on biodiversity	Natural capital erosion and loss or degradation of nature's contributions to people that lead to economic costs, restrictions on growth and societal wellbeing. Loss of public goods at the expense of private benefits. Governance capacity loss and increased likelihood of policy failures.	Increased financial risks. Disruption to supply and revenue due to loss or damage to natural capital. Reputational damage.	Increased financial risks and reduced rate of return on investments. Potential for stranded assets. Reputational damage. Market uncertainty.	Increased cost of living. Cultural ecosystem services loss. Increasing dis-connect with biodiversity. Life quality and well-being loss. Loss of biodiversity and financial option value (intrinsic and time value).	Direct impacts to ecosystem services used or upon which IPLCs relate. Cultural and spirituality impact. Life quality and well-being loss. Loss of access. Loss of biodiversity option value.
Implications on the methodologies used to assess impacts to each stakeholder group	Insufficient inclusion of macro-economic impacts, measures and understanding of the effectiveness of decision-making policies and regulations in driving businesses to reduce biodiversity impacts. Need for consistent approaches and metrics in assessing and managing direct and indirect impacts.	Insufficient data or knowledge to inform business decision-making. Need to better assess and quantify direct, indirect and cumulative impacts.	Inadequate information to de-risk decisions due to insufficient comparable data on indirect and direct impacts at the company level across sectors. Lack of detailed understanding of the potential cumulative and in-combination risks across multiple investments.	Lack of inclusion of the impact (including health and wellbeing) in retail prices. Inability to recognize or understand business impacts on biodiversity. Insufficient information for informed consumer choice. Inability to determine whether there is fair distribution of costs and benefits of biodiversity loss.	Lack of inclusion of biodiversity-related cultural and spiritual values into assessments of business impacts on biodiversity. Incapacity to determine and address trade-offs.

assessments process Gallardo & Bond (2023). In addition, due attention should be given to power imbalances and information asymmetries when IPLCs are involved as their traditional systems may suffer irreversible losses (Athayde *et al.,* 2019; Heiner *et al.,* 2019).

While there are few reviews on the effectiveness of environmental and social impact assessments globally, numerous projects or regional studies have illustrated their limited effectiveness (e.g., Kahangirwe & Vanclay, 2022; Omenge, 2023). No impact methodology or assessment fully takes into consideration the complexities of ecological systems (e.g., biodiversity, ecosystems, taxonomic groups and essential biodiversity variables classes) (Damiani *et al.,* 2023). In their imperfection, environmental and social impact assessments can also be politically manipulated and rendered ineffective: not learning from past mistakes continues to undermine the potential good environmental and social impact assessments can do (Athayde *et al.,* 2019).

More recently, the increasing number of disclosure frameworks and standards (e.g., Taskforce on Nature-related Financial Disclosures, European Union Corporate Sustainability Reporting Directive, Carbon Disclosure Project (CDP), Global Reporting Initiative), benchmarking (Nature Action 100, GIST), as well as an increasing number of agencies rating business performance in relation to biodiversity (e.g., Morgan Stanley Capital International, Sustain Analytics) (Billio *et al.,* 2021) has been driving businesses to better understand their biodiversity impact. Yet, details on disclosures related to how businesses assess impacts can be limited (Machado *et al.,* 2021), and there is restricted progress towards adopting measurable, time-bound commitments (zu Ermgassen *et al.,* 2022b). Challenges associated with how businesses understand and act on biodiversity impacts are discussed further in **Annex 3.1**.

Scenarios and the application of the IPBES Nature Futures Framework (Durán *et al.,* 2023) can be a key tool for businesses to enable understanding of ways to measure and assess potential business impacts, business resilience and options for action by decision makers. Scenarios may be used to identify potential biodiversity impacts resulting from different investment decisions or business activities, which may then be used to determine the resilience of a business, its strategies, identify business risks and align with Kunming-Montreal Global Biodiversity Framework goals and targets (Schlüter *et al.,* 2023). It remains key to recognize limitations of global transition risk scenarios due to the complexity of ecological systems and insufficient data (Maurin *et al.,* 2023). Scenario analysis at the local scale has been more widely used to inform local business decisions (e.g., Blattert *et al.,* 2020; Di Pirro *et al.,* 2021). Being able to consistently measure and assess business impacts is critical if scenario analysis is to be used to inform sector or corporate-level business strategies and plans.

3.6.3 Implications for financial institutions

Financial institutions cannot successfully de-risk their choices or identify emerging investment opportunities without understanding the risks, leading to their inability to innovate and transform the business sector (Flammer *et al.,* 2023). Likewise, the lack of clear and systematic information regarding business impacts on biodiversity may significantly impede good decision-making. Similar challenges occur when aggregating impact data across a portfolio of investments, which precludes attribution of impact, for example if more than one financial institution has invested in the same project (Addison *et al.,* 2019; Houdet *et al.,* 2012; Stephenson *et al.,* 2021).

There is a need for universality and consistency in the methodologies, tools and metrics used by businesses to ensure comparability, facilitate decision-making by financial institutions and shift investments flows from negative to positive biodiversity impacts. At present, a majority of tools for financial institutions focus on initial screening of potential impacts and risks across their portfolio, rather than tools to assist decision-making and derisking (Hadji-Lazaro *et al.,* 2023; Svartzman *et al.,* 2021), and use modelled or global datasets with limited resolution.

3.6.4 Implications for consumers and civil society

The economic value of biodiversity is well documented (Dasgupta, 2021; Sukhdev, 2010), as is the impact of biodiversity loss on the economy, livelihoods and society. Yet, consumers have limited information on the implications of biodiversity loss for their livelihoods, whether it may be related to the availability and cost of products consumers purchase (Cheng *et al.,* 2024) or to the degradation of ecosystems and loss of species affecting food security, livelihoods, mental health and wellbeing (WHO, 2021). This interconnectivity between biodiversity loss and human development, cultural diversity, society and human behaviours is complex (Clark *et al.,* 2014; Crist *et al.,* 2017; Levis *et al.,* 2024).

For consumers, the main implications associated with business impacts on biodiversity and nature's contributions to people are related to the price and availability of goods and services, while being influenced by business image and reputation. Negative externalities of business activities that harm biodiversity can lead to consumer and societal mistrust and apathy (Camilleri *et al.,* 2023) and the likelihood of potential constructive alliances between consumers and businesses is reduced (Sanchez & Miller, 2024). Option value loss of biodiversity closes the door to future societal benefits including innovation and improved wellbeing (Agliardi *et al.,* 2024).

3.6.5 Implications for Indigenous Peoples and local communities

For IPLCs the implications of business impacts on biodiversity are considerable due to their inherent interrelationships with biodiversity. Except perhaps for sustainable business models associated with IPLC businesses, activities undertaken by businesses may fundamentally conflict with IPLC cultures and beliefs (IPBES *et al.,* 2023) and have impacts on the resources and nature's contributions to people upon which IPLCs directly depend for their livelihoods.

Typical methodologies used by businesses to assess and subsequently manage impacts on biodiversity with consequences for IPLCs have improved but remain limited (P. McElwee *et al.,* 2020; Yletyinen *et al.,* 2022). Integrating inclusive and participatory decision-making processes (Herse *et al.,* 2020), strengthening IPLCs' rights and investing in community led nature-based business initiatives can mitigate the adverse effects of biodiversity loss and foster more resilient and sustainable societies while strengthening the participatory rights of IPLCs (IPBES *et al.,* 2023) and addressing trade-offs (Van Rees *et al.,* 2025).

3.6.6 Synergies and trade-offs in impacts and implications for decision makers

Decisions by governments and businesses will have synergies and trade-offs with other societal goals, including the Sustainable Development Goals and the Kunming-Montreal Global Biodiversity Framework. Positive progress towards certain Sustainable Development Goals at the expense of the biodiversity-related Goals (14 & 15) is well documented, as is the failure to meet any of the 2020 Aichi Biodiversity Targets (Buchanan *et al.,* 2020).

Sustainable development policies have failed to reverse global decline in biodiversity and nature's contributions to people (Brownlie *et al.,* 2013), which may be due to different values attributed to different goals whereby the loss of biodiversity represents a trade-off for socioeconomic gains resulting in continued ecological degradation. Given the best estimate of biodiversity impacts by sector and the need to meet the Kunming-Montreal Global Biodiversity Framework 2050 goals and 2030 targets, trade-offs need to be avoided to the extent possible (e.g., Gibson, 2006) if society is to make the transformative changes needed to meet the 2050 Vision for Biodiversity.

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Chapter 4

APPROACHES FOR MEASUREMENT OF BUSINESS DEPENDENCIES AND IMPACTS ON BIODIVERSITY[1]

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Chapter **4**

APPROACHES FOR MEASUREMENT OF BUSINESS DEPENDENCIES AND IMPACTS ON BIODIVERSITY

EXECUTIVE SUMMARY

1 Methods for measuring business dependencies and impacts exist that are suitable for various spatial and organizational scales *(well established)* {4.2, 4.4}. The appropriate application of methods depends on the level of decision-making (i.e., portfolio to operational level), and the specific purpose to which it is being applied – whether high-level screening, comparing options, tracking change in pressure or reliance or observing change in biodiversity *(well established)* {4.2; 4.4}.

2 Methods vary in their overarching characteristics of coverage, accuracy, and responsiveness and these differences need to be considered when applying them *(well established)* {4.2, 4.4}. The five main categories of methods include participatory mapping and monitoring, location-based observations, spatial analysis, life-cycle approaches and ecological-economic modelling. Within these categories, methods vary in their coverage (both geographical and in terms of impacts and dependencies considered), accuracy (which includes spatial granularity), and responsiveness – their ability to recognize differences caused by business actions *(well established)* {4.2}. The connections between the state of biodiversity and nature's contributions to people and the pressures, reliance and responses of businesses are important to understand both impacts and dependencies, requiring multiple complementary methods. More attention is needed to fully understand the sensitivity of biodiversity to pressure types and implications for the continued provision of nature's contributions to people, especially given the variation across space, time, realms and ecosystems *(well established)* {4.4}.

3 Metrics on biodiversity and nature's contributions to people are often used to express the outputs of methods but in many cases remain limited to certain aspects and values *(well established)* {4.2, 4.3}. Biodiversity and nature's contributions to people metrics are important for assessing the potential or realized impact or a dependency. All biodiversity metrics are limited in their coverage and there is a lack of metrics of genetic diversity for business assessments. Those focused on species assemblages (e.g., the two commonly applied metrics: mean species abundance and endemic species richness) are limited to taxonomic groups for which data are available, and they don't adequately reflect all components of ecological communities and functions needed to understand ecosystem condition. Ecosystem metrics on extent and condition can reflect a wider set of nature's contributions to people values. Metrics of the actual or potential flows of nature's contributions to people either directly measured or modelled from ecosystem data can support the incorporation of local nature's contributions to people values in assessments. The choice of metric is non-neutral and represents different world views and values with implications for the ways in which metrics are interpreted *(well established)* {4.3.3}.

4 The evolution of 'top-down' scalable approaches for assessing impacts and dependencies is important for supporting higher levels of decision-making and addressing gaps in the availability of operational-level information, but these estimates will have less accuracy and are not appropriate for all decisions *(well established)* {4.2, 4.4}. Top-down methods infer the impact or dependency of a large number of activities and include life cycle approaches and economic-ecological models that typically have a more limited set of output metrics. Multi-regional input-output based and other sectoral methods can be useful at the portfolio and corporate level for initial screening, making use of business-specific data for more accurate results. Decisions at the value chain level can be guided by more granular life-cycle approaches that can integrate location or region-specific data to estimate changes in biodiversity and nature's contributions to people. These top-down methods connect business pressures to changes in the state of biodiversity, making use of general indicators such as ecosystem intactness. While global-scale models provide valuable insights, they often exclude the consideration of local ecosystem specificities, local (including social and cultural) values, and rights and interests of other groups, including Indigenous Peoples and local communities. High-level decisions may significantly influence site-level outcomes across wide scales and therefore finding ways to incorporate local knowledge, values and stakeholder interests into scalable approaches will strengthen both site-level management and high-level decision-making *(well established)* {4.2; 4.4}.

5 Methods that estimate or observe changes in biodiversity and nature's contributions to people for specific locations are required for operational-level

decisions, but it is not currently feasible to apply them at scale *(well established)* {4.2, 4.4}. These 'bottom-up' approaches include both location-based observations, based on expert and scientific assessment, and participatory mapping and monitoring involving the active participation of local stakeholders. They are necessary for operational decisions, such as planning locations of infrastructure or designing management actions. These decisions require site-specific models or methods that consider the characteristics of local biodiversity and nature's contributions to people and recognize the diverse values for local rightsholders and stakeholders *(well established)* {4.4.4}. Location-based observations of the state of biodiversity require interpretation, including the use of counterfactuals, to attribute changes to business activities *(well established).* The outputs of bottom-up methods can feed into secondary datasets used in spatial analysis and improve the accuracy and coverage of other methods over time, but due to their limited coverage and need for variation are challenging to apply across large geographic scales. Methods that make use of remote sensing offer a more scalable approach but are limited to variables that can be remotely detected. Coarse, generalized, aggregate metrics, such as mean species abundance or potentially disappeared fraction of species derived from global models, are not suitable to measure the change in biodiversity outcomes at sites *(well established)* {4.4.4}.

6 Location-specific information is needed to advance the development and application of impact and dependency methods *(well established)* {4.4}. Impact and dependency assessments at higher levels of decision-making can apply information with low granularity for the purposes of risk exposure and assessment *(well established)* {4.4}. For example, a number of economy-wide studies have been performed on exposure of financial institutions to physical dependency-related risks using non-location-specific information {4.2.4} However there remains a need for more granular environmental data that consider the location-specific availability and delivery of nature's contributions to people to the business and other stakeholders, including Indigenous Peoples and local communities. Equally improved and spatially explicit information on value chain activities is needed to improve corporate assessments across value chains. Progress has been made regarding the availability of asset location data of businesses' direct operations, yet value chain assessments rely heavily on the limited general and sectoral background data *(well established)* {4.4.3}.

7 Scenarios, in combination with models, are important for forward-looking decision-making and risk management, though their use in a business context is still highly variable and not yet making effective use of their potential *(established but incomplete)* {4.2.4.}. Scenarios can be used to understand how impacts, dependencies and associated risks could evolve in the future but there remains a need for a consistent set of nature-related scenarios for this purpose. While economy-wide studies have been conducted to assess long-term systemic risks, this area remains limited and not applicable at the business level and there is a need for stakeholder-driven scenarios and models at appropriate scales for decision-making. These approaches carry significant uncertainty which is limiting their application. Central banks conduct stress tests of financial stability using scenarios of extreme events that lead to the complete loss of services, though this field remains under development and faces several methodological challenges.

8 Effective and equal participation of Indigenous Peoples and local communities in the development and application of measurement approaches is needed for the incorporation of Indigenous and local knowledge and for consideration of the diverse values of nature and social issues. This helps ensure greater accountability and effectiveness in business decision-making *(well established)* {4.3.1}. Indigenous Peoples and local communities are custodians of biodiversity and holders of extensive dynamic knowledge relevant to its conservation, restoration and sustainable use, whose ways of life are directly associated with diversity in nature. Measurement approaches that incorporate Indigenous and local knowledge and involve active participation of communities (i.e., participatory mapping and monitoring) can help ensure that impacts, responses to impacts and business dependencies consider the values and rights of Indigenous Peoples and local communities (*well established*) {4.3.1}.

9 Uptake and application of measurement approaches by businesses is limited and varies across sectors and geographies *(well established)* {4.5}. Uptake of biodiversity measurement approaches is likely driven by reporting standards and regulation, and therefore more prevalent in sectors that are typically subject to site-level regulations, such as mining, and those subject to regulatory reporting standards such as the financial services sector. Although only a small share (less than 1 per cent) of businesses that provide annual or sustainability reports currently mention biodiversity, this is likely to increase in coming years as a result of emerging reporting standards. Reporting by businesses predominantly relates to impacts, with currently very limited information on dependencies. There is, however, information available on specific dependencies of businesses on individual nature's contributions to people. Most of the businesses that mention biodiversity in their public reports are incorporated in North America and Europe, with some uptake in Asia. This is likely driven by the larger extent of regulatory developments in those regions *(established but incomplete)* {4.5.4}.

10 **Integrating metrics and values of nature in accounting and reporting systems for businesses is crucial to transform how impacts and dependencies are managed *(well established)* {4.6.1}.** Approaches for integrating metrics and values (monetary or non-monetary) into accounting systems can be characterized by (i) the degree of integration of these metrics and values within existing conventional (non-environmental) business accounts and processes; (ii) the value lens that is applied to nature, and consequently in the way materiality of interaction between businesses and biodiversity is conceptualized. This has implications for how businesses are held accountable for their interactions with biodiversity, and how these are then managed. Political choices associated to the worldviews on which sustainability reporting standards are built directly influence the level of transformative change that can be achieved through their adoption. Biodiversity reporting and disclosure practices are mostly based on anthropocentric worldviews and present a low level of integration with business financial statements, focusing on managing risk and stakeholders' expectations without providing specific, timebound measures that can indicate effective management of biodiversity *(well established)* {4.6.1}.

11 **A small but growing number of 'biodiversity accounting' frameworks and methodologies are being developed that allow more holistic consideration of interactions between businesses and biodiversity *(well established)* {4.6.2}.** So far, most existing methodologies remain grounded in an anthropocentric worldview where only instrumental values of nature are taken into account, and propose to establish *ad hoc* accounts separate from conventional business management and financial reports. Approaches which seek a higher degree of integration within business management and financial accounts and which are based on biocentric or pluralistic worldviews, taking into account intrinsic or relational values of nature, have a stronger potential to support transformative change (improvements of governance, valuation, and accountability). They are also better aligned with Indigenous Peoples' and local communities' values and conceptions of business *(established but incomplete)* {4.6.1}. Such alternative accounting methodologies can link businesses' financial valuation and profit to its commitments to repay its debt to nature. 'Biodiversity accounting' methodologies for businesses can be applied at various levels of management and decision-making within a business, thus supporting different business functions. There is also emerging innovation of accounting methods at the landscape scale to support the involvement of businesses in collective action. The uptake of business-level biodiversity accounting methods is currently limited, with little knowledge of the outcomes of their application *(well established)* {4.6.2}.

4.1 PURPOSES OF IMPACT AND DEPENDENCY ASSESSMENTS FOR BUSINESSES

4.1.1 Drivers for corporate measurement of biodiversity

Businesses can have different motivations for measuring impacts and dependencies. Measurement can be driven by regulations that are determined by subnational, national and supranational institutions. Measurement can be driven by investors, customers or consumers or by an internal recognition of the value of biodiversity to the business (Aladağ, 2023; Van Tulder, 2015). In all cases, measurement should be unbiased and avoid greenwashing.

Dependency assessments enable the business or financial institution to understand their reliance on nature's contributions to people, and the ecological processes and biodiversity elements underpinning them (UNEP, 2023). Dependency assessments inform the business on risks and opportunities that may be associated with changes in biodiversity and nature's contributions to people. Actions based on a dependency assessment could potentially include nature-based solutions that restore or protect biodiversity in the locations where dependencies occur and as such, businesses may help to achieve their own internally set biodiversity targets as well as national and global biodiversity targets such as those set out in the Kunming-Montreal Global Biodiversity Framework. Nature's contributions to people can also be substituted by businesses by using technological solutions. Substitution reduces business dependence on biodiversity and can reduce financial risk. However, it also reduces incentives to conserve, restore or sustainably use biodiversity. The provision of pollination services for almond production in California presents an illustrative example. This practice has developed into the largest managed crop pollination event in the world (IPBES *et al.,* 2016; Lee *et al.,* 2019; Valido *et al.,* 2019).

Impact assessments enable a business or financial institution to understand the potential, predicted or observed changes in biodiversity and nature's contributions to people that result from its activities. This can be based on different dimensions of biodiversity (species and ecosystems) (UNEP-WCMC *et al.,* 2022) and different types of nature's contributions to people. An impact assessment can inform business targets and actions to reduce pressures and enhance positive outcomes for biodiversity, at the level of individual operations or value chains or at corporate or portfolio levels. However, the results of an impact assessment do not always provide information on the links

between business commitments and actual changes in the state of biodiversity and nature's contributions to people, leading to greater calls for measurable outcome-based targets that reduce impacts (zu Ermgassen *et al.,* 2022).

When conducting impact and dependency assessments to inform action, businesses may consider what is relevant, both for the business and for society. In an effective enabling environment (see **Chapter 6**), these conditions can be aligned, they can however also be (and currently mostly are) in conflict. European policymakers recently formalized the concept of 'double materiality', whereby businesses are required to analyze and report environmental and social issues from both a financial materiality perspective (those issues that can significantly affect the financial results of the business), as well as an impact materiality perspective (those issues where the business significantly affects society and environment) (Baumüller & Sopp, 2022). Inherent in the concept of double materiality is the recognition that issues material to society, but not financially to a business or financial institution, would go unaddressed unless requirements are put in place. The concept of double materiality is variably interpreted and applied in existing reporting and disclosure frameworks globally (UNEP, 2024).

4.1.2 Levels of decision-making and business purpose for measurement

Business decisions can be taken at different levels **(Figure 4.1)**, ranging from individual operations on sites through value chains to corporate- or portfolio-level decisions. Ultimately, all decisions need to guide action that takes place within the landscapes and seascapes where business activities are occurring. These locations

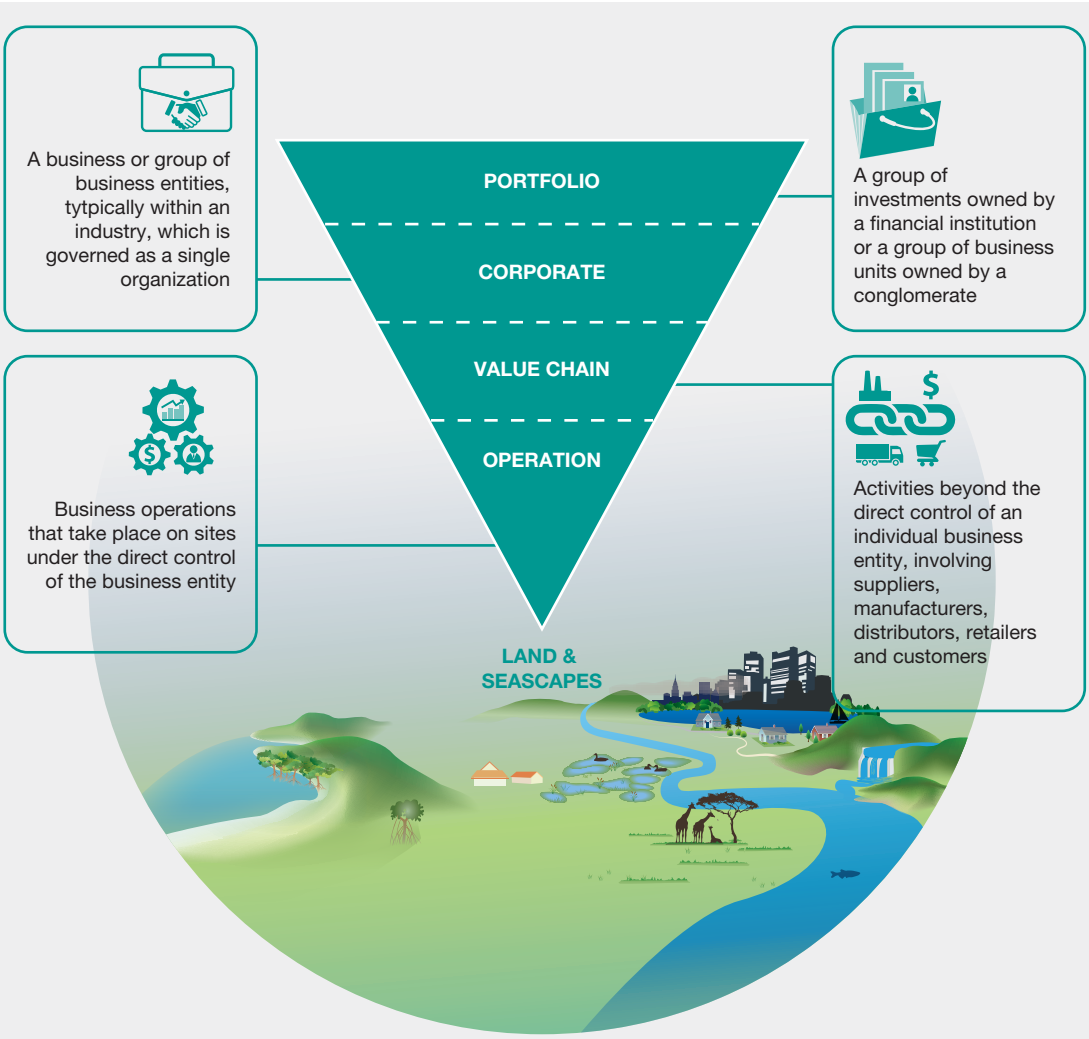


Figure 4 1 **Levels of business decision-making which determine the choice of methods.**

include those where resources are produced, transported, manufactured, sold or consumed. Value chains consist of a range of actors that the business can influence upstream and downstream of their operations.

The level at which decisions are made affects the ability to attribute biodiversity outcomes on the ground to those decisions. Higher levels of decision-making may have a bigger scale of the overall impact but also a less direct connection to the outcomes at sites. For instance, financial institutions are connected to biodiversity through the portfolios of businesses they invest in, loan to or insure. Their influence is indirect – through engagement or by providing businesses with or depriving them of access to financial services. Similarly, manufacturing businesses are connected to biodiversity through the activities of their suppliers (upstream) and customers (downstream) in their value chains. This does not lessen the responsibility of actors with indirect influence but makes it challenging to attribute changes on the ground to the decisions taken. This effects the applicability of measurement methods that can be applied in this context.

There is no single method or metric that considers all impacts and dependencies at all levels of decision-making. Methods need to serve the specific business and purpose for which they are deployed, including the required scale and scope of assessment.

At each of the levels of decision-making there are specific purposes for which measurement methods are needed. This includes screening to identify priorities requiring further analysis or action, comparing options by evaluating potential impacts and dependencies of activities relative to alternatives, tracking changes in levels of pressure or reliance of activities, and observing changes in biodiversity and nature's contributions to people. This is a fundamental aspect that drives the selection of suitable measurement methods and is discussed in **Section 4.4** on measurement methods in decision-making.

Stakeholders such as governments, civil society, and Indigenous Peoples and local communities (IPLCs), can share different perspectives on how business activities affect and rely on biodiversity and nature's contributions to people. As such, their engagement can provide great insights and benefits for the accurate measurement and valuation of business impacts and dependencies. For instance, the involvement of local stakeholders in participative processes and inclusion of Indigenous and local knowledge at sites and within landscapes is essential to get a full understanding of the changes to biodiversity and nature's contributions to people that are occurring. This also provides an understanding of the consequences of that change, including through affecting local dependencies of IPLCs. This is further discussed in **Section 4.3.1** on IPLC values and knowledge.

4.2 METRICS AND METHODS FOR ASSESSING IMPACTS AND DEPENDENCIES

4.2.1 Characteristics for the evaluation of metrics and methods

Metrics and methods for assessing dependencies and impacts of business activities were evaluated using a set of core characteristics.[2] This builds on existing work related to classifications (Addison *et al.,* 2020; Align, 2022; Heink & Kowarik, 2010), but does not represent a complete list of possible evaluation criteria. Aspects such as data availability or resource needs to apply the method were not included. Furthermore, the characteristics do not apply equally to all aspects of measurement. Their relevance to metrics and impact and dependency assessment methods is indicated in the relevant sections:

Metrics: To evaluate the choice of metrics the following characteristics are important:

- **Interpretability**. Refers to whether a metric has a clear, normative interpretation (i.e., is it clear what an increase or decrease means in terms of outcomes). In some cases, the metric value can easily be interpreted as positive or negative, allowing for comparison and aggregation, in other cases further interpretation is needed to achieve this.

- **Representativeness**. Refers to whether the metric adequately represents the biodiversity component being measured. Some metrics directly measure the component, whereas others can use proxy variables and are therefore less representative of what is being measured.

Methods: For understanding the choice of methods to assess impacts and dependencies the following characteristics are important:

- **Coverage**. This includes geographic coverage that refers to the spatial area covered by the approach. Some are only applicable for certain regions of the world and others have global coverage. It also includes the coverage of relevant business activities whereby there can be variability among methods in being able to assess impacts associated with pressure types (e.g., land use, pollution) or dependencies on

2. Data management report referring to snowball search to identify approaches and families of methods that are addressing biodiversity impacts https://doi.org/10.5281/zenodo.12783316

nature's contributions to people (e.g., water provision, pollination).

- **Accuracy**. Refers to the degree to which the method can correctly describe the phenomenon it is designed to measure. In this context, this is the extent to which an estimate reflects real impacts and dependencies. Some methods will estimate a potential impact or dependency, while others will measure realized or actual impacts or dependencies. An aspect of this relates to spatial granularity whereby higher resolution methods have more potential to yield more accurate results. However, even highly granular site-level assessments can vary in accuracy based on factors such as survey intensity and data collection methods applied.

- **Responsiveness**. This characteristic enables the method to link the outputs to the activities and actions taken by the business and is closely related to *attributability* (the degree to which the outputs of the method can be attributed to the activities of a business, rather than detecting changes that can result from multiple actors and natural processes). Responsiveness refers to how the outputs of a method change in response to business actions to manage their impacts and dependencies. For example, the outputs of some methods will respond only to a total reduction in activities, while some will respond to fine-scale management measures at site level. Responsiveness therefore depends on both the ability of a method to show change over time, as well as pick up influences of business actions on output metrics. These characteristics are dependent both on the method and input data used.

These characteristics apply differently to methods used for different purposes and at different levels of decision-making. For example, understanding the impact of a large financial portfolio requires global geographic coverage. Operations-level management would, however, require high accuracy and responsiveness but does not require global geographic coverage. These different requirements will be further discussed in the following sections.

4.2.2 Metrics

Metrics are used to capture aspects of business impacts and dependencies that were outlined in **Chapters 2** and **3** and include both biophysical metrics on biodiversity and those that represent socio-cultural or economic values. These relate to different components of the IPBES conceptual framework. Metrics on drivers of nature change, often referred to as pressures, can infer potential impact of business activities. Metrics on biodiversity, often referred to as state of nature metrics, can be used alongside metrics of drivers to infer potential impacts of business activities, or be used to evaluate actual impacts when observed change can be attributed to business activities. Biodiversity metrics can also be used to understand the likely resilience of ecosystems and nature's contributions to people that businesses depend upon. Metrics on nature's contributions to people can be used to understand both business dependencies and the consequences of impacts on biodiversity for people and can relate to both the biophysical provision of nature's contributions to people and the benefits derived. Metrics of human wellbeing can relate to both the direct and indirect impacts of business activities on people and can also capture the benefits of nature's contributions to people.

Metrics can be outputs of methods for assessing impacts and dependencies. In that sense, a given metric may be produced through different measurement methods, resulting in different numerical values. Measurement methods are further discussed in **Section 4.2.3**. A wide range of metrics can be populated with primary data, for example, vegetation cover derived from field surveys. Methods that apply modelling-based methods such as life cycle analysis or input-output modelling produce a more limited range of output metrics, for example, the Potentially Disappeared Fraction (PDF) of species that is derived from information on pressures. Often, the values of a metric are calculated and the results expressed in the form of spatial layers. These spatial layers are then used as inputs to spatial analysis methods for assessing impacts and dependencies. A recent review identified 573 global terrestrial biodiversity spatial metrics for use by government, business and civil society (Burgess *et al.,* 2024).

"State of nature" metrics

Biodiversity metrics that focus on the biophysical state of nature describe the state of genes, species and ecosystems at varying spatial scales. Thematically, these metrics link to the state-based goals and targets of the Kunming-Montreal Global Biodiversity Framework, such as Target 4 on reducing the rate of species extinctions. Metrics for capturing impacts and dependencies of businesses on genetic diversity are less available than for species and ecosystems, representing a key gap in assessment needed to inform action (Shaw *et al.,* 2025; Zhu *et al.,* 2024). Two broad groups can distinguish the types of state metrics applied in business decision-making (Burgess *et al.,* 2024):

- The first capture a snapshot of the 'significance' of a location for biodiversity in relation to local or global biodiversity goals, for example, the significance of an area in terms of occurrence of threatened species or a risk of ecosystem collapse. These metrics can be used alongside metrics of drivers and responses to contextualize them in terms of the strategic importance

of the biodiversity that has been impacted. As such, these metrics are incorporated in many of the early screening steps of assessment and disclosure frameworks such as the GRI (2024), TNFD (2023b) and SBTN step 1 (2023a).

- The second capture the condition or 'intactness' of biodiversity in a location. These metrics compare biodiversity variables against a reference condition to understand the current state of that variable, for example, habitat quality of an area relative to a pristine state. Inherently, therefore, intactness metrics have implicit value assumptions and worldviews embedded in their production and application, as the metrics depend on what is used as the reference state. This is discussed in **Section 4.3.3**. Alongside metrics of drivers, changes in intactness metrics can be used to infer impacts of business activities on biodiversity, or support understanding dependencies on biodiversity, where the delivery of a given ecosystem service can be linked to intactness of a given ecosystem. While some metrics reflect only the change in intactness caused by a driver, other metrics can quantify the baseline condition before business activities, and the residual condition after business activities (Houdet *et al.,* 2020) to track how impacts accumulate over time.

Table 4 1 **Common types of metrics for assessing status and trends in individual focal species and ecosystems in the context of business impacts and dependencies, with examples provided.**

This table builds from metrics extracted from the list of 'off-the-shelf' tools compiled in **Chapter 3**, supplemented with further literature review. These metrics are assessed against two criteria commonly applied for assessing suitability of metrics for decision-making: 'interpretability' refers to whether a metric has a clear normative interpretation (is it clear what an increase or decrease means in terms of outcomes) and has a clear unit and scale that allows comparison; 'representativeness' refers to whether the metric can adequately represent a certain component of biodiversity (Czúcz *et al.,* 2021).

Group	Common metric types and examples	What is being measured	Interpretability	Representativeness
Species				
Significance	Species extinction risk unit, e.g., International Union for Conservation of Nature species threat abatement and restoration (STAR) metric or global extinction probability (GEP) (Mair *et al.,* 2021; Verones *et al.,* 2022).	Species threat status combined with range size to reflect how pressures at a particular location would contribute to changing extinction risk.	Directional interpretation and metric values can be directly compared and aggregated. Integration of multiple types of information (threat status and range size) makes interpretation challenging. Can be disaggregated based on documented threat (Salafsky *et al.,* 2008), although threats are often extrapolated across the whole range.	Good representation of component although limited coverage of taxonomic groups due to data availability.
Intactness	Baseline/change in species population size (Houdet *et al.,* 2020).	Change in number of individuals of a species. Can be assessed at many different spatial scales (e.g., local population, metapopulation vs. global population size).	Interpretation depends on the focal species being measured as to whether population changes reflect a positive outcome. Information on thresholds and targets required to interpret how local population changes reflect species persistence.	Metric is a direct reflection of intactness at the level of individual species.
	Baseline/change in area of suitable habitat (Turlure *et al.,* 2010).	Area of suitable habitat often applied as a proxy for change in population size of a species.	Clear directional interpretation-information on area requirements for different species often required to interpret changes.	Proxy variable and unlikely to capture full impacts where habitat loss not the key driver of change (i.e., impacts from direct exploitation).

Table 4 1

Group	Common metric types and examples	What is being measured	Interpretability	Representativeness
Ecosystems				
Significance	Ecosystem collapse risk classification, e.g., IUCN Red List of Ecosystems (Nicholson *et al.,* 2024).	Aggregate information on extent, range threat levels and tipping points to assess the threat status of an ecosystem.	Provides a simple and readily interpretable ranking of the significance of ecosystem types in terms of collapse risk.	Does not reflect importance of ecosystems in terms of the biodiversity they contain and their ability to generate nature's contributions to people.
Intactness	Baseline/periodic change in ecosystem extent.	Area coverage of ecosystem type used to assess extent of that ecosystem type within a defined area.	Simple metric that allows to interpret trends over time.	Extent reflects only one aspect of ecosystems and can mask underlying changes in ecosystem condition.
	Baseline/periodic change in scaled ecosystem condition index (0-1 scale), e.g., Mean Species Abundance, Biodiversity Intactness Index, WET-Health Index, Forest Landscape Integrity Index (Czúcz *et al.,* 2021).	Key characteristics of ecosystems are used to assess condition compared to the maximum and minimum levels found in reference conditions. These characteristics can be specific to different ecosystems (e.g., coral cover, canopy height) or generic (e.g., mean species abundance).	Scaling from 0 to 1 provides a clear interpretation, with 1 being intact and 0 meaning fully degraded. The interpretation of condition indices is heavily driven by the reference condition chosen. For example, whether it is being compared to a historical or more contemporary reference condition.	Condition indices tailored to specific ecosystem types are more likely to represent the condition of specific ecosystems. Condition indices that cover multiple aspects of condition (e.g., encompass function as well as composition) more likely to comprehensively reflect condition.
	Baseline/periodic change in surface area equivalents (area x condition index) (Houdet *et al.,* 2020).	Adjusting the extent of ecosystem by a scaled condition index combines information on extent and condition into one accounting unit.	Condition adjusted areas provide a simple and readily comparable indicator of ecosystem intactness. As an aggregate indicator it can be challenging to interpret what is driving a change.	Combined information on both extent and condition of ecosystems provides good representation of ecosystem change but is dependent on the condition indices used (see row above).
	Time-integrated loss of condition, including potentially disappeared fraction of species (Winter *et al.,* 2017; Woods *et al.,* 2018).	Loss of condition over a given time interval, to assess potential persistent change associated with business pressures. Mainly applied in life cycle assessments (e.g., potentially disappeared fraction of species in a year per unit stressor, such as ha land use or kg emission).	Does not provide a measure of condition against a baseline. This means that while the metric can be used for estimating impacts of a business, it cannot be used to interpret of trajectories in condition of specific ecosystems.	Potentially disappeared fraction of species, and other time-integrated metrics produced from life cycle assessment largely reflect elements of change in composition (e.g., loss of local species richness) so are limited in the extent they reflect component.

Metrics to assess nature's contributions to people

Metrics of nature's contributions to people, often referred to in the business context as ecosystem service metrics, can support an assessment of a business's impact and dependency. These metrics quantify the change in the provision of nature's contributions to people (quantity provided), as well as the actual or potential flow of nature's contributions to people (benefits or values realized). In the context of impact assessment, they capture a change in nature's contributions to people that results from business activities. In the context of a dependency assessment, they capture the provision or benefits of nature's contributions to the business. As such they are referred to in corporate assessment and disclosure frameworks and standards (GSSB, 2025; TNFD, 2023). These metrics also link to the goals and targets of the Kunming-Montreal Global Biodiversity Framework, in particular Target 11 on restoring, maintaining and enhancing nature's contributions to people.

State of nature metrics can be used to describe the capacity of biodiversity to provide services and inform an understanding of the potential resilience of specific nature's contributions to people on which businesses depend as well as of the impacts of business activities in a location. Selecting benefit-relevant indicators (Olander *et al.,* 2018) that capture elements of ecosystem state and capacity in units relevant to specific beneficiaries enables the interpretation of the consequences of changes in the metric. For example, metrics such as 'abundance of catchable fish in accessible fishing grounds' can describe impacts on the biophysical state that reflect potential changes in nature's contributions to people provided to local communities or business dependencies. Although ecosystem attributes have a positive link with different types of nature's contributions to people (A. C. Smith *et al.,* 2017) the exact relationship between the state of ecosystems and their capacity to provide nature's contributions to people is complex, often non-linear and context specific. This is especially true for regulating services that provide benefits through regulating environmental conditions and maintaining quality.

Metrics that measure potential or actual flows of nature's contributions to people from ecosystems to beneficiaries, such as crop yield for food provision or volume of available water for water supply, are available to measure state and change in material nature's contributions to people. Flows of regulating nature's contributions to people are more challenging to capture directly in simple metrics, but can be derived from models that quantify potential flows from ecosystem data.

In turn, metrics of flows of nature's contributions to people can be used for both understanding the significance of locations for the provision of nature's contributions to people, and to measure change in flows of services in the context of businesses' impacts and dependencies. Significance of locations can be considered through metrics describing the relative contribution of locations for providing different nature's contributions to people, derived from location-based observations or spatial modelling. An example is the global map of critical natural assets, defined as natural and semi natural ecosystems required to maintain 'local' nature's contributions to people (R. Chaplin-Kramer *et al.,* 2022).

Often flows of nature's contributions to people to businesses are inter-regional and benefits are realized in locations far removed from the ecosystems providing them (Fisher *et al.,* 2009). This occurs through, for example, the trade and transport of goods as exemplified in the trade of agricultural products where significant dependencies on non-material or regulating nature's contributions to people exist (Marques *et al.,* 2024). A further example is the use of digital sequence information (DSI), whereby genetic data provide intangible benefits to industries and societies (e.g., through vaccine development and biomedical research) far removed from the source location (Coltman *et al.,* 2025). Equally, services such as flood defence are often provided over large spatial scales (Schröter *et al.,* 2018). Metrics covering actual flows of nature's contributions to people to businesses need to consider these complex tele-coupled processes.

Human wellbeing metrics

The dependencies and negative impacts of businesses on biodiversity and people are multifaceted and inextricably linked, due to the close relationships that exist between the natural environment and human wellbeing, with deeper connections in the case of IPLCs who hold strong cultural ties with nature. Despite the interconnections, social and environmental dimensions of sustainability are often treated independently (Schleicher *et al.,* 2018; Waites *et al.,* 2024). As such, effective corporate measurement of nature-related impacts, dependencies and responses necessitates the incorporation of social metrics alongside the biophysical measures.

Human wellbeing metrics can be used to understand both the direct and indirect impacts of a business activity on people. The latter are those whereby loss or degradation of biodiversity can cause or exacerbate negative social outcomes such as loss of livelihoods or reduced food security. These indirect impacts on human well-being are captured by metrics of the benefits and values of nature's contributions to people (Dreoni *et al.,* 2022). Metrics of direct social impacts of business activities are important to capture how businesses influence social systems, particularly for IPLCs, that can in turn reduce the ways communities are able to manage their lands (IPBES *et al.,* 2024). They also provide early warning of biophysical changes. For example, the occurrence of conflict and protests in response to an actual or proposed business activity can be a sign of current or future environmental changes, as environmental changes are often closely intertwined with social harms (e.g., polluted waterways, resettlement linked to conversion or exploitation).

Social metrics can represent different dimensions of human well-being. While income is a common and often easier to measure metric, well-being is a multi-dimensional concept including elements such as food/nutrition, health, education, living standards, social relations, security, safety from risk (including risks from nature), cultural values and freedom of choice (Schaafsma *et al.,* 2023). Gender equality is an important consideration given the differing roles that men and women play in the value chains of businesses, as exemplified in the agricultural sector (Doss, 2018). As for biodiversity, human wellbeing metrics can be 'static' based on the existence or prevalence of key aspects that can be used for risk screening purposes at wider scales (e.g., social hotspot database indicators include child labour and poverty

levels (Proforest, 2019)). Publicly available geographical information on social issues is much scarcer than data for the environment but country-level databases exist for social risk mapping in the case of global supply chains (Sihvonen *et al.,* 2024). Risk metrics and indices, such as the Human Development Index, are composite values that can indicate overall trends but are typically not responsive to individual interventions and do not reflect the full dimensions of human well-being. Locally specific (and locally developed) metrics and indicators based on primary data studies are needed to reflect human wellbeing outcomes of economic activities in a given location (Dreoni *et al.,* 2022). There are also potentially opportunities to engage with and (with consent) draw social metrics information from existing, autonomous community-based monitoring and information systems (Farhan Ferrari *et al.,* 2015).

4.2.3 Methods

Ways to measure impact and dependence encompass a broad range of methods. These make use of monitoring data at different levels of aggregation and transformation. They range from methods that collect primary observations on biodiversity and nature's contributions to people directly, to ones that apply outputs from models or meta-analyses. Methods and associated tools for measuring biodiversity and their application in corporate assessment is a rapidly developing field and we can expect further advancements with the deployment of artificial intelligence in the field of ecological monitoring, for example, applications linked to remote sensing, the ability to combine multiple data sources and types, and predicting species responses through advanced models (Reynolds *et al.,* 2025).

Methods integrate metrics on biodiversity or nature's contributions to people, described in **Section 4.2.2**. Metrics on human well-being are largely captured in the form of nature's contributions to people, although some methods (e.g., participatory mapping and monitoring) potentially enable a broader set of human well-being metrics that can capture direct social impacts. Metrics can be integrated as inputs in the form of spatial data or produce metrics as outputs to measure impacts and dependencies. For impact measurement, measuring the connections between drivers and state is important – measuring drivers by themselves does not capture a robust understanding of impacts, and measuring the state of nature in the absence of drivers prevents an understanding of who is responsible. An understanding of impact can be based either on the biophysical change in biodiversity or on the consequences for people captured through nature's contributions to people-related indicators. To fully assess dependencies, it is necessary to capture both the reliance of an activity on nature's contributions to people as well as the resilience of that dependency. The latter incorporates metrics of the state of nature underpinning the supply of nature's contributions to people (UNEP-WCMC, 2023). Many of the methods can be used for both impact and dependency assessments but in different ways. For example, location-based observations of ecosystem condition can be used to understand the resulting impact of a business activity known to drive ecosystem degradation, or the resilience of a dependency when a business activity is known to rely on nature's contributions to people provided by that ecosystem.

Methods differ in the characteristics described in **Section 4.2.1** and their suitability to assess impacts and dependencies across different levels of decision-making. Methods can be grouped into 'method categories', each of which comprises a non-exhaustive list of example methods that share certain characteristics. We evaluate methods at the level of categories. There are five categories of methods as highlighted in **Chapters 2** and **3,** namely: location-based observations, participatory methods, spatial analysis, life cycle approaches and economic-ecological modelling **(Table 4.2)**.[3] These method categories are not mutually exclusive and are often used in combination. For example, participatory methods can be used in combination with other method types, particularly location-based observations, as indicated by the sub-category on co-monitoring. These methods can provide input data to spatial analysis and models, which in turn are able to be used within life cycle-based approaches and economic-ecological models. When incorporating the results of community-based monitoring, ethical considerations can apply, for example ensuring free, prior and informed consent of Indigenous knowledge-holders (Newing *et al.,* 2024).

This review of methods is limited to their ability to measure the actual or potential changes in biodiversity and nature's contributions to people that result from business activities or affect business dependencies. To further understand the consequences of impacts and dependencies, valuation methods (monetary and non-monetary) can be used (see **Chapters 2** and **3**). While some methods express impact in monetary terms, many don't and represent impacts in other units. Footprints are a particularly commonly used category of approaches for different environmental pressures (like land-use, or greenhouse gas emissions) that has evolved over time and is also used to calculate impacts and dependencies on biodiversity. Footprint analyses are, however, not well defined or delineated, and also have a large overlap with several methods already present in **Table 4.2** like LCA and MRIO analyses and are therefore not included in the table (biodiversity footprint definition is further discussed in **Box 4.1**).

3. Data management report referring to a snowball review to identify approaches and families of methods addressing biodiversity impacts https://doi.org/10.5281/zenodo.12783316

Table 4 2 **Method categories for measuring biodiversity impacts and dependencies of business activities.**

Method category	Description
Location-based observations These methods use primary data collection to assess impacts and dependencies through taking direct measures of the state of biodiversity and nature's contributions to people at specific locations, such as through field observations, remote sensing, as well as emerging survey methods such as eDNA and bioacoustics. This includes museum collections and *ex situ* collections that can form the initial surveys and local monitoring of natural resources and their use (such as hunting and fishing).	
Field survey	Field surveys are a systematic approach to collect data in a specific region or for a specific issue and include ecological surveys, experiments and observations, eDNA techniques, as well as qualitative social surveys including questionnaires.
Remotely sensed products	Based on remotely sensed data they can monitor changes in physical characteristics of an area over time. Limited to features that can be detected remotely.
Participatory mapping and monitoring Methods that involve collaboration with external stakeholders, rightsholders or communities, including IPLCs.	
Incorporation of results from autonomous community-based information and monitoring systems	Incorporation of conclusions/results (and/or, in some cases, underlying data and information) provided, by agreement, by autonomous community-based information and monitoring systems, for example of IPLCs (Farhan Ferrari *et al.,* 2015). These systems may use indicators derived from one or a combination of: Indigenous and local knowledge, human rights approaches, scientific methods, or other approaches, to monitor nature and/or socio-cultural health (Danielsen *et al.,* 2009; IPBES *et al.,* 2024).
Co-monitoring with communities or local people	This involves co-generation of relevant data through scientists working alongside directly-affected communities or local people (including IPLCs), which may include co-development of indicators, co-collection of data and/or joint data interpretation. Indicators may be derived from, e.g., traditional and local knowledge, scientific methods, or human rights-based or other approaches (Danielsen *et al.,* 2009).
Citizen-based approaches, in some places known as citizen-science	This involves collection of scientific data by the public on nature indicators proposed by scientific researchers (Danielsen *et al.,* 2009).
Spatial analysis These methods involve using spatial data and models to infer impacts and dependencies on nature. Location-based observations, which feed into secondary databases, and participatory methods can provide an input to these methods, e.g., for maps of species populations or habitat extents.	
Spatial overlay	Static overlays (e.g., business operations and biodiversity data layers).
(Geo-)spatial models	Geospatial modelling helps to perform scenario studies, based on the spatial interaction of the underlying data. Spatial predictions extrapolate into the future (forecasting) from existing data using scenario assumptions. Spatial modelling can show the current (and potential future) distribution and composition of ecosystems and land area and can include species distribution models, habitat prioritization models, ecological connectivity, network analysis of trophic systems, hydrological models and modelling of ecosystem services.
Life cycle approaches Includes both full life cycle assessments (ISO14040) or ones that draw from life cycle thinking, such as applying characterization factors to assess potential impacts of pressures within value chains. Life cycle approaches quantify impacts on either midpoint level (where impacts are not comparable across impacts but standardized within each impact category) or endpoint level (where impacts are assessed specifically for human health, biodiversity loss or loss of natural resources).	
Life cycle assessment	Quantifies environmental impacts for a number of pressures for several impact categories simultaneously, allowing for highlighting trade-offs between impacts and improvement potentials. It includes the supply chain or total life cycle of a product or service. Regarding biodiversity, current life cycle assessment models do not yet contain many models for impacts on ecosystem services, and the focus is mostly on species loss.

Table 4 2

Method category	Description
Characterization factors (non-full value chain)	Application of life cycle impact assessment models to only one flow or emission, without considering the entire life cycle of a product. For example, assessing the biodiversity impacts of one m^2 of land used for a certain purpose without a larger system boundary or value chain.
Economic – ecological models Use information about the economy to determine the contribution of different pressures (caused by economic activities) to ecological changes and biodiversity loss. These can be both qualitative and quantitative. The chain of logic follows the sequence from economic drivers, to environmental pressures to state-of-nature. Likewise, economic information can be used to trace where in the economy relevant dependencies on nature exist, related to the demands of economic activities of inputs derived from natural capital. A wide range of models fit here, covering different parts of economy and geographies: from micro-economic, sectoral, regional and landscape scale, to macro-economic or global. Several of these models can be used for scenario analysis, by analyzing the consequences of choices and decisions on economic structures, and financial and environmental policies.	
Qualitative assessment methods	Methods that qualitatively map the impacts and dependencies of economic activities on nature
Environmentally extended multi-regional input-output analysis (EE-MRIO)	Shows actual, mostly global, trade flows either in monetary or physical terms and can therefore help to trace impacts through the whole economy. An environmentally extended multi-regional input-output analysis uses the trade flows to calculate environmental pressures, by applying characterization or intensity factors.
Integrated assessment models (IAMs)	These are models that combine knowledge from multiple disciplines—such as economics, climate science, agricultural and energy systems—to analyze the interactions between human and environmental systems. They have often been used to evaluate the potential impacts of climate change and to assess policy options for mitigation and adaptation in scenario assessments. Likewise, they are used to assess the consequences of economic and demographic trends on biodiversity loss and the delivery of nature's benefits to society.
Computable general equilibrium (CGE) models	These are economic models that use actual economic data to simulate how economies might respond to changes in policy, technology, demography or environmental changes. They represent the behaviour of different agents (households, firms, government) and ensure that supply and demand are balanced across all markets. They can be used to assess different economic structures and policies, as part of policies for transformative change.

Box 4 1 Biodiversity footprints.

Definition, scope and use of biodiversity footprints

Businesses increasingly mention the term 'biodiversity footprinting'. There is, however, a lot of variation in footprint definitions (Matuštík & Kočí, 2021; TNFD & PBAF, 2023). The term stems from a broader development around 'environmental footprinting'. The term 'ecological footprint' was first used to capture the global environmental consequences of consumption (Wackernagel & Rees, 1998; World Wide Fund for Nature, 2010), mostly determined by land-use and greenhouse gas emissions. An important aspect was to give a different view on responsibilities, beyond that of national territories. Some scholars have noted that the promotion of carbon footprints, including by fossil-fuel businesses, can function as a calculative device that allocates responsibility and potential regulatory costs (e.g., carbon taxes) across the value chain rather than concentrating them on energy producers (Naef, 2024; Turner, 2014).

The footprint concept evolved into a set of indicators that covers a broad set of environmental and even socio-economic subjects. Footprints usually focus on one issue only, such as land-use or carbon, in contrast to a full life cycle assessment that aims to include all relevant environmental impacts. Footprint indicators currently include subjects like material flow, nitrogen and carbon emissions, and finally effects on biodiversity. Together these indicators are referred to as the 'footprint family' (Galli *et al.,* 2012;

Box 4 1

Matuštík & Kočí, 2021; Ridoutt & Pfister, 2013; Vanham *et al.,* 2019).

The Institute for European Environmental Policy (2021) proposed a definition of biodiversity footprint for decision-making: "The impact of a commodity, company, person or community on global biodiversity, measured in terms of biodiversity change as a result of production and consumption of particular goods and services". The footprint standard developed by the Partnership for Biodiversity Accounting Financials (PBAF) (2022), defines it as: "Model-based biodiversity footprinting approaches, where a potential impact on biodiversity is quantified based on quantified changes in impact drivers or pressures and pressure-impact models."

These definitions leave room for the variety of methods outlined in **Table 4.2** and can make use of a range of the metrics outlined in **Table 4.1**. Footprinting can therefore be used to both model a potential impact using generalized metrics (using characterization factors), and measure observable changes on the ground (TNFD & PBAF, 2023; see **Section 4.4** for further description of these purposes).

Common biodiversity footprinting methods

Several methods have been developed to calculate footprints at different scales and scopes and can be categorized as 'top-down' based on life cycle approaches and economic-ecological models, and 'bottom-up' based on location-based observations (see **Section 4.3** for further description of these categories).

Top-down footprinting represents model-based calculations of biodiversity loss, that deliver an estimate or proxy of what truly happens on the ground (TNFD & PBAF, 2023). Footprints of products and services are determined by performing life cycle analysis, which is formally described in an international standard (ISO, 2006). It is based on data inventories of material and environmental flows, from which biodiversity impacts are inferred. For calculating the footprint of a whole economy or national financial system, EEMRIO (environmentally extended multi-regional input-output) models that use monetary transactions between economic sectors as the basis for calculating environmental effects are used. Combinations are also possible, for instance for the footprint of large a organization like Oxford University (Biggs *et al.,* 2021; Bull *et al.,* 2022). Central to these footprinting methods is the perspective of a value chain or product life cycle (present in the definitions of biodiversity footprints by Institute for European Environmental Policy (2021); PBAF (2022); TNFD & PBAF (2023), whereby, all environmental flows to and from each economic activity in every step of the value chain have to be assessed. This includes all steps from extracting natural resources, processing and transporting raw materials; producing and transporting products; selling products to consumers; and treating end-of-life products (waste treatment).

To calculate a biodiversity footprint, the effects of multiple environmental pressures are combined to produce a composite indicator for biodiversity loss. Different methods have been developed to calculate the combined effects of environmental pressures on biodiversity, using different metrics and giving different weights to each pressure (De Weert *et al.,* 2025; Goedkoop *et al.,* 2008; Verones *et al.,* 2020; Wilting *et al.,* 2017).

Next to these model-based calculations, performing a biodiversity account for the level of individual business operations has been proposed by Houdet and Teren (2022). Instead of using generalized indicators, location-based biodiversity data is used to calculate biodiversity gains and losses, by summing up the total negative and positive changes in the extent (area) and quality (ecological status) of ecosystems occurring at specific operational sites. Such accounts can be used as part of a whole value chain assessment, providing a more representative picture of biodiversity encountered at specific locations for operations in the value chain.

Table 4.3 provides a list of the available categories of methods and their varying characteristics. As each category consists of multiple methods, there will be considerable variation in their characteristics, for example, regarding required input data, model performance, impact types covered/ability to assess and metrics included. The table, however, provides a broad overview of the characteristics for each category, noting this variation.

Table 4 3 **Characteristics of impact and dependency measurement methods.**

Example categories	Coverage	Accuracy and spatial granularity	Responsiveness
Location-based observations			
Field survey	High potential for coverage of impacts and dependency types due to range of metrics that can be populated with data from specific locations. Mostly conducted over small spatial scales and therefore low geographical coverage.	Potential to achieve high accuracy as data can reflect details of real-world conditions at high spatial granularity. Accuracy of results will depend on specific survey protocol applied; survey intensity and the features being surveyed.	Observed changes based on field survey or remote sensing may be caused by influences other than business activities and actions. Further interpretation, such as comparing to a counterfactual often required to attribute to business activities and actions.
Remote sensing	Limited to variables that can be remotely detected and can vary in the spatial coverage measured with some datasets having global coverage.	Remote sensing products will have varying spatial resolution, with higher resolution assessments emerging over time. The accuracy of measurement will depend on the feature with greater suitability to certain environments (Erfanifard *et al.,* 2025), as well as the level of ground truthing.	
Participatory mapping and monitoring			
Incorporation of results from autonomous community-based information and monitoring systems **Co-monitoring with communities or local people** **Citizen-based approaches, in some places known as citizen science**	High potential to represent diverse values and provide qualitative and quantitative results across a range of impacts and dependency types for specific locations. Although mostly site-specific, some methods can cover extensive Indigenous territories. Despite global prevalence of information, may lack universal metrics and accessibility of information to support larger scale assessments (N. Johnson *et al.,* 2021).	Potential to achieve high accuracy as data can reflect details of real-world conditions at high spatial granularity.	Potential for high responsiveness due to continual monitoring. Ability to attribute changes to business activities and actions, due to the combination of quantitative and qualitative knowledge types.
Spatial analysis			
Overlay of spatial data layers	Available data layers for overlay analyses will cover a range of variables and metrics. The spatial coverage of data layers for overlay analysis varies from local (e.g., orthophotos) to global (e.g., built from remote sensing data).	Vary in both resolution and accuracy depending on whether data layers are built from direct measurement or model outputs.	Changes identified can be challenging to attribute to specific activities. Often assumed that direct spatial overlap between activities and changes in state is a good proxy for attribution (such as changes in land cover used as proxy for effects of, e.g., agricultural activities). Typically represents a snapshot in time, but when using data layers with high update frequency a greater level of attribution and responsiveness to intervention can be achieved. Models can be responsive depending on input data availability. Represents a snapshot in time, that can show effects of interventions if repeated several times.
Spatial modelling	Models can be applied across different spatial areas, focusing on different components of biodiversity and ecosystem services. Some have the ability to be applied globally.	Accuracy depends on the quality of the input data and the complexity of the models, which is highly variable across the world. Accuracy will also depend on the level of ground-truthing.	

Table 4 3

Example categories	Coverage	Accuracy and spatial granularity	Responsiveness
Life cycle approaches			
Full life cycle assessment (full value chain, several impact categories)	Models that are integrated into life cycle assessment software can have global (like LC-Impact or Recipe) or local coverage (e.g., Swiss Agricultural Life Cycle Assessment), and can cover a large number of different pressures, for example land use, greenhouse gasses, toxicity and other forms of pollution. Limited to the metrics included in underlying models. Life cycle assessment methods provide an estimate of potential impacts based on pressures. Spatial granularity varies from more spatially resolved characterization factors (e.g., ecoregion specific factors) to global characterization factors. They do not track accumulated impacts on specific ecosystems.		Life cycle assessment outputs are potentially responsive to small changes in the production system (e.g., on a product basis) and can link potential impact estimates to specific activity. The responsiveness will depend on the granularity and specificity of input data.
Characterization factors	Measures potential impacts of one impact driver at a time and often presents an aggregated footprint using top-down biodiversity metrics, limited to the metrics included in underlying models.	Varying between spatially explicit (watersheds) to globally generic characterization factors. When site-level pressure data are used, precision is high and the potential for accuracy is higher, as outputs reflect the specific location and activity being measured. If global average pressure is used, precision is low with no spatial specificity (e.g., results are globally applicable) but are likely less accurate for the impact of a specific activity.	
Environmental-economic models			
Qualitative assessment method	Can make use of industry-wide information that can be applied across a wide range of economic activities and geographic scales.	Low accuracy for specific business contexts and locations due to reliance on global, regional or industry-wide information.	Can respond to changes in the extent of economic activity conducted or invested in but not responsive to company or location-specific actions.
EE-MRIO	Measures financial and trade flows globally using broad or more detailed economic sector resolutions. Trade flows are both within and between countries or main world regions. Calculates all inputs over supply-chains to deliver a certain final output.	Broad economic sector resolution means data may be highly aggregated and therefore inaccurate when used in specific business contexts. The spatial granularity of MRIO databases is variable but some have some country-level information plus larger “rest of the world” regions included.	Shows trade flows and changes thereof between countries or industry sectors, but not between individual actors or businesses. Can be combined with life cycle assessment in hybrid methods to estimate impacts of business activities.

Table 4 3

Example categories	Coverage	Accuracy and spatial granularity	Responsiveness
Environmental-economic models			
General equilibrium models	Just like EE-MRIO, based on actual economic data per sector, provided as input-output tables. Depending on the database used, coverage of sectors and geographies differ.	Calculations of equilibrium between (final) demand and supply of goods and services based on cost equations. Outputs are given in product prices, wages and labour, assuming a preference for cost-minimization. The mathematical formulations represent a hypothetical state of balance or equilibrium in an economy, not necessarily a perfect reflection of reality.	Mostly suitable to analyze consequences of financial, technological, trade and economic policies that affect the financial performance of economic activities.
Integrated assessment models	Range from regional to global coverage, including different populations, economies and sectors. Different coverage of pressure and state variables.	Developed for assessing systemic change at higher levels of aggregation, of contrasting scenarios. As such, an important tool to investigate the inherent uncertainty of future pathways. Especially the geographic consequences in scenario analyses are limited.	Able to analyze consequences of changes in demographic and economic developments and interventions in production and consumption structures.
Key considerations for applying methods to assess impacts and dependencies			
Baselines and counterfactuals: Ecological methods to measure biodiversity and nature's contributions to people – whether using primary location-based field surveys or secondary information in spatial analysis – need to be coupled with protocols on spatial scale and appropriate baselines to support inferring impacts and implications for dependencies. Emerging methods for setting counterfactuals can support interpreting whether observed changes are a result of business activities or part of wider trends (Devenish *et al.,* 2022, 2024).			
Bundling uncertainties: 'Life cycle approaches' and 'economic-ecological modelling' carry varying levels of uncertainty as they convert available input data into estimated pressure and state outputs. These uncertainties have been categorized as epistemic, parametric, linguistic or of a decision-based nature (Bromwich *et al.,* 2025). These methods are often packaged together into commercial methodologies and tools, which in turn can compound their characteristics. For example, methodologies may combine values from a MRIO database, with the characterization factors building on each other, which affects the overall accuracy of the output.			
Scientific traceability: Many available tools have been developed for commercial purposes and not all have received traditional scientific peer-review. Therefore, the level of empirical testing or validation may vary. They may display significant variability in the degree to which scientific traceability is possible to discern and may have limited documentation. Insufficient documentation makes it hard for users to assess the validity of thresholds and metrics chosen and precludes evaluation of how capable a methodology is in delivering on its objectives.			

4.2.4 Scenarios

Business and policy decisions require an understanding of possible future trajectories and a means to explore possible outcomes of different decisions. Scenarios, through linking to models, can provide a systematic way of assessing the environmental consequences of alternative long-term socio-economic developments (IPBES, 2016). Scenario analysis is often applied in addition to the assessment of the current situation and past trajectories and can be used to inform stakeholders on how decisions and actions may contribute to societal goals.

In a business context, several reports (NGFS, 2023; TNFD, 2023a) emphasize the importance of using scenarios to inform strategy, specifically to understand potential future states of nature, examine trajectories of impacts and dependencies, and assess nature-related risks and opportunities. For example:

- Assessing 'business as usual' and other scenarios can help to evaluate potential global future developments under current and alternative policies, and thus identifying the need for action based on trajectories of impacts and dependencies (e.g., climate change affects

nature's contributions to people and might aggravate impacts of business actions).

- Scenarios can help understand potential changes (threats and opportunities) to the future supply chains of businesses (through changes in background data resulting from the scenario models). For instance, decarbonized electricity or increased use of biobased materials can alter impacts and dependencies in the future.

- Sector- and country-level results of scenarios can help identify the required or expected contribution of specific sectors/regions and potentially economic players to biodiversity loss. This might translate into policies and restrictions for businesses in the future.

- Scenarios can help identify acceptable or even sustainable pathways for the global economy that reach global biodiversity and climate targets, and identify the contribution of specific business actions in these pathways.

Business use of long-term global scenarios

Long-term global scenarios help understand business and financial implications of possible futures. A variety of scenarios of global development exist. For instance, the set of long-term scenarios based on shared socioeconomic pathways, which explore the potential future impacts of ongoing societal development on a global scale. They were designed to complement the representative concentration pathways, which focus solely on greenhouse gas emissions trajectories. There are five socioeconomic pathways scenarios, which can be used to calibrate integrated assessment models, leading to highly differing outcomes and thus normative choices and uncertainties. These global scenarios can inform a variety of models to investigate possible biodiversity outcomes, and the consequences of those for society and the economy (Simkin *et al.,* 2022). The uncertainty associated with models in scenario analysis is, however, poorly evaluated and no single set of scenarios and models can address all spatial and temporal scales. Participatory approaches to develop locally relevant scenarios and models are recommended for meaningful analysis at a finer spatial scale (IPBES, 2016).

Based on the IPBES Methodological Assessment Report on Scenarios and Models, experts engaged in a participatory process that led to the development of the Nature Futures Framework, for deriving multiscale and integrative nature-people scenarios (Pereira *et al.,* 2020). The Nature Futures Framework is a tool for modelling desirable futures, applying a multiscale approach, and explicitly incorporating diverse values and perspectives on human-nature relationships. The Nature Future's Framework builds on the values of nature (intrinsic, instrumental and relational) and provides an opportunity for businesses to forecast a wider set of impacts and dependencies on biodiversity (see **Section 4.3.3**).

Such global scenarios are not meant to predict the future, but to show the effect of a potential future state under the given assumptions. See for instance scenarios that combine pathways that meet targets for both limiting climate change, securing food supply and reversing biodiversity loss (Ambrósio *et al.,* 2024; Kok *et al.,* 2023; Leclère *et al.,* 2020).

Scenarios and financial risk

Some studies have assessed the consequences of long-term nature scenarios on the economy and financial stability of the economic system, both at the global level exploring systemic risks (J. A. Johnson *et al.,* 2021) and at a more regional level, investigating stability of financial of institutions in the European Union region (Boldrini *et al.,* 2023). Such studies assess outcomes of economic-ecological models and spatial ecosystem service models under a range of policy scenarios to support identification of future economic risks faced by sectors and regions. These studies provide a high-level understanding of potential risk that is useful to inform policy development, but assumptions and uncertainties inherent in these models limit their application in decision-making.

Scenarios can also be used to assess the economic and financial consequences of short-term sudden shocks in environmental conditions. This is consistent with the stress-testing performed by central banks to assess the financial stability of the financial system (banks, insurances, pension funds) under their supervision (Daniëls *et al.,* 2017; Holden, 2006). Shocks are defined as sudden disruptions (both severe and plausible) that may cause economic effects that undermine the financial position of businesses. An example could be the sudden collapse of pollinator populations that significantly impacts the yields of pollinator dependent crops (Dicks *et al.,* 2021). Examples of stress testing in the field of climate change are widely available (modelling shocks like heat stress or flooding) (Caloia & Jansen, 2021; Weber, 2024), and the existence of climate scenarios has informed assessments of climate-related risk as part of risk management and strategy processes (TCFD, 2020). For biodiversity this is less common, although TNFD (2023a) has tried to address the need to develop nature scenarios to move beyond static sensitivity analysis to a more dynamic assessment of nature-related risks based on plausible futures.

NGFS (2023b) define risk as a combination of three elements: hazards or shocks occurring, exposure of financial capital to these shocks, and vulnerability including the capacity to cope with the shocks. There are several methodological challenges in assessing risks related to impacts and dependencies on

biodiversity. For instance, the use of economic models based on generalized computable general equilibrium models is commonly used to assess changes in economic structures, related to transformative change, but due to the basic principle of calculating an equilibrium, they cannot provide information on shocks, limiting their usefulness in stress testing (Prodani *et al.,* 2023).

Interpreting scenario analyses

Lack of standardized modelling approaches, scenarios and timeframes makes it difficult to compare scenario-based assessments, as differences among modelling approaches and scenario runs can be high. This leads to several questions to be answered when interpreting results:

- What scenario or scenarios were chosen (e.g., shared socioeconomic pathways) and what do they consider (e.g., implementation of key international environmental agreements)?
- How does this scenario choice align with the purpose and timeframe of the scenario assessment? Global assessment scenarios are typically run for 2030, 2050, while financial institutions use scenarios with a 3–5-year time horizon for stress testing.

4.3 VALUES IN DECISION-MAKING

4.3.1 Indigenous Peoples' and local communities' values and knowledge

Incorporating IPLCs' knowledge and values in business impact assessment and management responses

IPLCs play a vital role in maintaining connections with nature and sustaining livelihoods and are central in achieving global commitments on biodiversity. The Kunming-Montreal Global Biodiversity Framework validates their importance as custodians of biodiversity and holders of broad traditional dynamic knowledge essential for its conservation, restoration and sustainable use (CBD, 2024). IPLCs' ways of life are directly associated with diversity in nature. For example, while just nine plant varieties represent 66 per cent of global agricultural production, the Indigenous Peoples of the Amazon use around 200 tree species as timber sources and 100 other species for several types of products (WWF, 2022). IPLCs' ways of life generate Indigenous and local knowledge about biodiversity and nature's contributions to people, which can match and enhance results from scientific enquiry (Danielsen *et al.,* 2014; Legge *et al.,* 2024; Nagendra & Ostrom, 2011; Zhao *et al.,* 2016), and can inform management interventions (e.g., management of wild fires (Rodríguez *et al.,* 2023)). Given the significant values associated with nature for IPLCs, the harm to nature caused by business activities can have severe consequences. Equally, business impacts on IPLCs can affect their stewardship of nature and further aggravate environmental degradation (IPBES *et al.,* 2024). Measurement methods that incorporate Indigenous and local knowledge and involve collaboration with IPLCs are needed to ensure that business impacts and response actions respect the values and rights of IPLCs alongside long-term conservation or business objectives.

Respecting the values and rights of IPLCs

To assess the holistic well-being of IPLCs, including the nature they steward, it is important to understand the ways in which IPLCs use and engage with nature, and how the activities of businesses may affect them. The monetary values of land and resources for businesses through their dependencies do not capture the broader values of other groups, such as cultural, spiritual and medicinal values. Still, Indigenous and local knowledge does not broadly inform business assessments, and there is limited consideration of the wider values of nature to IPLCs in business assessments of their impacts and dependencies on biodiversity.

Most impact measurement methods stop at biophysical impacts and neglect the consequences of biodiversity loss and ecosystem degradation for people. The use of metrics of nature's contributions to people and well-being can help address impacts on those that benefit from nature (see **Section 4.2.2**). However, these impacts can have particularly strong repercussions for IPLCs, since, in addition to supporting their economies and livelihoods, biodiversity is central to the identity, customs and traditions of many IPLCs. The value of nature to IPLCs cannot generally be adequately represented purely in monetary terms using traditional valuation methods, as these generally underestimate its importance. For example, many intangible benefits arise from the interconnections between economic and socio-cultural, spiritual and capacity benefits. These diverse values would therefore be excluded from the planning and implementation of business policies (Costanza *et al.,* 1997; Gosal *et al.,* 2018; Sangha *et al.,* 2019).

Addressing this requires first and foremost recognition and respect for IPLCs' own valuation systems and perspectives. Complementing this, there are a range of techniques that can supplement business valuation of biodiversity dependencies and impacts to better incorporate the values of IPLCs. These include methods for non-monetary valuation of cultural ecosystem services, which covers a collection of methods that gather information about

emotions, symbols, cognition or ethics related to the importance of biodiversity using quantitative, qualitative, hybrid and deliberative methods (Arias-Arévalo *et al.,* 2018). Governments and businesses must also make an effort to understand – through collaborative approaches with IPLCs the extent of business impacts on IPLCs. These can include, for example interruption of food supply and quality, loss of traditional knowledge and cultural identity, or loss of sacred places for ritual practices (Yletyinen *et al.,* 2022).

Social and cultural impact assessments and social indicators of business activities can be used alongside those that measure the state of nature and nature's contributions to people (see **Section 4.2.2**). These should adhere to clear performance standards that recognize traditional knowledge and sacred sites, including those adopted by the Conference of the Parties to the Convention on Biological Diversity (CBD, 2004), and should involve affected IPLCs in the assessment and decision-making process. Indicators related to social performance may exist in some circumstances as a means of maintaining a social license to operate that relates to the acceptance and approval of a business activity by local community members and stakeholders (Bice & Moffat, 2014). However, the full relationship between impacts on biodiversity and impacts on IPLCs from business activities is rarely captured. Social indicators should assess both outcomes (harm to people that is linked to biodiversity loss) and processes (e.g., effective participation of IPLCs in decision-making processes that affect their rights, cultures, livelihoods and lands and the use of genuine free, prior and informed consent processes). Unfortunately, many existing frameworks and guidelines for consulting IPLCs fail to incorporate many of the indicators used to measure impacts on them (Instituto Kabu *et al.,* 2022; Juruna da TI Paquiçamba *et al.,* 2017; Povo Munduruku/Takuara & Conselho Indigenista Missionário, 2021; Yanomami *et al.,* 2019). Integrating Indigenous perspectives into ecosystem accounting is also a critical area for further work (see **Section 4.6**).

Improving decision-making through incorporating Indigenous and local knowledge

Beyond respecting special rights of Indigenous Peoples and also the relevant rights of local communities, it is important to acknowledge the role of Indigenous and local knowledge to improve business assessments and responses, and therefore to reduce impacts on biodiversity (and people) at the local level. So far, Indigenous and local knowledge has not been incorporated in the widely used indicators on biodiversity and nature's contributions to people, although there is potential for it to significantly enhance the quality of decision-making. Emphasis must be placed on co-development of measurement and monitoring frameworks with IPLCs. This requires a focus on dialogue and co-learning, where the autonomy of Indigenous Peoples is recognized, self-determination and nationhood is honoured, and Indigenous knowledge systems are recognized (Agrawal, 1995; Reed *et al.,* 2023).

IPLCs monitor the impact and dependence on biodiversity and nature's contributions to people using proprietary methods through observations of biodiversity over time. This is distinct from scientific research, which often relies on periodic monitoring (Peacock *et al.,* 2020a) and is not as representative of the diverse values of biodiversity. Some scientific methods may also be considered disrespectful or inappropriate by Indigenous and local knowledge holders, for example because they harm animals or generate changes in animal behaviour (IPBES, 2024).

Indigenous and local knowledge methods include, for example, the perception of the abundance and diversity of species, or the flow of nature's contributions to people such as food and water. Indigenous and local knowledge often provides insights on the interaction between species abundance or behaviour and environmental conditions (IPBES, 2024; Stewart, 2023). Often the records of these observations do not follow conventional methodological standards and they may be recorded in maps, calendars, life plans, and stories – or they may not be captured at all. In addition, different forms of knowledge may be held by different members of the community. For example, in some places, women may have a greater knowledge of the location of certain medicinal plants, and children may hold knowledge of bird species, due to the unique interactions with them in everyday life (IPBES *et al.,* 2024).

Indigenous and local knowledge indicators can sometimes be termed biocultural as they jointly consider biodiversity and human quality of life. They are locally-based, contextualized indicators that can generate an understanding of diverse phenomena in remote locations. Indigenous and local knowledge indicators can be considered accurate as they reflect local specificities and values, but they are difficult to upscale (McElwee *et al.,* 2020). Indigenous and local knowledge can however provide relevant input data for models (for example, it can be considered in the Integrated Valuation of Ecosystem Services and Trade-offs Models (InVEST)).

Critically, however, Indigenous and local knowledge should be used on the basis of collaboration and agreement with knowledge holders, in processes that include knowledge-holders in interpretation and decision-making, rather than extracting Indigenous and local knowledge for potentially inappropriate use in external, non-consensual ways (IPBES, 2024). In fact, translating Indigenous and local knowledge into external scientific systems is often inappropriate as it is learned in practice and cannot always be taken out of context. In addition, some forms of knowledge are sacred.

There are, however, many examples of community-based monitoring programmes that combine Indigenous and local knowledge and scientific methods, that demonstrate how this can provide a more holistic understanding than conventional science can provide alone (Peacock *et al.,* 2020b). For example, in the Arctic region, community monitoring of biotic, abiotic and socio-cultural components including methods such as transects, interviews, focus groups and participatory mapping exercises has been used to inform natural resource management, commercial fisheries, tourism, industrial development, and planning for oil and gas (Murray *et al.,* 2014). A further example is the Imalirijiit project in Quebec, Canada where a partnership between the local community and researchers monitored the biodiversity and water quality in response to rare earth mining projects using a variety of Indigenous and local knowledge and scientific methods (Imalirijit and Nunami Sukuijainiq, 2020).

Such integrated knowledge can provide a more comprehensive understanding of the impacts of business activities on biodiversity and nature's contributions to people. There are some examples of this informing business responses. For example, the Moana project in New Zealand, which built a bridge between traditional Indigenous knowledge and science to inform the seafood industry, highlighting the important role of collaboration rather than consultation to bring knowledge systems together. Examples of business uptake of this form of knowledge outside of IPLC businesses themselves are less apparent in the literature. (Souza *et al.,* 2023).

4.3.2 Underlying value assumptions in methods and metrics

Valuation in the context of biodiversity is a process of formulating 'indicators of quantitative measures (monetary or non-monetary) and qualitative preference rankings/ratings, perceptions and Indigenous and local knowledge narratives that indicate importance of nature to people' (IPBES, 2022). Different methods for assessing impacts and dependencies of businesses on biodiversity, apply different value assumptions and implicit worldviews **(Table 4.3)** (IPBES, 2022; Pascual *et al.,* 2023), which has important implications for how interactions between businesses and biodiversity are framed in terms of materiality, responsibility and accountability (discussed further in **Section 4.6**).

Methods that produce biophysical metrics of impacts and dependencies (reviewed in **Section 4.2**), without any further specific valuation tools or methods applied, cannot be assumed to be neutral. Metrics are often interpreted compared to reference or target ecological states that are defined through non-neutral scientifically informed socio-political and legal processes (Bouleau *et al.,* 2009, 2017). For example, where impacts on species populations are compared to national or global targets on reducing extinction risk, impacts are largely valued based on a biocentric worldview assuming an intrinsic value of biodiversity.

Table 4.4 **Worldviews and value lenses that influence the interpretation of business impacts and dependencies.**

The lines of the table are based on the categories of the IPBES Values Assessment (IPBES, 2022; Pascual *et al.,* 2023).

Worldviews	Interpretation of business impacts and dependencies on biodiversity	Example measurement methods that support interpretation
Living from or in nature **Anthropocentric (prosperity, livelihoods, health)** **Specific values: instrumental**	Business impact on biodiversity as the degradation (or improvement) of utility and instrumental values of nature's contributions on which this given business or other organizations or society depend.	Biophysical methods for dependency measurement Market and non-market economic valuation methods of impacts and dependencies as well as the assessment of impacts to health or other components of wellbeing
Living with nature **Bio/ecocentric (stewardship, responsibility)** **Specific values: intrinsic**	Business impact on nature valued as a degradation (or improvement) of biodiversity and ecosystem condition based on their intrinsic value. Reference levels for degradation/improvement established based on scientifically informed social-political and legal processes.	Biophysical methods for impact measurements Conservation and restoration cost methods
Living as nature **Pluricentric (oneness, harmony with nature)** **Specific values: relational**	Business impact and dependencies on nature valued as a degradation (or improvement) of biodiversity and ecosystem condition and the relational values associated with their conservation in specific places, as established through socio-cultural and political processes.	Biophysical and socio-cultural valuation methods

Methods that further interpret biophysical metrics by applying market and non-market economic valuation methods (described in **Chapter 2**) are based on an anthropocentric worldview that conceptualizes biodiversity as a source of economic or utilitarian value for the business or society (notably through nature's contributions to people). Impacts on biodiversity can cause changes in the provision of nature's contributions to people that result in a gain or loss of wellbeing of people or business profits. Monetary values can then be derived through understanding the market and non-market values of these changes in nature's contributions to people (Dasgupta, 2021).

Other monetary valuation methods used in the context of business impact and dependency assessment can be consistent with a biocentric or pluralistic worldview. Methods based on conservation or restoration costs can capture the costs of the actions required to achieve a target state determined by a diversity of values (European Commission *et al.,* 2024, pp. 292–294; Kervinio *et al.,* 2023; Rambaud, 2024; Vanoli, 1995). For instance, in a biocentric worldview, companies would need to estimate the costs of the actions necessary to preserve and restore ecosystems previously impacted by their productive activities (Rambaud, 2024).

4.4 MEASUREMENT METHODS IN DECISION-MAKING

There are a variety of purposes for impact and dependency measurements. This assessment distinguishes four types of primary business purposes for which measurement methods can be applied at all levels of decision-making. These purposes often form part of secondary purposes such as risk and opportunity identification, commitment and target setting and reporting:

- **'Screening'** – identifying priorities requiring further analysis or action.

  In life cycle assessment and biodiversity literature screening is also referred to as 'hotspots analysis' (Damiani *et al.,* 2023). Its purpose is to identify areas of particular importance (geographically or along the value chain) to guide further analysis or action. These purposes can rely on high-level proxy information about the potential impacts and dependencies associated with a given activity, product or business, or the location where those activities occur.

  Examples: Identifying investment portfolios of an asset manager with the highest impacts or dependencies on biodiversity, identifying product portfolios or business areas with the highest impacts, identifying types of materials or supply chains with the highest impacts and dependencies, identifying operational locations with the greatest sensitivity.

- **'Comparing options'** – evaluating potential impacts and dependencies of business activities relative to alternatives.

  This relates to evaluating potential impacts and dependencies of business activities that affect or depend on biodiversity to compare against alternatives. It can support investment decisions, product or process design decisions, supplier or site selection through understanding the expected relative impact or dependency of a given investment, product or operation relative to an alternative. This purpose can rely on proxy information about potential impacts and dependencies but the information needs to be comparable between specific investments, products, operations, etc.

  Examples: Portfolio manager choosing individual securities for an investment fund, manufacturer choosing the types of raw materials for a product, or a specific supplier, and business assessing the relative impact of proposed new acquisitions.

- **'Tracking change in pressures or reliance'** – as part of an impact assessment, the potential or actual change in pressures over time, or as part of a dependency assessment, the change in reliance of business activities on nature's contributions to people over time.

  This purpose requires time series information to assess how potential impacts or dependencies are changing over time.

  Examples: Asset manager tracking the change in the overall biodiversity footprint of all investment portfolios over time, corporation assessing the change in its biodiversity footprint, manufacturer tracking the change in the extent of dependencies of the business on biodiversity, credit analyst assessing the change in the risk profile of an investee business.

- **'Observing changes in biodiversity'** – showing positive or negative changes in biodiversity and nature's contributions to people that can be attributed or linked to the business activities or action on biodiversity.

  This involves monitoring changes in biodiversity and ecosystem service metrics. For example, the extent and condition of ecosystems, species populations and extinction risk, or the availability of water supply or pollination services that may be impacted or depended upon. Observing outcomes can also involve monitoring

changes in the benefits of nature's contributions to people and human wellbeing. This type of measurement can be done through location-based observations as well as participatory mapping and monitoring. For impacts, these changes need to be able to be attributed to the business activities, and for dependencies, these changes need to be linked to the nature's contributions to people the business relies on.

Examples: Mining business measuring changes in ecosystem condition at their operations, food business measuring changes in pollinator abundance in a key sourcing region, governments measuring the extent of natural ecosystems in an agricultural landscape, a non-governmental organization measuring changes in populations of migratory marine species in areas of offshore energy development.

Each of these four business purposes requires methods with the appropriate set of characteristics, with increasing accuracy and responsiveness when moving from screening to observing changes **(Figure 4.2)**. The characteristics required for a method to be fit for purpose also depend on the level of decision-making. Portfolio-level decisions can rely on less accurate information as long as it has the appropriate coverage geographically, typically global, and includes all significant pressures and dependencies. For operational decisions, accurate methods become more critical, and the methods need to be location-specific but not globally comparable. These two ends of the measurement spectrum can broadly be described as 'top-down' assessment primarily based on models and secondary data, and 'bottom-up' assessment based on observing realized outcomes with on-the-ground data **(Figure 4.2)**. Not all methods can serve all purposes and each carries limitations.

Most of the 'top-down' methods are based on input data representing sectoral or product averages. For life cycle approaches, large databases are often needed to generate the inventory for the assessment, mostly for data on processes happening in the background (e.g., the production of fuel and a farm machine, such as a tractor, for the field operation for an agricultural field). A wide range of tools have been developed to support top-down assessments, including many that are listed by industry accountability initiatives such as the TNFD tools catalogue (TNFD, 2025a) and the SBTN step 1 toolbox (Science Based Targets Network (SBTN), 2024). These vary in their scope, coverage of biodiversity, and practicality of application (Barth *et al.,* 2025). Top-down assessments can be supported by biodiversity databases and spatial layers such as Projecting Responses of Ecological Diversity in Changing Terrestrial Systems (PREDICTS) (Hudson *et al.,* 2017) that shows sensitivity of species towards human pressures, the Global Biodiversity Information Facility (GBIF) that currently holds 3 billion species occurrence records, and data layers within the Integrated Biodiversity Assessment Tool (IBAT, n.d.).

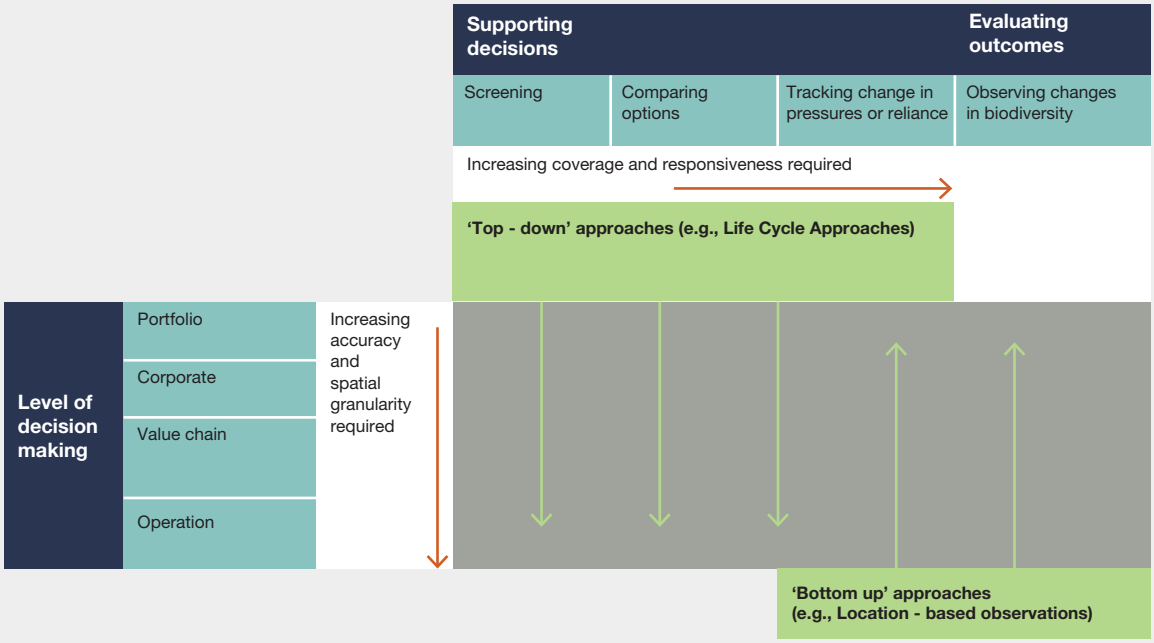


Figure 4 2 **The relative application of top-down and bottom-up methods at different levels of decision-making and for different purposes of decision-making.**

Bottom-up assessment methods are based on directly measured quantitative or qualitative data. The outputs of bottom-up methods can feed into secondary datasets used in spatial analysis (Hawkins *et al.,* 2023). These can also feed into top-down methods to improve their accuracy and in theory can be aggregated to carry out impact assessments for entire portfolios or businesses. However, on-ground assessments are currently limited in geographical coverage and are not standardized for the purposes of aggregation. At best data would only be available for the most material impacts of a business's value chain or for a business with a small geographic scope. Data availability therefore underpins the suitability of method applications.

Efforts are ongoing to connect the biodiversity monitoring efforts underway across the globe through digital systems, such as the Global Biodiversity Information Facility and stakeholder networks (Kühl *et al.,* 2020). Nonetheless context-specific information that represents the values of diverse stakeholders at locations remains challenging to scale. Further research and discussions on aggregation and for setting standards are required. Therefore, it is currently not possible to measure the realized outcomes of decisions made at the portfolio and corporate level, and for value chains this remains limited to specific commodities and geographies.

Business decision-making level	Purpose of measurement	Method categories				
		Location-based observation Involves using direct measurements at specific locations, including field observations and remote sensing	**Participatory mapping and monitoring** Involves collaboration with external stakeholders, rights holders or communities, including Indigenous Peoples and local communities	**Spatial analysis** Includes overlays of spatial data layers, and ecological and hydrological modelling	**Life-cycle approaches** Includes full life-cycle assessments and various forms of environmental footprinting	**Macro-scale environmental economic models** Includes qualitative and quantitative approaches
Operations Business operations carried out at sites under the direct control of the business entity		✓	✓	✓	✓	✗
		✓	✓	✓	✓	✗
		✓	✓	✓	✓	✗
		✓	✓	✓	✗	✗
Value chain Activities beyond the direct control of an individual business entity, involving suppliers, manufacturers, distributors, retailers and customers		✗	✗	✓	✓	✗
		✗	✗	✓	✓	✗
		✓	✓	✓	✓	✗
		✓	✓	✓	✗	✗
Corporate A business or group of business entities, typically within an industry, governed as a single organization		✗	✗	✓	✓	✓
		✗	✗	✓	✓	✓
		✗	✗	✓	✓	✗
		✗	✗	✗	✗	✗

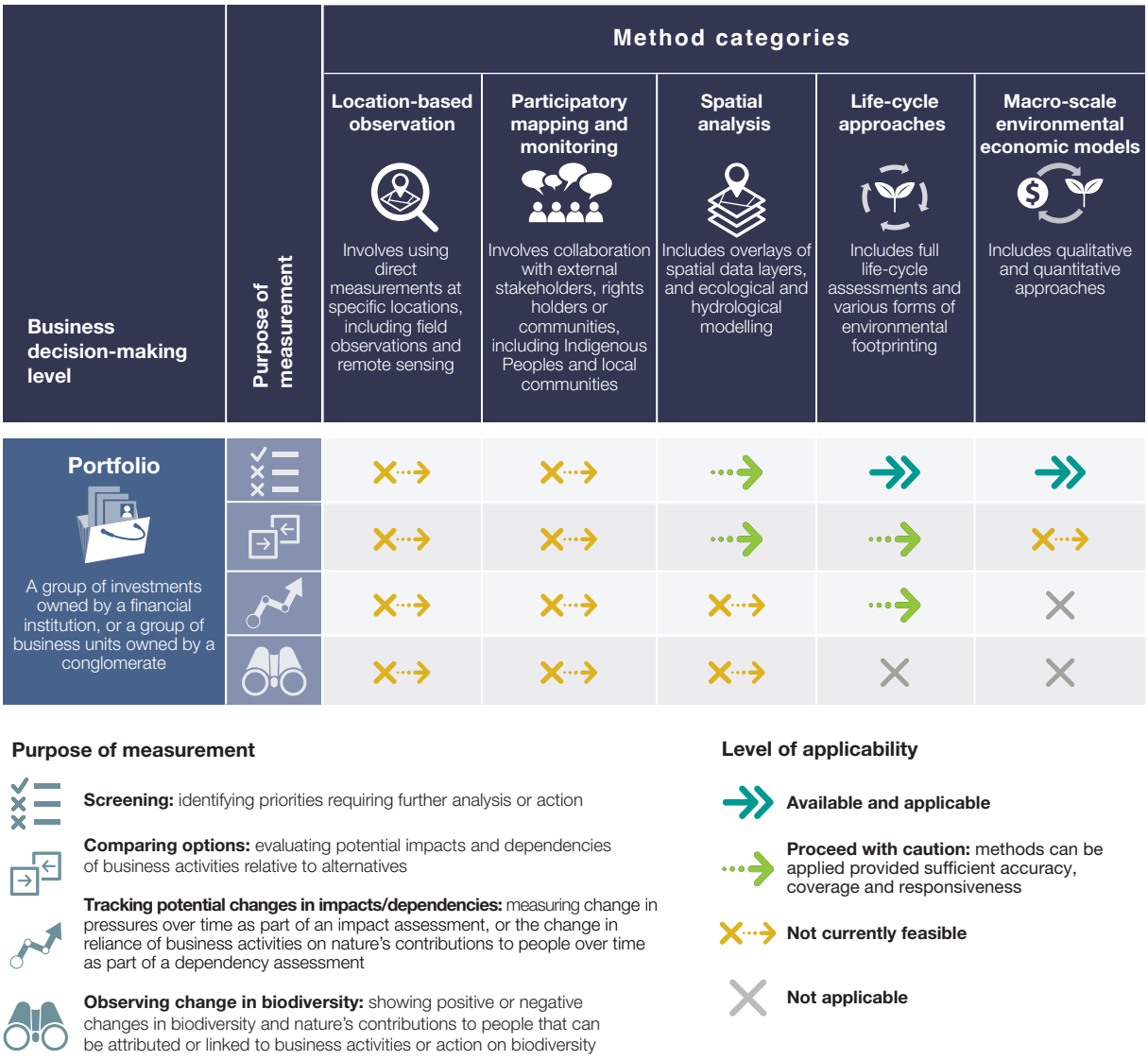


Figure 4 3 **Suitability of various categories of methods to measure impacts and dependencies for different business purposes at different levels of decision-making.**

4.4.1 Portfolio-level decision-making

Examples of business decisions at the portfolio level:

- **Screening:** asset manager or asset owner wanting to understand impacts and dependencies across their investment portfolios.
- **Comparing options:** portfolio manager choosing a business to add to their portfolio. Business conglomerate deciding on an acquisition.
- **Tracking change in pressure/reliance:** asset manager, asset owner or a conglomerate assessing and reporting on progress towards pressure-based targets.

Portfolio manager assessing changes in potential biodiversity impacts or dependencies of their portfolios.

- **Observing change in biodiversity:** financial institution or a conglomerate claiming a positive change in biodiversity attributable to their investments.

Both environmental-economic models and life cycle approaches can be used for screening purposes due to their wide coverage of business activities and wide geographic scope (Kulionis *et al.,* 2024). While MRIO-based methods can provide reliable results at a macroeconomic level, uncertainty increases as the models are used to investigate individual sectors, businesses and products

(Moran *et al.,* 2016). Qualitative tools, such as ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure), can also help to identify hot-spot areas within financial portfolios or parts of portfolios that are particularly dependent on, or impacting biodiversity based on non-spatial industry average information. These methods can therefore identify priority areas of the portfolio for further analysis and have informed a number of macro-economic studies on risk exposure. Some studies are starting to incorporate an understanding of the location-specific status of biodiversity and nature's contribution to people through spatial analysis but this remains limited due to a lack of location-specific asset-level data (Green Finance Institute, 2024; van Toor *et al.,* 2020).

Life cycle approaches can be used to compare the relative impact and dependency of portfolios based on the estimated pressures and reliance on nature's contributions to people of activities within a portfolio. Where more business-specific information can be obtained, these methods can also track changes over time. For example, asset managers could potentially use lifecycle approaches or data derived from them to track change in the overall biodiversity footprint of all investment portfolios over time.

Spatial analysis can also be used for screening and comparing purposes where asset-level location data are available and cover all the geographies relevant to the portfolio. Asset-level data is cited as a key barrier by financial institutions (Christiaen *et al.,* 2025). As global databases of field measurements based on location-based observations evolve, the utility of spatial analysis is likely to increase. However, given the breadth of impacts and dependencies across portfolios it is currently not feasible to measure the change in the state of nature at this scale to determine realized outcomes of portfolio decisions or the resilience of nature's contributions to people underpinning portfolio investments. The relationship between secondary investment or divestment and social and environmental outcomes remains debated and there remains a need for greater empirical evidence to inform decision-making at this level (Kölbel *et al.,* 2020).

Biodiversity footprint datasets currently available on the market for financial institutions can be categorized as life cycle approaches but are typically based on generic multi-regional input-output databases. These do not capture key value chain nuances that differentiate the actual performance of corporations, for example types and origins of materials within the supply chain. These can be useful for screening purposes, but not for investment decisions concerning individual business portfolios. There are also considerable gaps between the metrics that they cover and what is needed to support the goals of the Kunming-Montreal Global Biodiversity Framework (Zhu *et al.,* 2024).

4.4.2 Corporate-level decision-making

Examples of business decisions at the corporate level:

- **Screening:** to understand impacts and dependencies across the whole business to prioritize further action.
- **Comparing options:** setting corporate targets. Informing business model options.
- **Tracking change in pressure/reliance:** business assessing and reporting on progress towards its targets linked to reducing impacts.
- **Observing change in biodiversity:** business claiming a positive change in biodiversity attributable to its activities.

Similar to portfolio-level decisions, economic-ecological models and life cycle approaches can support initial screening to prioritize hot-spot areas for action. Spatial analysis can also be used providing it has sufficient geographical coverage, and the business has known or estimated location information across operations and value chains.

Life cycle approaches can be used to set and track progress on targets, provided that the methods are responsive enough, i.e., they recognize changes in pressures resulting from strategic changes in business activities. For example, actions such as establishing biodiversity conservation areas or shifting to less intensive land use can be recognized by a life cycle assessment but only if it is based on a detailed inventory of local land use. MRIO-based methods are not specific enough for this purpose.

Location-based observations and participatory approaches are required to assess outcomes for biodiversity, and while applicable for priority locations, are generally impractical for use across corporate levels.

4.4.3 Value chain-level decision-making

Examples of business decisions at the value chain level:

- **Screening:** to understand impacts and dependencies of materials and sourcing regions for one or more of its products.
- **Comparing options:** choosing input materials for a new product or choosing suppliers.

- **Tracking change in pressure/reliance:** assessing and reporting change in impacts or dependencies from adopting a product or switching suppliers.
- **Observing change in biodiversity:** business claiming a positive change in biodiversity attributable to a new product or supplier.

Decisions at this level typically involve product or process design or sourcing and supplier choices. Used with caution, life cycle approaches can be helpful to inform these choices. Life cycle assessment is a key method for assessing broad life cycle impacts and incorporating multiple drivers of biodiversity loss (Hellweg & Milà I Canals 2014), and as such can be integrated in research and product development processes to prioritize product designs with lower potential impacts on biodiversity. These methods bring varying levels of uncertainty with regards to data inputs, coverage and scope of business activities and therefore their application needs consideration of the specific context (Bromwich *et al.,* 2025). To provide comparable results across multiple pressure types, proxy endpoint biodiversity metrics are sometimes used. Although these methods continue to evolve, their coverage of biodiversity components and ability to recognize the spatial variability and local specificity remains limited.

Life cycle approaches can be used together with spatial analyses that incorporate secondary biodiversity data to screen and compare potential impacts and dependencies across suppliers and geographical regions. However, this information should not be directly used for selecting options, for example by an automatic exclusion of whole regions from supply chains. There can still be sustainable practices in high-risk regions. Suppliers from higher-risk regions (identified in the screening phase, or by a due diligence approach) can be scrutinized more carefully using location-based observation and participatory methods, or more detailed inventory data that can better represent actual practices. The application of these methods requires spatially explicit information on the location of activities, and while availability is increasing for direct operational assets for some sectors, it is largely lacking for business value chains (Christiaen *et al.,* 2025). A growing number of supply chain tools and initiatives are emerging but there remains a need for granular information on type and extent of activities at specific locations, and business-specific data collection (Beck-O'Brien & Bringezu, 2021).

To measure the outcome of sustainable practices and choices for specific value chain locations where known, location-based observation and participatory methods are required. Outcomes need to be defined locally and involve the active participation of local stakeholders, including IPLCs. It is feasible to use participatory methods and location-based observations to measure change in biodiversity within value chains, although for cost and operational reasons it is challenging for corporates to do that at scale. To achieve transformative change, these methods would need to be scaled up across whole corporate value chains.

4.4.4 Operational-level decision-making

Examples of business decisions at the site level:

- **Screening:** to identify high priority sites for management action.
- **Comparing options:** comparing sites for acquisition.
- **Tracking change in pressure/reliance:** assessing and reporting change in impacts or dependencies from choosing specific sites *versus* others.
- **Observing change in biodiversity:** assessing effectiveness of mitigation measures or resilience of dependencies at a specific location.

Top-down methods are generally not appropriate for estimating the potential impacts and dependencies associated with specific business operations. Economic-ecological models lack the spatial specificity, and life cycle approaches can support an assessment only when spatially resolved input data are included. While it is possible to compare operational sites where data and models are available, this comparison is generally not appropriate to support operational decisions.

Provided there is sufficient resolution and accuracy, spatial analysis can be used to assess changes in drivers or outcomes for biodiversity at specific operational sites, but such methods are limited in the variables they measure and ability to represent locally specific values.

Decisions concerning operational locations such as site design or management practices at sites require information from location-based observations or participatory mapping and monitoring. This has long been recognized by best practice standards for biodiversity baseline studies (e.g., guidance produced by an industry initiative across finance and extractive sectors (Equator Principles, 2022). These methods are required to observe changes in biodiversity to demonstrate outcomes and understand resilience of the nature's contributions to people provided. While efforts to standardize the state of nature metrics for this purpose continue, methods that recognize diverse forms of knowledge and values can and should be used to measure outcomes at this scale (Strange *et al.,* 2024). The use of field surveys and participatory mapping and

monitoring that include Indigenous and local knowledge can best consider local specificities and values. Attributing biodiversity outcomes to individual business activities and actions requires the use of counterfactuals, as well as qualitative methods based on expert and local stakeholder perceptions and knowledge (Zavaleta Cheek *et al.,* 2023). Remote sensing, if of sufficient resolution, is a more scalable approach to track change in the distribution of certain ecosystems over time. It is generally less accurate and more limited in the scope of biodiversity and nature's contributions to people that can be measured (e.g., forest cover change), compared to field surveys, but can be effectively combined with location-based observations for a more cost-effective assessment across wider scales (Rhodes *et al.,* 2015).

4.5 UPTAKE OF BIODIVERSITY IMPACT AND DEPENDENCY MEASUREMENT METHODS BY BUSINESSES

Although many methods, metrics and tools are available for assessing business impacts and dependencies (see **Chapter 2** and **3** and **Section 4.2**), uptake by businesses has been limited (Addison *et al.,* 2018, 2019). Evidence shows that businesses disclose information about biodiversity and natural capital for a variety of reasons, primarily driven by shareholder and regulatory demands, reputational concerns, and financial considerations (Hassan *et al.,* 2022; MSCI ESG Research, 2023). Emerging policies are expected to drive an increase in nature-related assessments by businesses in the future. Examples of this include the Corporate Sustainability Reporting Directive in the European Union, the Canadian Sustainability Disclosure Standards, the Australian Sustainability Reporting Standard, and taxonomies for sustainable activities in many geographies. Furthermore, the United Nations Environment Programme Finance Initiative (UNEP FI) and the World Wide Fund for Nature (WWF) reported that at least 29 jurisdictions around the world have formulated nature-related considerations in policy frameworks for the financial sector.

4.5.1 Analysis of business reports on impacts and dependencies

A keyword search was performed across the Alphasense database (AlphaSense, Inc., 2025) of published business reports covering around 68 000 businesses worldwide.[4]

This showed that less than 1 per cent of businesses (around 500 within the database) refer explicitly to 'biodiversity loss' and 'biodiversity impacts' in their reports over the last 10 years. These 500 businesses mention general environmental assessment approaches, like water and carbon footprints with a relatively high number referring explicitly to life cycle assessments. The drivers of change most often mentioned were land use (change and occupation) and greenhouse gas emissions, but also invasive species. About 250 businesses mentioned biodiversity footprint or biodiversity impact assessments. A longitudinal analysis shows that the use of the term 'carbon footprinting' started to increase around 2007, 'water footprinting' approximately five years after that, and 'biodiversity footprinting' only since 2020 **(Figure 4.4)**. Location-based observations such as field surveys are hardly mentioned, although these types of methods are potentially more likely to appear in operational-level management reports rather than corporate level reporting.

Over 500 businesses refer to biodiversity features such as threatened, protected or invasive alien species and intactness/naturalness, and 360 businesses refer to species richness. More specific biodiversity metrics like 'potentially disappeared fraction of species' and 'mean species abundance' (that are often used in life cycle assessment and environmentally extended multi-regional input-output methods) are only referred to by tens of businesses.

While around 500 businesses mention 'natural capital' or 'ecosystem services', 'dependencies on nature' is found far less. The term 'nature related risks' was referred to by around 450 businesses and might be considered to encompass the way businesses view 'dependencies' for instance when it relates to physical risks.[4] There are only limited results for the specific methods that are used in dependency assessments, with the highest score for natural capital accounting. More specific methodologies like economic or monetary valuation show very low scores, which may indicate that these methods – that are well represented in academic literature on ecosystem services – have not been used for business reporting. Individual components of nature's contributions to people are mentioned more frequently. Water-related contributions, pollination and genetic diversity are referred to by about 500 businesses.

The Integrated Biodiversity Assessment tool (IBAT) was the most referenced tool (around 300 businesses) in the context of impact assessment. Around 200 to 300 reporting businesses mention other widely known tools like ENCORE, and World Wide Fund for Nature's Biodiversity Risk filter that provide an understanding of both impacts and dependencies (UNEP-WCMC & Natural Capital Finance Alliance, 2020). Several of the comprehensive tools that can be used to assess dependencies on multiple ecosystem

4. Data management report referring to an uptake analysis on approaches for measurement of business impacts and dependencies on biodiversity and ecosystems https://doi.org/10.5281/zenodo.12786115

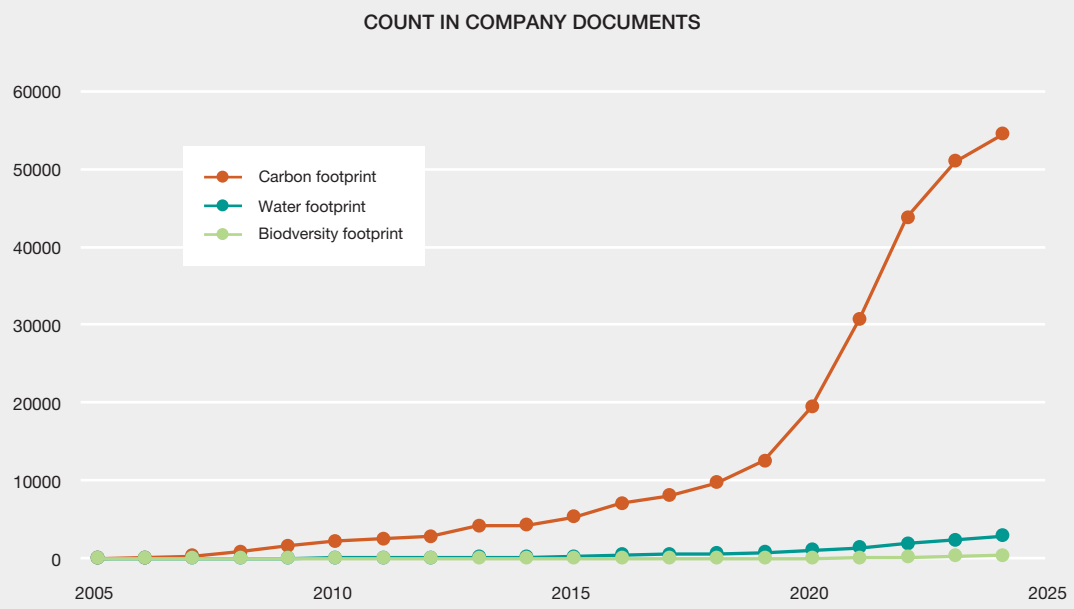


Figure 4 4 **Trend in total word use in business documents of footprint keywords.**

services are mentioned, with over 500 businesses referring to World Wide Fund For Nature's Water risk filter and the World Resources Institute's Aqueduct Water Risk Atlas. Water has been identified as a major natural resource in several analyses of financial exposure to ecosystem services due to its importance across sectors (Boldrini *et al.,* 2023; Svartzman *et al.,* 2021; van Toor *et al.,* 2020). The Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) model that is often encountered in academic literature on ecosystem assessments (R. Chaplin-Kramer *et al.,* 2019) is mentioned in only a few reports. The market for tools available to businesses is developing quickly, so it is not possible to provide an accurate view on the uptake of all branded tools.

4.5.2 Sectoral and regional patterns

There are strong sectoral and regional patterns of keyword use.[5] Disproportionately more businesses in the materials (mining, forestry, construction), financial (banks, insurance and mortgages) and industrial sectors mention biodiversity-related keywords in their reports. Together, these sectors are responsible for about 50 per cent of all mentions. Disproportionately more businesses from Central and Western Europe and North America report on biodiversity impact keywords (together almost 70 per cent of all keyword scores), while North-East Asia is responsible for another 12 per cent. Businesses from Europe, North America and Asia are also more present in reporting on dependencies on biodiversity. There is also a significant number of businesses from South Africa, while businesses in the rest of Africa rarely mention biodiversity.

4.5.3 What's causing the low uptake?

Analyses based on keyword searches of disclosure has limitations, as it does not consider the context in which the keywords are used. Nonetheless uptake can be considered low based on these results, which can be explained by several causes. A discrepancy and time-lag has been mentioned between scientifically available metrics, methods and tools and their practical application by businesses (Carvalho *et al.,* 2023; Maas *et al.,* 2024). Time-lags between method development and uptake can be due to cost barriers and knowledge gaps in businesses. It may also be due to the perceived complexity of the biodiversity concept by businesses, where biodiversity and nature's benefits cannot be easily covered by a single approach or metric (Addison *et al.,* 2018, 2019; Bull *et al.,* 2022; Lambooy *et al.,* 2018).

5. Data management report referring to an uptake analysis on approaches for measurement of business impacts and dependencies on biodiversity and ecosystems https://doi.org/10.5281/zenodo.12786115

4.6 EMBEDDING BIODIVERSITY METRICS AND VALUES IN BUSINESS FUNCTIONING, GOVERNANCE AND ACCOUNTABILITY PRACTICES

4.6.1 Approaches for integrating metrics and values of nature into business accounts

Within 'business as usual', accounts of stocks, flows, transactions, budgets and debts are the dominant information used to support both internal strategic management, decision-making and external reporting by businesses. Through systematically recording, classifying, summarizing and assessing organizational events, use of resources as well as financial and non-financial performances, a business takes informed judgements and can be held accountable by stakeholders (Breton, 2018; Carnegie *et al.,* 2021; Duncan, 1909; Richard & Collette, 2008). Transforming these accounting systems and processes to integrate metrics and values (monetary or non-monetary) of nature can therefore underpin transformation of how businesses manage their impacts and dependencies and are held accountable for their interactions with biodiversity.

Approaches and associated methodologies for integrating metrics and values of nature into organizational processes and accounting systems were reviewed.[6] These approaches are not neutral as they are based on social choices and

6. Data management report referring to a snowball search of the academic field of biodiversity accounting https://doi.org/10.5281/zenodo.12785745

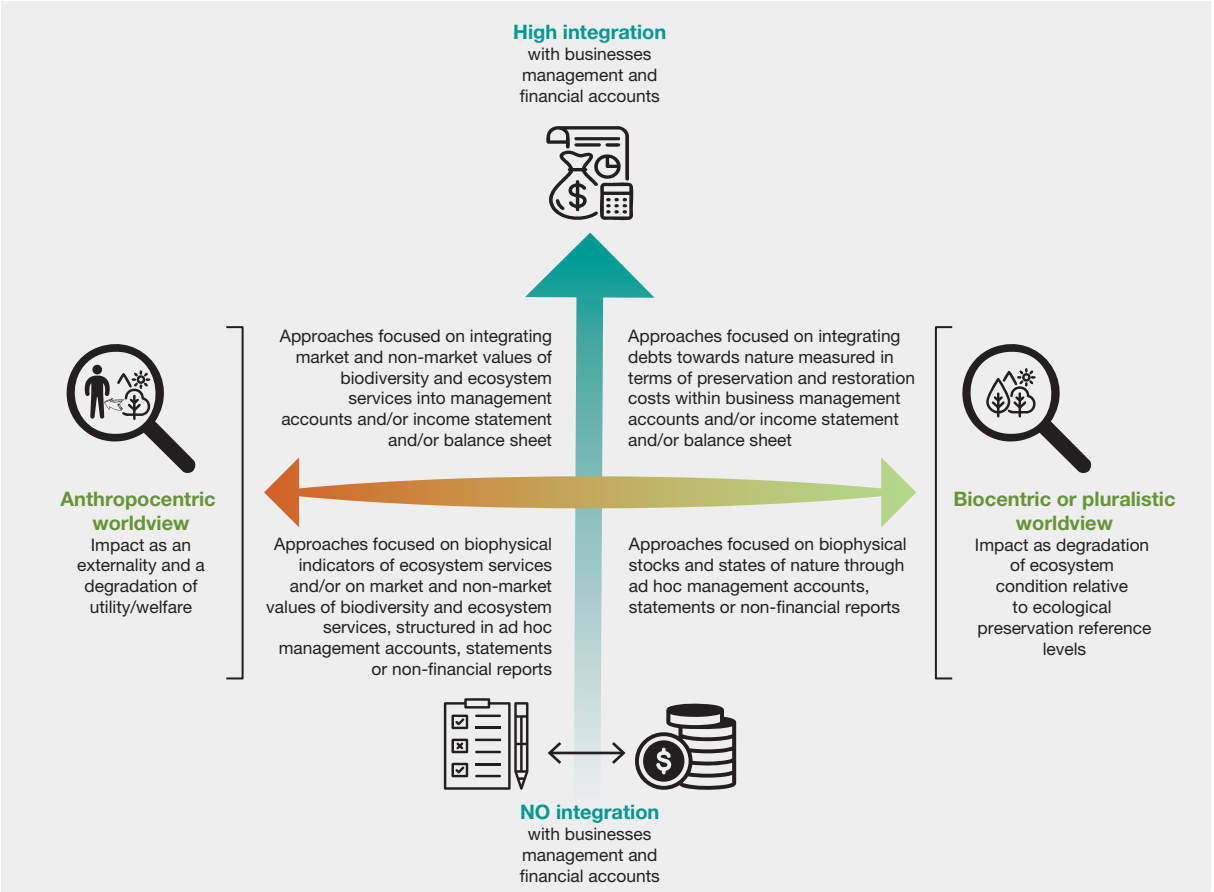


Figure 4 5 **Two main axes distinguish approaches for integrating metrics and values of nature into organizational accounting systems and processes: worldview and level of integration within conventional business management and financial accounts.**

Four main approaches are identified along these axes. For approaches in the upper part of the diagram, monetary valuation is deemed necessary to allow integration of nature metrics and values into business financial accounts and reports, while it is deemed as optional for approaches in the lower part of the diagram.

conventions that define what should be made visible or not, how this should be valued, for what purpose and for whom (Hines, 1991; Morgan, 1988). Different approaches can support different models of corporate governance, i.e., how power and accountability are structured, and how business value is defined and for whom (Feger & Mermet, 2021a; Lamberton, 2005; Rambaud & Richard, 2016; Richard, 2012; DFCG & CNOEC, 2021) **(Figure 4.5)**.

Approaches vary in terms of the degree of integration of metrics and values within existing conventional (non-environmental) business accounts and processes. At one end of the spectrum, nature metrics are fully integrated within business-as-usual accounts. At the other end of the spectrum, *ad hoc* biodiversity accounts are developed but not integrated with business accounts (see vertical axis in **Figure 4.5**). Due to the central role accounts play in business overall functioning**,** deeper integration of nature values and metrics is likely to support the systematic uptake of biodiversity information into strategic management, decision-making and corporate governance. Such integration requires precise framing of how nature metrics and values affect business costs, revenues, financial values and calculation of profit, both positively and negatively.

Approaches to integrating nature metrics into business accounts also vary in terms of the value lens that is applied to nature, and consequently in the way materiality of business impact on nature is conceptualized (see **Section 4.3.2**), with implications on the transformative effects that it may (or may not) produce (Miller & Power, 2013). On one end of the spectrum are approaches based

Box 4 2 Key findings from research on biodiversity reporting.

Biodiversity "reporting" is the act of preparing, disclosing and communicating financial and non-financial information regarding business impact and dependencies on biodiversity to external stakeholders (e.g., investors, regulators, civil society) according to specific guidelines, frameworks or standards (Lamberton, 2005).

Research shows that business reporting on biodiversity is increasing globally, driven by the development of voluntary and regulatory frameworks, standards and guidelines, encouraging more transparency and accountability (Bebbington *et al.,* 2021; Bhattacharyya & Yang, 2019; Oka *et al.,* 2022). This is especially true in the sectors with most impact on biodiversity and those that are most exposed to regulations and reputational risks, such as large businesses in mining or forestry (Adler *et al.,* 2017; Boiral & Heras-Saizarbitoria, 2017a, 2017b, 2017c).

In most cases, biodiversity disclosure practices are found to be falling short of providing specific, time-bound and measurable indicators necessary for a thorough, continuous and transparent assessment of businesses acting (or not) on their commitments (Addison *et al.,* 2019; Adler *et al.,* 2018; Lamont *et al.,* 2023; Skouloudis *et al.,* 2019; Van Liempd & Busch, 2013). Businesses are often found to be using biodiversity reporting to manage stakeholders' expectations and defend their license to operate rather than disclosing their real impacts and responsibilities regarding biodiversity protection (Boiral, 2016; Cho *et al.,* 2015; Haque & Jones, 2020; Maroun *et al.,* 2018; T. Smith *et al.,* 2019; Syarifuddin & Damayanti, 2019).

Global development and uptake of frameworks and standards for disclosure of business impacts and dependencies on biodiversity is expected to lead to further increase in reporting by businesses (UNEP-FI & UNEP-WCMC, 2024). These include the European Union's Corporate Sustainability Reporting Directive (CSRD) containing the European Sustainability Reporting Standards (ESRS) focusing on both financial risks and impacts on biodiversity based on reference levels (legal or science-based); as well as industry-led voluntary initiatives such as the disclosure recommendations of the Taskforce on Nature-related Financial Disclosure (TNFD, 2023c) and the International Sustainability Standards Board (ISSB; extending International Financial Reporting Standards to sustainability issues) which focuses on financial risk only (IFRS, 2023).

Depending on whether they focus on impacts on biodiversity, financial risk or both, underpinned by their specific worldviews, reporting frameworks and standards will drive uptake of corresponding accounting methods – more anthropocentric worldviews will favor accounting for potential impacts on ecosystem services flows to infer financial risk, more biocentric or pluralistic worldviews will account for time series change in ecological conditions that can represent the actual impacts of a business on biodiversity and people (see **Figure 4.7**). Frameworks based on the assumption that business accounting and disclosure of financial risks will ensure that markets manage biodiversity for long-term sustainability have been criticized for being unsupported either by theoretical or empirical evidence (Adams & Mueller, 2022; Ameli *et al.,* 2020; Christophers, 2017; Dempsey *et al.,* 2021; Irvine-Broque & Dempsey, 2023; Le Ravalec *et al.,* 2022; Rainforest Action Network, *et al.,* 2024). So far, existing sustainability reporting standards that include biodiversity requirements do not provide for integration with financial accounting standards – e.g., International Financial Reporting Standards (IFRS), United States Generally Accepted Accounting Principles (US GAAP), other national accounting norms – which limits the possibility to fully integrate nature metrics and values within business accounts.

on anthropocentric worldviews and instrumental values. On the other end are biocentric or pluralistic worldviews that seek to integrate nature's intrinsic and relational values into business accounts (see horizontal axis in **Figure 4.5**). These latter approaches link more directly to business commitments and accountability on achieving ecological reference levels of conservation, as opposed to approaches solely focused on measuring gains or losses of the flows of benefits from ecosystem services (Jones & Solomon, 2013).

Policy governance contexts and accountability regimes strongly shape the way business accounts are structured, used and disclosed (Bebbington *et al.,* 2021; Jones & Solomon, 2013). Political choices regarding emerging voluntary and regulatory sustainability reporting frameworks and standards addressing biodiversity issues therefore have a strong influence on the two factors mentioned above (level of integration, worldview and value lens applied) and the level of transformative change that they can achieve (Capitals Coalition, 2020; Negash, 2012; Richard, Bensadon, Rambaud, 2018) (See **Box 4.2** and **Figure 4.6**) (see **Chapter 6**).

Corporate governance perspectives and choices shape the structure and content of business accounts by determining

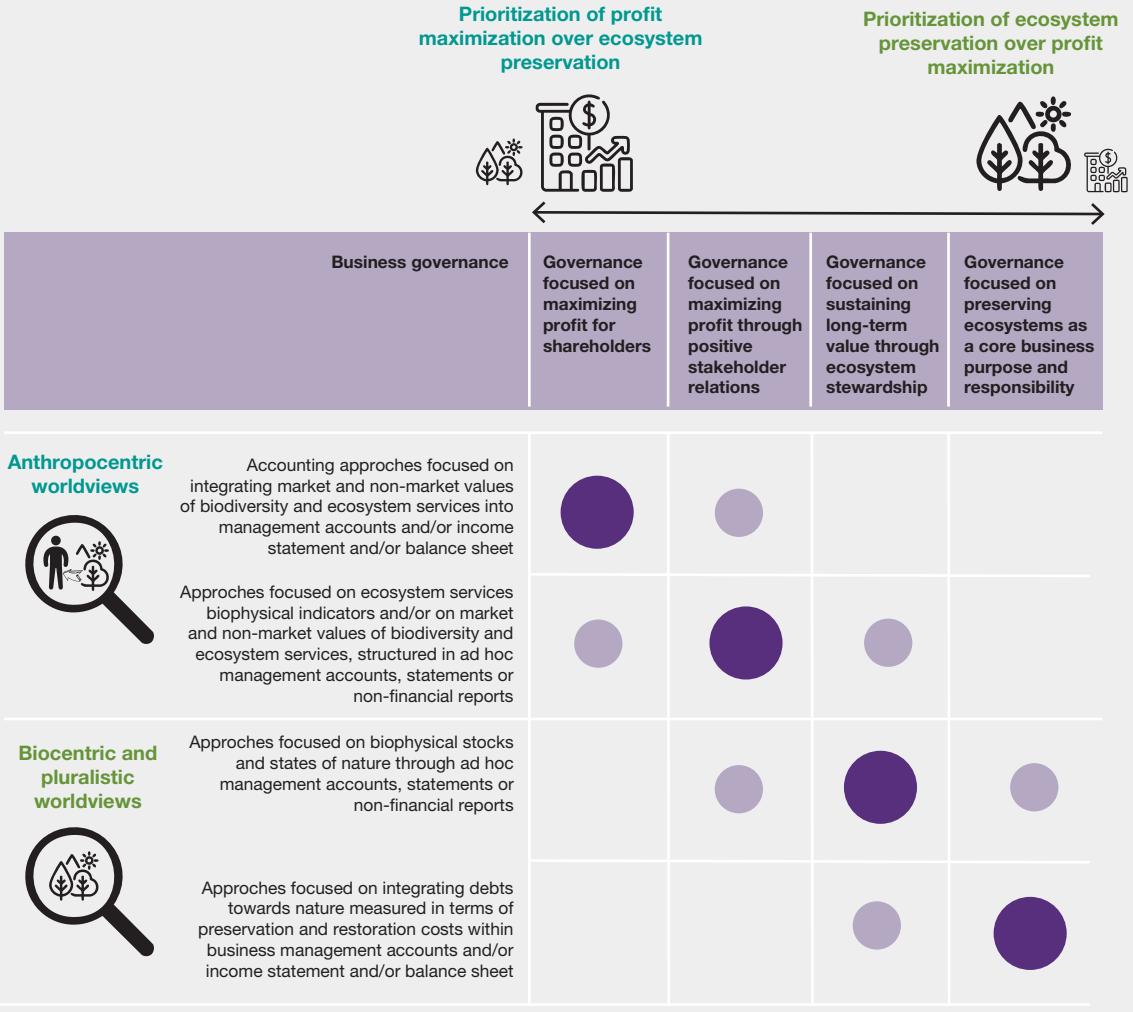


Figure 4 6 **Approaches for accounting for impacts and dependencies on biodiversity across levels of transformative ambition.**

Different approaches for accounting for impacts and dependencies on biodiversity (see **Figure 4.5**) can support different business governance models, with different levels of transformative ambition in terms of business participation in the achievement of global biodiversity goals. They span from 'pristine corporate' governance, where the focus is on financial materiality and maximizing profit for shareholders, through to 'transformative sustainability' governance, where the focus is on environmental and societal materiality and where conserving ecosystems is a core part of business purpose (Larrinaga, 2021).

what information is material and to whom, and therefore what should be made visible and valued (Müller, 2014; Richard & Rambaud, 2022, 2024). As a consequence, the selection and integration of metrics and values of nature in business accounts will also depend on how businesses integrate nature conservation and sustainable use goals in their governance, how they discharge accountability for it and to whom (Bebbington *et al.,* 2024, p. 2; Larrinaga, 2021). As such, a change of governance can result in a change of accounting approach with implications for decision-making and priorities.

Governance approaches can be distinguished according to the extent to which they integrate (or do not) nature protection goals as a core business responsibility relatively to the pursuit of profit (see **Figure 4.6** (Larrinaga, 2021)).[7] On one end of the spectrum, businesses follow the goal to maximize shareholder value, view nature as productive assets and a source of financial opportunities or risk, and therefore integrate metrics and values of nature into business accounts with the aim to understand and show the implications for enterprise value. On the other end of the spectrum, businesses recognize that 'radical and systemic shifts are necessary for corporate and societal functioning' (Bebbington *et al.,* 2024; Chaffin *et al.,* 2016; Larrinaga, 2021; Richard, 2012), repurpose their business models to systematically restore nature impacted by their activities, and therefore integrate metrics and values of nature in business accounts in a way that conditions financial profit to the achievement of biodiversity goals. The latter approach aligns with IPLC conceptions of businesses, which often include co-ownership, different purposes and distribution of values for the community and nature.

4.6.2 Emerging business biodiversity accounting methodologies

To support the integration of nature metrics and values into business accounting and reporting systems, a growing number of biodiversity accounting frameworks and methodologies for businesses are being developed. Biodiversity accounting refers to methodologies that seek to systematically identify, record, frame, organize, track over time, and value business impacts and dependencies on biodiversity (in monetary and non-monetary terms) according to a set of principles.

These methodologies use a variety of impact and dependency metrics as identified in previous sections of this chapter, are underpinned by different worldviews and use different techniques for integration into business accounts **(Box 4.2)**. Some of the methodologies only use biophysical data, while most use a combination of both biophysical and monetary metrics, based on different valuation methods (see **Section 4.3.2**, and **Chapter 2**).

Applications at different organizational levels

Biodiversity accounting methodologies vary in terms of main audiences, purposes, and therefore level of decision-making they have been designed for **(Figure 4.7)**. First, at the value chain and operational levels (in particular when sites are under the direct ownership and management of a business), biodiversity management accounting methods can track transaction costs and benefits associated with management of impact and dependencies (Eftec, 2015; Hanson *et al.,* 2011; Houdet *et al.,* 2009, 2016; Houdet & Germaneau, 2014). They can assist businesses' managers in risk and performance assessment, as well as strategic planning, business model change and implementation of impact mitigation of specific business units, operations, projects or products (Endangered Wildlife Trust, 2020; Feger & Mermet, 2022; Houdet *et al.,* 2020; Schaltegger *et al.,* 2023) (see **Chapter 5**).

Second, at the portfolio and corporate level, a number of methods are proposed which cover mostly non-financial reporting and disclosure, or integration of biodiversity into financial accounting and reports (balance sheet and income statement) (Barker & Mayer, 2017; BSI, 2021; Capitals Coalition, 2020; Global Sustainability Standards Board (GSSB), 2025; IFVI & VBA, 2024; Ingram *et al.,* 2024; ISO, 2024; Koshy *et al.,* 2019; Rambaud & Richard, 2015; Roberts *et al.,* 2021) (See **Box 4.2**).

Levels of integration and value lenses

Most of the existing business biodiversity accounting methodologies do not propose complete integration with business management accounts and financial reports and thus do not require changes to existing accounting standards. This limits the influence these methods can have on re-shaping business decision-making, governance and management processes.

Most existing methods are based on anthropocentric worldviews and instrumental perspectives on the value of nature rather than biocentric or pluricentric worldviews (Atkins *et al.,* 2014; Bebbington *et al.,* 2021; Jones & Solomon, 2013). Examples of methods which adopt an anthropocentric value lens and which have a low degree of integration with business accounting systems include methods such as the Environmental Profit and Loss Accounts (Chaplin-Kramer & Green, 2016; Kering, 2015), the 'Impact accounting' method (IFVI & VBA, 2024), or the Natural Capital Management Accounting Methodology (Transparent, 2023) (see lower left quadrant of **Figure 4.6**).

7. See supplementary materials in **Annex 4.3** for further details.

Methods which adopt the anthropocentric value lens but seek a high degree of integration with conventional business accounts include the 'integration of natural capital measures' as intangible assets (Koshy & Dickie, 2020) or 'integrating natural capital into financial reporting' (as proposed by Nicholls & Koshy, 2020) (see upper left quadrant of **Figure 4.6**). Methods such as BS 8632 and ISO 14054 and the "corporate natural capital accounting" stream of work on which they are founded (e.g., Eftec (2015); Forico (2023); Ingram *et al.* (2024); Koshy *et al.* (2019)) sit in the middle, depending on the levels of integration of proposed 'natural capital statements' with their business financial statements (see **Box 4.2**).

Fewer biodiversity accounting methods for businesses are based on biocentric worldviews and intrinsic perspectives on the value of nature, although research efforts seek to further develop such approaches (Asni & Sawarjuwono, 2020; Christian, 2014; Raar *et al.,* 2020; Russell *et al.,* 2017; Samkin *et al.,* 2014). Examples of such biocentric methodologies, with a low degree of integration include extinction accounting (Atkins & Maroun, 2018; Roberts *et al.,* 2021), disclosure frameworks adopting a deep ecology lens (Samkin *et al.,* 2014) or the Biodiversity Protocol (Endangered Wildlife Trust, 2020; Houdet *et al.,* 2020). Even fewer accounting methodologies are based on pluricentric worldviews and on a relational perspective on values (Birkin, 1996; Rambaud & Richard, 2015).

Under a biocentric or pluricentric value lens, monetary valuation based on conservation or restoration costs is preferred as a complement to the use of biophysical metrics. These represent the actual costs of conservation or restoration actions to be undertaken by a business to restore ecosystems that it has degraded through its activities. Businesses thus have to reimburse the debt that they incurred towards nature while creating economic value, as proposed in the Sustainable Cost Accounting framework (Gray, 1992, 1994; Murphy, 2021) or in the Comprehensive Accounting in Respect of Ecology (C.A.R.E) model (Rambaud & Feger, 2019; Rambaud & Richard, 2015; Richard, 2012) (see **Box 4.3**).

As the uptake of business biodiversity accounting methods keeps growing, more empirical research is needed to systematically track and assess their real world application

Box 4 3 Comparison of two biodiversity accounting methods.

The variation in business biodiversity accounting approaches outlined in this section can be illustrated by comparing two different methods which envisage the integration of nature within business financial accounts. The first rests on a series of initiatives, which currently aim to consolidate methods under the broad label of Corporate Natural Capital Accounting (CNCA) (Eftec, 2015; Forico, 2023; Ingram *et al.,* 2024; Koshy *et al.,* 2019; Nicholls & Koshy, 2020) and to develop standards under the label of natural capital accounting for organizations (BS 8632 and ISO 14054). The second method labelled Comprehensive Accounting in Respect of Ecology (C.A.R.E) is based on a scientific programme theorized and experimented since 2013 (Feger *et al.,* 2023; Rambaud & Chenet, 2021; Rambaud & Feger, 2019; Rambaud & Richard, 2015; Richard, 2012; Richard *et al.,* 2018) with private businesses and public organizations. This table summarizes key differences, which are further described in the supplementary materials in **Annex 4.2**.

Methods	Corporate Natural Capital Accounting (CNCA)	Comprehensive Accounting in Respect of Ecology (C.A.R.E.)
Worldview / Definition of Natural Capital	Anthropocentric; 'natural capital' as assets generating benefits to business and society	Pluralistic; 'natural capitals' as ecological entities to be preserved individually based on critical thresholds
Valuation Approach	Market and non-market valuation of natural capital stocks and services	Biophysical gap analysis + valuation of prevention/restoration costs to preserve ecosystem integrity
Integration into Accounts	Separate natural capital statements; optional integration via fair value adjustments in financial statements	Full integration into financial accounts; ecological debts recorded as liabilities and affect profit calculation
Accounting Philosophy	Fair value accounting	Historical cost accounting
Practical Implications	Supports risk-opportunity analysis, disclosure (e.g., TNFD), and investment decisions	Mandates preservation costs, supports transition planning, aligns with CSRD/ESRS and impact materiality focus
Adoption (2024)	~33 early adopters (UK, AU, ZA, DK)	~37 early adopters (mostly France)

outcomes. Available research on more general sustainability accounting methods highlights implementation challenges (Adams & Larrinaga-González, 2007; Carn & Pernias, 2022; Hababou, 2022; Herbohn, 2005; Taïbi *et al.,* 2020), and cases of ineffective outcomes for nature exist when ecological limits and critical thresholds are not considered (such as in the case of the triple-bottom line model, despite its large-scale application worldwide) (Elkington, 2018).

Links with biodiversity and natural capital accounting methods at ecosystem and national levels

Biodiversity accounting frameworks and methodologies are also developed at national and ecosystem levels, beyond the formal boundaries of private organizations. At the operational and landscape level, specific 'ecosystem-centred accounting' systems and methods are emerging that aim to support collective ecosystem valuation processes, dialogue and negotiation on the assignment of responsibilities within shared landscapes, monitoring of collective ecological targets, and the organization of co-management strategies (Feger, 2024; Feger *et al.,* 2019, 2021; Feger & Mermet, 2017). These methods can support landscape engagement approaches, as described for instance by the Science-based Target Network (SBTN; Step 3 Landscape Engagement target) (SBTN, 2023b). They also have the potential to play an important role in representing IPLCs and in incorporating Indigenous and local knowledge and values in business decision-making, by supporting multi-stakeholder dialogue and accounting

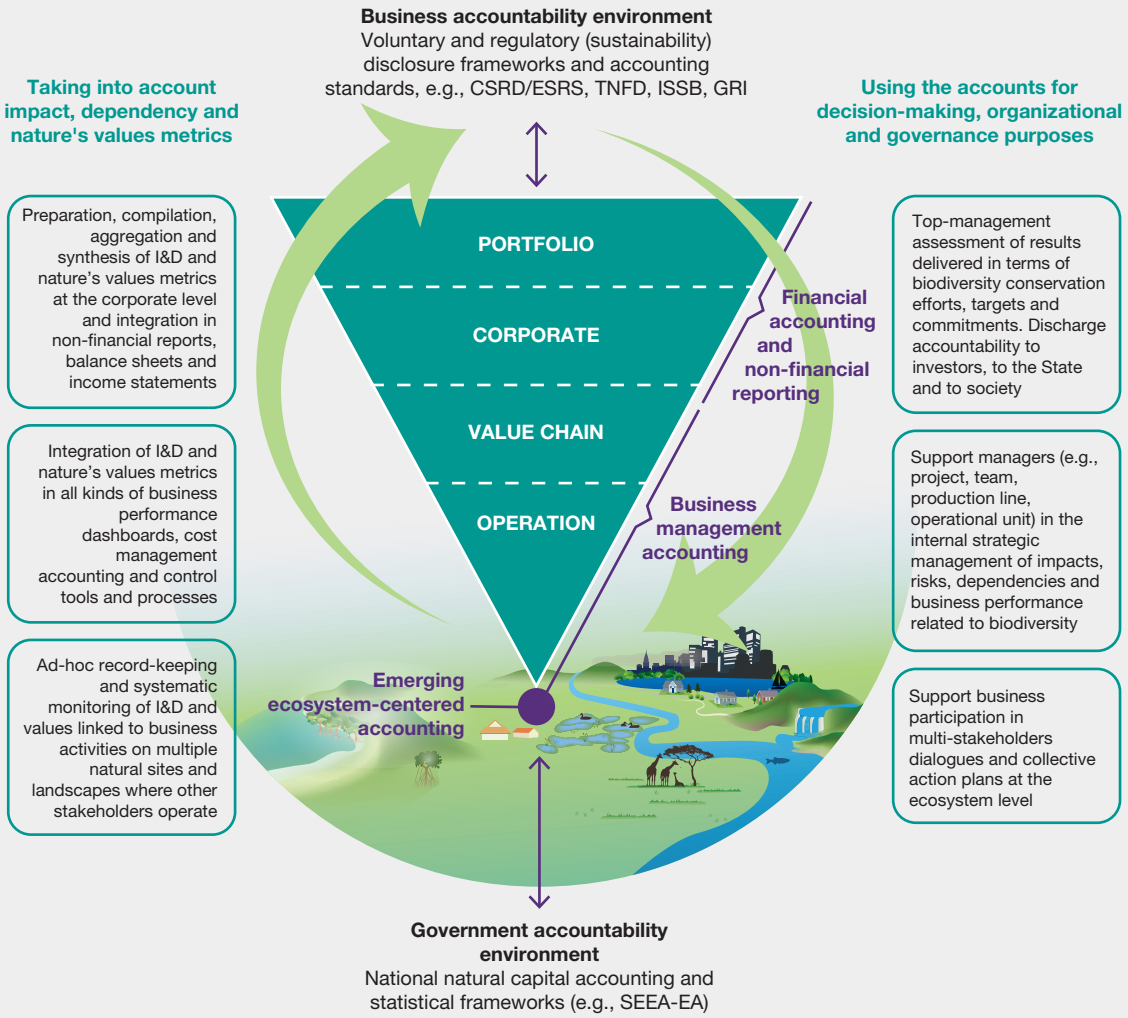


Figure 4 7 **Biodiversity accounting methods used by businesses at different levels.**

Biodiversity accounting methods which can be used by businesses are being proposed and experimented at different levels (Feger & Mermet, 2021). These levels are linked to one another both in terms of information flow and in terms of organizational decision-making and management processes. They are shaped by the overall existing accountability environment in which business operates.

for worldviews alternative to Western science and specific to given places (Agrawal, 1995; Arjaliès & Banerjee, 2024; Boiral & Heras-Saizarbitoria, 2017c; Brown *et al.,* 2015; Brown & Dillard, 2015; Manetti *et al.,* 2021; Normyle *et al.,* 2022).

In addition, the importance of interlinking and aligning developments in business biodiversity accounting with diverse methods of national natural capital accounting, and in particular with the System of Environmental Economic Accounting – Ecosystem Accounting (SEEA-EA), is increasingly being acknowledged (European Commission *et al.,* 2024; Feger *et al.,* 2021, 2023; Feger & Mermet, 2021; Grunewald *et al.,* 2024; Ingram *et al.,* 2022, 2024; McKenzie *et al.,* 2025; Surun, 2023). Some suggest that the development of biodiversity accounts at the business level could draw inspiration from the recently adopted SEEA-EA statistical standard (European Commission *et al.,* 2024; Ingram *et al.,* 2022, 2024; McKenzie *et al.,* 2025). Others propose alternative perspectives such as the adoption of a debt towards nature approach, in order to measure and articulate ecological debts from the business level to the national level (Kervinio *et al.,* 2023; Surun, 2023). These approaches endorse different worldviews regarding how to interpret business impact and dependencies on nature in a policy and public investment context (Bérard, 2019) (see **Section 4.3.2**). Political choices by governments on this matter will have implications on how the business accountability environment is shaped and will ultimately influence business choices in terms of integration of approaches for integrating impact and dependencies in their own accounting systems (see **Chapter 6**).

The development of more comprehensive biodiversity accounting methods that would connect and cover these different levels (business, ecosystem, national) in a consistent vision and value lens (Feger *et al.,* 2021, 2023) could be a key step in bridging the current management and governance gaps between top-down target setting measurement approaches at the national, sectoral and at the corporate level; and bottom-up nature monitoring and valuation across the value chains and at the operational and wider ecosystem level.

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Chapter 5

Chapter **5**

BUSINESSES AS KEY ACTORS IN TRANSFORMATIVE CHANGE: OPTIONS FOR ACTION[1]

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Chapter **5**

BUSINESSES AS KEY ACTORS IN TRANSFORMATIVE CHANGE: OPTIONS FOR ACTION

EXECUTIVE SUMMARY

1 Businesses have a key role to play in scaling-up action to achieve the 2050 Vision for Biodiversity *(well established)* {5.1, 5.2, 5.5, 5.6, 5.7}. All businesses, including financial institutions, impact and depend on biodiversity and nature's contributions to people. While an increasing number of businesses now assess their own biodiversity-related risks and opportunities, the groundswell of concerted and systemic action needed for transformative change is lacking and the projected outcome of continued business-as-usual is a net global drawdown in biodiversity. Many more businesses need to take more effective actions, including actions to recover biodiversity in areas of conservation priority. Businesses with significant control and influence over global biodiversity outcomes have a particularly large role to play. This includes primary industries with significant resources (e.g., land ownership), large private financial institutions and transnational corporations with substantial influence through their portfolios and value chains, and actors whose actions can shape regulatory frameworks and market conditions. Small and medium-sized businesses also play an important role, particularly supported through partnerships and collaborative initiatives, to implement actions and drive positive outcomes.

2 While some factors motivate business action on biodiversity and business-led initiatives offer guidance for planning, implementation and reporting, significant barriers to transformative change remain *(well established)* {5.2, 5.3, 5.4}. Motivations for business action can be both intrinsic and instrumental, driven by internal values or external pressures, such as access to finance, opportunities to maximize profits through environmental markets or consumer demand for sustainable products. However, systemic barriers, such as existing business models and economic systems that externalize the costs of biodiversity loss, government policies that incentivize harmful practices and fail to regulate poorly performing actors, widespread gaps in data capacity and gaps in context-specific knowledge, continue to constrain action. These barriers are particularly acute for small and medium-sized enterprises, despite many of the strongest examples of action in favour of biodiversity coming from this group. Business-led initiatives have helped address some barriers, but their focus remains skewed toward large businesses in high-income countries, often prioritizing disclosure and risk management over requirements to deliver tangible biodiversity outcomes. Some have also advanced faster than the scientific evidence underpinning their theories of change. Critically, businesses face a lack of clear expectations from consumers, investors and governments on what constitutes an appropriate and credible contribution to global biodiversity goals.

3 Businesses can act at four decision-making levels (corporate, operations, value chain and portfolio) to address their own biodiversity impacts and contribute to system-level changes that create enabling conditions for transformative change and inspire actions by others *(well established)* {5.2.1, 5.5, 5.6, 5.7}. Actions taken at one decision-making level drive actions at others. For example, at the corporate level, actions aim to transform the business by embedding biodiversity and nature's contributions to people into corporate goals and strategy, policies, governance, systems and culture. These actions must be supported by sufficient resources, stakeholder engagement, capacity-building, innovation and a consideration of alternative business models. Together, they enable businesses to address their own impacts and dependencies and deliver outcomes on the ground within their operations and across value chains. System-changing actions include responsibly advocating for the conservation and recovery of biodiversity and nature's contributions to people and against incentives that cause damage and loss, either individually or through collaborative initiatives. This can include addressing government policies at different levels (from local to national and international) and positions by industry and trade associations. Social signalling, aimed at influencing other actors' impacts and dependencies on biodiversity and nature's contributions to people, is possible at all decision-making levels for both private and system changing actions; although this relies on businesses first taking these actions themselves and needs to be supported by robust and transparent disclosures.

4 While measurement can guide and improve outcomes, many corporate-level actions can be implemented immediately, despite incomplete biodiversity data, especially when carried out through engagement with internal and external stakeholders *(established but incomplete)* {5.5, 5.6.1}. Corporate-level

actions include establishing ambitious biodiversity commitments, targets and strategy, integrating these into broader business strategy, creating and revising policies and standards (including procurement, incentives, investment, product and service design and use, marketing, stakeholder engagement and grievance mechanisms) and developing associated management systems (including for measurement, monitoring and reporting), transitioning the business to support implementation (together with capacity and resourcing), and exploring alternative business models, where appropriate. Corporate actions are essential to set the direction and enable action at other decision-making levels and for driving measurement and use of knowledge and data in decision-making for biodiversity and nature's contributions to people. Opportunities exist to integrate biodiversity targets with other sustainability goals, including those related to climate and other components of nature, to improve uptake, implementation and outcomes. Meaningful engagement is key for knowledge acquisition, more democratic environmental governance, and improved corporate legitimacy in biodiversity conservation initiatives. This includes working with internal and external stakeholders to build capacity of staff, promote environmental leadership at the board level, gather diverse perspectives on biodiversity values and actions, receive input on biodiversity strategy and assessment of impacts and dependencies and target setting, establish alliances to audit, and to monitor and assess performance.

5 Delivering meaningful and lasting biodiversity outcomes on the ground requires business operations to conduct robust impact assessments, rigorously apply the mitigation hierarchy, and implement credible monitoring, adaptive management and stakeholder engagement *(well established)* {5.6.2}. This includes undertaking environmental and social impact assessments at ecologically appropriate scales; applying the mitigation hierarchy in sequence to avoid, minimize, restore and, as a last resort, offset negative impacts; monitoring biodiversity outcomes as well as actions; and engaging with rights-holders and stakeholders prior to, throughout and after the life of business operations. Although the mitigation hierarchy is recognized as leading practice, adoption remains partial, since many business activities and impacts fall outside regulatory requirements; even when applied, demonstrating sufficient impact avoidance is often difficult for businesses. Later-stage measures such as restoration and offsetting are typically more costly, uncertain and less effective at returning biodiversity to baseline conditions, reinforcing the need to prioritize early-stage avoidance and minimization. Very few business operations have achieved or demonstrated no net loss of biodiversity. Monitoring outcomes requires appropriate, sector-specific metrics that link actions to biodiversity targets, yet reporting often lacks sufficient data for independent verification. Early and ongoing engagement with affected communities, including Indigenous Peoples and local communities, is essential to build trust, align actions with local priorities and enable collaboration.

6 Numerous opportunities exist for action at the value chain level, particularly for businesses beyond primary and extractive sectors. Approaches that emphasize value chain integration, collaboration and innovation hold the greatest potential to lever transformative change *(well established)* {5.6.3, 5.7.3}. Biodiversity has received limited attention in the literature on sustainable value chain management, but examples of relevant actions and a growing body of guidance have emerged. Value chain mapping provides the transparency needed to link products and materials to specific suppliers, locations and impacts, helping businesses to identify risks and prioritize actions. Improving traceability is especially important for businesses with global or complex value chains, although mapping beyond tier-one suppliers often remains a challenge. Once value chains are mapped, businesses can set and communicate clear expectations for suppliers, monitor performance and address non-compliance, including, where appropriate, through suspension or exclusion of poor performers. Approaches that incentivize performance and build long-term relationships and supplier capacity through training, knowledge exchange and innovation are essential and can be more effective. This is particularly critical for small businesses in enabling their adherence to biodiversity standards, supported by incentives and penalties. Voluntary sustainability standards can complement these efforts as part of due diligence systems and consumer-facing strategies such as product labelling, education, incentives and post-purchase engagement provide opportunities to shape behaviour and improve transparency. Yet, their effectiveness is often constrained by consumer scepticism, the costs of certification and business models reliant on unsustainable consumption.

7 Any effort to deliver transformative change depends on reversing harmful finance flows and allocating funds to achieve biodiversity outcomes aligned with global targets *(well established)* {5.6.1, 5.6.4}. Financial institutions can drive this shift through two complementary strategies: *greening finance*, which directs financial services away from activities that harm biodiversity and nature's contributions to people, and *financing green*, which channels funds toward biodiversity-enhancing activities. At the corporate and portfolio levels, lenders, investors and insurers can adopt a range of greening finance actions, including setting financing and investment criteria (e.g., biodiversity impact assessments, mitigation and no net loss/net gain requirements, and traceability and sourcing standards – applied at the level of the clients' projects or value chains), implementing stewardship by engaging with

clients to align practices with biodiversity targets exercising voting rights, and excluding or divesting from harmful activities. At the same time, corporate-level financing mechanisms, such as blended finance, impact investing and green or sustainability-linked bonds, can mobilize capital for enterprises that protect, restore or sustainably manage biodiversity. This also extends to bilateral or multilateral contributions to initiatives such as the Global Biodiversity Framework Fund or the Cali Fund. The actions and their influence on biodiversity outcomes vary across financial institutions – for example, between lenders and investors – but all have a role in redirecting finance flows to support biodiversity outcomes.

8 Significant opportunities exist for businesses to help halt and reverse global biodiversity loss by going beyond impact mitigation to invest in landscape conservation, restoration and sustainable management and system-changing actions that create the enabling conditions for transformative change *(established but incomplete)* {5.5, 5.7.1, 5.7.2}. Achieving global goals requires businesses to extend accountability beyond impact mitigation actions at their operations and value chains, by supporting additional conservation efforts. Businesses with strong dependencies on biodiversity or historical contributions to loss are particularly well placed to contribute. Actions that focus on ecological recovery (e.g., restoring species habitat) should be prioritized over those that simply avert potential future loss (e.g., creating new protected areas). Nature-based solutions are also a key pathway, delivering biodiversity benefits while supporting other sustainable development goals, such as climate adaptation, water security and social outcomes. Businesses further play a critical role in advocating for ambitious biodiversity policy, rejecting harmful lobbying and ensuring that industry associations align with global goals. Leadership includes making progressive policies public, addressing grievances transparently, and signalling the importance of biodiversity and sustainable lifestyles to consumers and society, for example, by tackling food consumption and waste. While large corporations and sector-wide initiatives may influence national or multilateral regulatory processes, smaller businesses can also contribute by, for instance, engaging local authorities and chambers of commerce.

9 Collaboration, partnerships and collective action with other businesses, governments and Indigenous Peoples and local communities can amplify biodiversity outcomes of business actions across all decision-making levels *(established but incomplete)* {5.3, 5.4, 5.6, 5.7.3}. Partnerships are essential for scaling implementation, enabling knowledge exchange, and ensuring more inclusive and legitimate governance. Trade associations and commodity roundtables can complement regulation by developing shared standards and raising expectations of good practice, while public–private partnerships can unlock resources, technology and governance capacity. Multi-stakeholder platforms and coalitions can align business strategies with global biodiversity targets and sector-wide initiatives, including voluntary sustainability standards, create a level playing field and extend commitments across value chains. Partnerships that include Indigenous Peoples and local communities are important for ensuring equitable and durable outcomes. Transboundary initiatives and global collaborations can address biodiversity challenges no single actor can resolve alone. Through participation in financial associations and adoption of voluntary standards, such as the Green Bond Principles, businesses can also help align capital flows with biodiversity outcomes and embed accountability across internal systems. Collaboration and partnerships represent a critical pathway for scaling impact, aligning diverse interests and embedding biodiversity into the core of business and financial systems.

10 Businesses could act more effectively with a clearer understanding of which actions, implemented where and by whom, drive positive biodiversity outcomes; which disclosures and reporting practices create meaningful change; and which tools best measure and manage impacts and dependencies at different decision-making levels *(established but incomplete)* {5.2, 5.3, 5.4, 5.6, 5.7}. Some evidence exists for operational-level actions with directly attributable outcomes, but most studies suggest these actions – including those aimed at achieving no net loss of biodiversity – have been largely ineffective to date. There is limited understanding of which actions at the broader landscape and system levels are most effective, how responsibilities should be shared among businesses depending on their dependencies and contributions to biodiversity loss, and what additional measures are needed to improve their effectiveness. Better, fit-for-purpose tools are required to systematically integrate innovation into business decision-making. Addressing these gaps will require a cultural shift, with businesses disclosing not only their impacts and dependencies, but also their actions, outcomes and progress in closing shortfalls against biodiversity targets. While some voluntary standards already require disclosure to enable third-party verification, greater knowledge is needed to strengthen the theory of change linking transparency, visibility of failures and incentives for improvement in performance.

KNOWLEDGE GAPS

Category	Section	Knowledge gap
Studies relevant to business	5.1	Lack of evidence on whether businesses with the greatest responsibility to act are implementing the most impactful actions.
Data and knowledge	5.2	Lack of clarity from consumers, investors, and governments on what constitutes an appropriate and credible business contribution to global biodiversity goals.
Methods	5.2.2, 5.3.2	Insufficient methods to translate and disaggregate global biodiversity goals into business-level targets at scales meaningful for decision-making.
Methods	5.3.2, 5.6, 5.7	Lack of robust methods to independently assure business claims about contributions to net biodiversity outcomes.
Data and knowledge	5.3.2	Limited knowledge within businesses about biodiversity, including their own impacts and dependencies and how biodiversity loss translates into business risk and informs action.
Data and knowledge	5.3, 5.7	Limited knowledge and guidance on how small and medium-sized enterprises can overcome acute capacity and resource barriers.
Studies relevant to business	5.4	Need for stronger scientific evidence to underpin the guidance and inherent theories of change developed by business-led initiatives.
Data and knowledge	5.4, 5.6, 5.7	Limited illustrative examples of businesses taking actions, including their motivations and barriers, impacts and outcomes, and explanatory factors underpinning success and failure.
Studies relevant to business	5.4, 5.6, 5.7	Lack of empirical studies to test and validate a theory of change linking actions related to risk disclosure to biodiversity outcomes.
Data and knowledge	5.6, 5.7	Limited evidence on the effectiveness of different types of business actions – what works, in which contexts and why.
Data and knowledge	5.6, 5.7	Limited availability of metrics and methods that capture multiple biodiversity values and perspectives to ensure actions deliver effective outcomes.
Data and knowledge	5.6	Lack of baseline biodiversity data to inform business actions at all decision-making levels.
Data and knowledge	5.6.1	Limited evaluation of how corporate governance tools (e.g., targets, policies, incentives, procurement, product design) translate into measurable biodiversity outcomes across scales.
Data and knowledge	5.6.2	Lack of rigour, consistency and clarity in environmental and social impact assessments, limiting their effectiveness in delivering biodiversity outcomes globally.
Data and knowledge	5.6.2	Inconsistent application of the mitigation hierarchy, with no agreed thresholds for avoidance, minimization or offsetting and weak evidence for restoration and offsets.
Methods	5.6.2, 5.7.1	Insufficient monitoring of site- and landscape-level outcomes, with inadequate metrics and no frameworks to assess whether cumulative actions contribute to global biodiversity goals.
Data and knowledge	5.6.3	Insufficient data on business value chains, including the location of operations and flows of globally impactful products, to enable biodiversity impact and dependency analysis.
Data and knowledge	5.6.3	Uncertainty about which consumer-facing strategies (labelling, education, incentives, post-purchase engagement) effectively change behaviour and deliver biodiversity outcomes.
Methods	5.6.4.2	Limited tools and scarce real-world applications for assessing biodiversity impacts and dependencies at the portfolio level.
Data and knowledge	5.6.4	Need for stronger evidence on how actions related to financial instruments and stewardship translate into biodiversity outcomes, and how lenders *versus* investors can best exert influence.
Data and knowledge	5.6.4	Insufficient biodiversity-related impact and dependency data collected by financial institutions (investors, lenders, insurers) on their investments and clients.

Category	Section	Knowledge gap
Methods	5.7	Lack of approaches to inform and monitor collective and system-changing actions, particularly for small and medium-sized enterprises that depend on such initiatives.
Methods	5.7	Need for approaches to better integrate business action on biodiversity with other societal goals (e.g., on climate), to minimize trade-offs and avoid budget fragmentation.
Methods	5.6, 5.7	Insufficient methods to support effective capacity-building on biodiversity, across businesses and their value chains.
Data and knowledge	5.6, 5.7	Gaps in knowledge about mechanisms linking transparency (including visibility of failures) to improved biodiversity performance.
Data and knowledge	5.7.1, 5.6.2	Limited understanding of how to attribute biodiversity outcomes at landscape or system scales to specific business actions, to support credible claims.
Data and knowledge	5.7.2	Lack of evidence on effective and responsible business advocacy for biodiversity, including how to influence government policy and trade associations.

5.1 INTRODUCTION

Businesses, including private financial institutions, have a critical role to play in achieving the 2050 Vision for Biodiversity, as part of the Kunming-Montreal Global Biodiversity Framework (O'Brien *et al.,* 2024). Many businesses are large and powerful actors that significantly shape global consumption and production systems and thus have great potential to contribute to halting and reversing biodiversity loss. Approximately 500 businesses control over 70 per cent of key global commodity markets (OECD, 2015), many of which directly or indirectly impact on biodiversity and nature's contributions to people (Carvalho *et al.,* 2023). Some businesses have begun to act, often to meet regulatory obligations, respond to stakeholder pressure or satisfy investor requirements. Others act to mitigate material risks to their operations and value chains that arise from declining biodiversity (G. S. Smith *et al.,* 2021). As of July 2024, more than 420 organizations across 50 countries have committed to begin aligning with the guidance of the Taskforce on Nature-related Financial Disclosures, including 25 per cent of the world's most important banks (TFND, n.d.). However, the extent to which actions are being taken by those businesses with the greatest responsibility to act on, or whether they reflect interventions with the greatest benefit for biodiversity and nature's contributions to people, remains unclear.

To date, the aggregate effect of business activity on biodiversity has been overwhelmingly negative **(Chapter 3)**. Businesses have contributed to all five main direct drivers of biodiversity loss identified in the IPBES Global Assessment of Biodiversity and Ecosystem Services (2019a): land- and sea-use change, direct exploitation, climate change, pollution and invasive species (IPBES, 2019a). For example, rapid expansion of oil palm plantations in Southeast Asia, driven by demand for vegetable oil, income growth and biofuel policies, has led to extensive deforestation and biodiversity decline (Carlson *et al.,* 2012; Vijay *et al.,* 2016; Wilcove & Koh, 2010). Large-scale agricultural production for beef, palm oil, soy and wood caused 40 per cent of tropical deforestation between 2000 and 2011 (Henders *et al.,* 2015). Most businesses still rely heavily on fossil fuels, contributing to both regional air pollution and climate change. Despite progress in some sectors, fossil fuels continue to account for ~80 per cent of global energy use (IEA, 2023) and some business models, such as aviation, still lack viable alternatives. Water withdrawals for irrigated agriculture, energy and manufacturing degrade freshwater ecosystems (Dudgeon *et al.,* 2006; Reid *et al.,* 2019), while global shipping facilitates the spread of invasive species (Hulme, 2009). Beyond the primary and extractive sectors, the value chain impacts of other businesses remain significant, yet often hidden in assessments of biodiversity loss and nature's contributions to people (Wieland, 2021), making it difficult to assign clear accountability for mitigating these impacts.

Business-as-usual trajectories, both in terms of the scale and effectiveness of current actions on biodiversity, are misaligned with global biodiversity goals and targets (Leclère *et al.,* 2020). While there is growing recognition of nature-related risks, action remains slow and commitments often lack ambition (UNEP, 2024). Recent assessments found that most large and transnational businesses still fail to identify, assess or disclose their biodiversity impacts and dependencies (WBA, 2024) and financial institutions largely overlook or undervalue biodiversity, due to a poor understanding of how its loss creates portfolio risks (McElwee *et al.,* 2020). However, even among those that do commit to action and disclosure, evidence of

implementation and effectiveness remains limited, and there is a lack of accountability mechanisms to ensure that claimed positive actions lead to meaningful biodiversity outcomes (zu Ermgassen, Drewniok, *et al.,* 2022). Some businesses have also been found to deliberately mask unsustainable practices under the guise of 'nature-positive' strategies, using aspirational framings to deflect their accountability (Buckley *et al.,* 2025).

Transformative change will require additional action, especially by the businesses that have been most responsible for impacts to date and which have the greatest potential to influence future conservation and regeneration outcomes. But this will also require fundamental reforms to internal business models and the external conditions (policy and legal frameworks, economic and financial systems, social values, norms and culture, technology and data, and capacity) within which businesses operate (IPBES, 2019) **(Chapter 6)**. In many cases, the absence of sufficient business incentives to act reflects a deeper framing problem: the economy is still treated as separate from, rather than embedded within, the biosphere (Dasgupta, 2021; Folke *et al.,* 2021). As a result, the depletion of biodiversity is not adequately internalized in business decision-making, making it difficult for businesses to justify action under traditional interpretations of fiduciary duty, which typically prioritize short-term shareholder returns. Addressing this challenge will require complementary action by non-business actors, including governments, the financial system, civil society and Indigenous Peoples and local communities (IPLCs), to reshape incentive structures and prevent continued economic growth from undermining ecological foundations (White *et al.,* 2023).

Nevertheless, given the urgency of the biodiversity crisis, there is a need for business to act in the absence of perfect enabling conditions, even if those actions are seemingly piecemeal (IPBES, 2024a). This includes scaling up actions at all levels of decision-making – from operations to value chains, and across portfolios – to address their own impacts and dependencies and to contribute towards broader systems change. In some cases, this will require businesses to go beyond short-term profitability, embracing new business models that prioritize long-term societal value. In other cases, it will require proactive engagement in advocacy and policy reform. Indeed, precedent exists. For example, in 2024, more than 130 businesses publicly endorsed policy recommendations for implementation of the Kunming-Montreal Global Biodiversity Framework and called for stronger biodiversity legislation (Business for Nature, 2024). Ultimately, these actions and their impact on biodiversity and nature's contributions to people will vary depending on the specific actor, sector, product and geography. Identifying priorities on where to act first, alongside the safeguards needed to manage remaining uncertainty and risks of greenwashing, is essential to ensure business contributions collectively support global biodiversity goals.

Chapter 5 reviews options for business action to contribute to the 2050 Vision for Biodiversity. **Section 5.2** conceptualizes the roles businesses can play in transformative change and outlines methods available to determine their individual responsibility to act. **Section 5.3** examines the factors currently driving business action and remaining barriers, highlighting key differences across business types and geographic contexts. **Section 5.4** summarizes the strengths and limitations of emerging risk disclosure frameworks and performance standards co-developed by businesses to guide action. **Section 5.5** presents a typology of business actions, organized by the decision-making levels at which biodiversity impacts and dependencies are measured, as described in **Chapter 4**. **Section 5.6** details options for private actions by businesses, including financial institutions, to address their own impacts on biodiversity and nature's contributions to people. **Section 5.7** outlines additional actions for businesses to drive the system-level change necessary for transformative change and influence the actions taken by others, including through partnerships and collective action. Examples of business action are provided throughout the Chapter and expanded in **Annex 5.1**. The evidence base for these examples remains limited, however, and inclusion does not imply endorsement or verification of performance.[2]

5.2 BUSINESSES AS KEY ACTORS

5.2.1 Roles for businesses in transformative change

Businesses and private financial institutions can play three interconnected roles in transformative change (Naito *et al.,* 2022; Booth *et al.,* 2024) **(Figure 5.1)**. (1) Private actions can be taken by businesses to address their own impacts and dependencies occurring from their operations, value chains and portfolios. Actions include assessing and mitigating biodiversity impacts, engaging with their suppliers and consumers to implement sustainable supply chain practices, and ensuring that corporate policies, processes and capacity drive and support these actions to deliver outcomes on the ground; (2) businesses can also take action to contribute beyond their own impact to reverse biodiversity loss and change the system within which they operate by intentionally contributing to macro-level conditions

2. Data management report referring to the literature reviews conducted for Chapter 5 https://doi.org/10.5281/zenodo.12789799

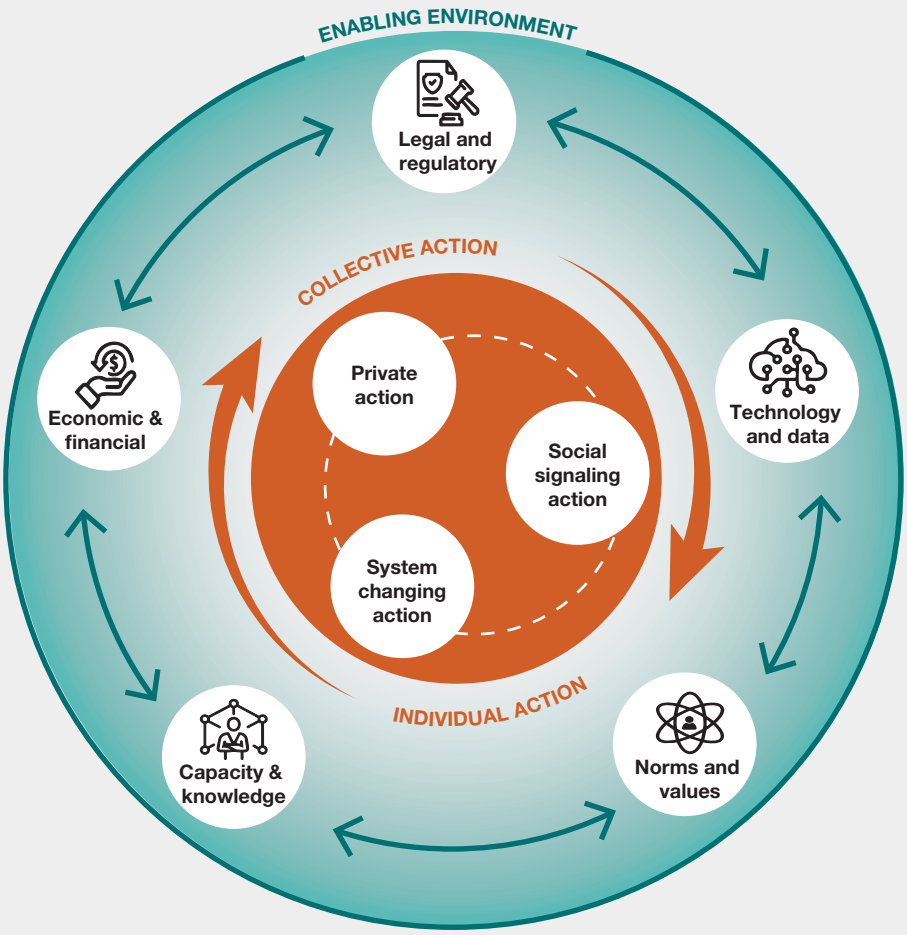


Figure 5 1 **Roles for businesses.**

These roles include private actions by businesses to address their own impacts and dependencies, system changing actions to create the enabling conditions for transformative change, and social signalling to influence and encourage actions by other actors. All three roles can be taken individually or collectively through partnerships and collaborations. Figure adapted from Naito *et al*. (2022).

enabling transformative change. For example, lobbying governments to strengthen laws and regulations to conserve biodiversity, shifting social norms and access to capital, and innovation in science and technology; (3) finally, businesses can publicly share and signal information about their actions and outcomes to inspire and influence the behaviour of other businesses and non-business actors. This could include marketing to showcase public commitments or certification of their products and services, provided that these actions are backed by credible strategies, commitments and tangible actions to avoid being perceived as greenwash **(Box 5.1)**.

The impact that private actions, system change and signalling actions have on biodiversity and nature's contributions to people, and their relative contribution towards global goals, will differ among businesses, dependent on their control and influence over biodiversity outcomes **(Figure 5.2)**. Larger businesses, including transnational businesses, with greater resource use by their operations, can play a larger role than smaller businesses because they have greater impacts to address within their direct control (Folke *et al.,* 2019)**.** The World Benchmarking Association identified 2,000 of the most influential keystone businesses, highlighting their crucial role as economic actors in contributing to transformative change (WBA, 2024). Large businesses have influence through their direct control of large operations, but also through their influence on suppliers and customers in their value chains, and through their influence on other entities (other businesses, non-governmental organizations, IPLCs and governments) (Ahen, 2019). Such businesses also have the potential to contribute to sustainable development and economic growth in low-income regions (Lawrence, 2023), as well as to shaping the economic landscapes of regions worldwide (Folke *et al.,* 2019; Yeung, 2009).

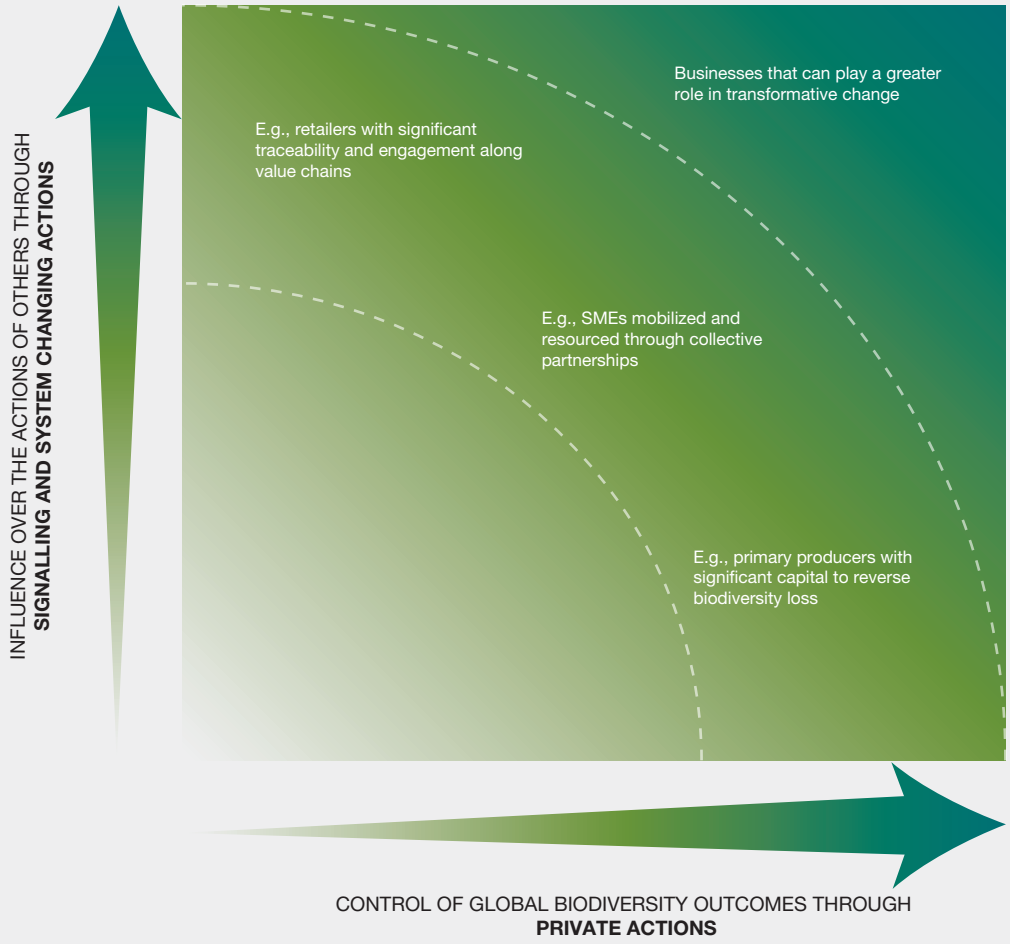


Figure 5 2 **The role of businesses in transformative change.**

The role that businesses can play in transformative change depends on their control over global biodiversity outcomes through private actions, and their influence over the actions taken by others through system changing actions and social signalling. Collective action can help to boost both the control and influence that any one individual actor has on biodiversity globally.

Box 5 1 **Greenwashing: challenges for business action on biodiversity.**

Greenwashing occurs when businesses mislead stakeholders about the environmental benefits of their products, services or operations (Delmas & Burbano, 2011; Krause *et al.,* 2021; zu Ermgassen *et al.,* 2022). It takes multiple forms, including the use of vague and undefined terms – such as 'eco-friendly' or 'nature-positive' – that lack measurable targets, clear and consistent definitions, or transparent reporting. These allow businesses to appear environmentally responsible without undertaking substantive action, undermining accountability and raising questions about the authenticity of their sustainability claims (Krause *et al.,* 2021; zu Ermgassen, *et al.,* 2022).

Selective disclosure is another form of greenwashing, in which businesses highlight positive environmental actions while concealing negative impacts (Lyon & Montgomery, 2015; Marquis *et al.,* 2016). This erodes trust, diminishes the credibility of corporate sustainability efforts and creates scepticism among stakeholders, including consumers, regulators and investors. It also creates reputational spillover, making it harder for genuinely committed businesses to gain recognition or build support for legitimate biodiversity actions.

The fear of being accused of greenwashing can deter businesses from engaging in biodiversity initiatives altogether, particularly when reputational or legal risks are high and sustainability efforts are vulnerable to public scrutiny. These risks are amplified by inconsistent regulations, weak enforcement, and low institutional capacity, especially in developing countries

Box 5 1

and emerging markets (Krause *et al.,* 2021; Treepongkaruna, 2024; zu Ermgassen, Drewniok, *et al.,* 2022).

Addressing greenwashing risks requires a commitment to transparency and accountability. This includes setting clear, time-bound and measurable biodiversity targets aligned with global goals; using standardized frameworks for disclosing risks, impacts and dependencies, and participating in credible third-party verification schemes. Genuine collaboration with trusted partners and independent reviewers can further enhance credibility and reduce risks of unsubstantiated claims (Andréasson, 2023).

5.2.2 The responsibility of businesses to act

The degree to which businesses are responsible for achieving global goals for biodiversity – or to be held liable for any inaction – is a societal decision. **Chapter 6** discusses the roles of non-business actors, including consumers, governments and IPLCs, in creating the enabling environment for transformative change. To drive business action, this environment must include clear expectations on which sectors in which locations are required to act and what outcome for biodiversity and nature's contributions to people needs to be achieved by these actions (Booth *et al.* 2024; White *et al.* 2024). Laws and policies, from local to national scales, governing business operations and their value chains, including fiduciary duties of businesses to address material risks and uphold voluntary commitments, are also essential (Mair *et al.,* 2024; Maron *et al.,* 2018; Pascual *et al.,* 2022). Some policy frameworks, including the Kunming-Montreal Global Biodiversity Framework, commit nations to take such action, including through National biodiversity strategies and action plans (CBD, 2022) and suggest responsibility is not evenly shared among business actors. Target 15, for example, emphasizes a disproportionate responsibility for large and transnational businesses and financial institutions (CBD, 2022). Some business-led initiatives also provide tools to guide decisions on which impacts and dependencies are material and thus require action (SBTN, 2024). However, expectations for small and medium-sized businesses to contribute towards biodiversity targets are less clear (Panwar, 2023). While their individual influence is small, collective mechanisms to address sector-wide impacts can be powerful. For example, The Roundtable on Sustainable Palm Oil has successfully traced impacts for over 48,990 farmers in 13 countries since 2013 (RSPO, 2024).

Uncertainty remains on whether societal responsibilities of businesses to act will 'add up' to achieve global goals for biodiversity (White *et al.,* 2024). Missing are clear methods for businesses to disaggregate global biodiversity goals, at a resolution that is sufficient to support effective decision-making to enable businesses to act. Some progress has been made in defining planetary boundaries (Richardson *et al.,* 2023; Simmonds *et al.,* 2022) and developing metrics and methods to enable related downscaling of business action (Clift *et al.,* 2017; Crona *et al.,* 2024). This approach is now being implemented for some global goals, such as mitigating climate change and achieving land, freshwater and oceans targets (SBTi, 2024, 2025; SBTN, 2020). The concept of planetary boundaries (Richardson *et al.,* 2023) has not yet led to defining specific limits for the full breath of biodiversity components, nor are rules for fair shares of resources clearly defined, making this concept difficult to understand by business actors (Clift *et al.,* 2017; Williams *et al.,* 2025), although used in the Science-Based Target Network (SBTN, 2020) and researched to identify rules by which 'fair shares' could be allocated to actors (Bai *et al.,* 2024). Some biodiversity goals and targets, including those of the Kunming-Montreal Global Biodiversity Framework and others (UNEP, n.d.), are not framed as ecological limits or outcomes-based targets (Maron *et al.,* 2018), with clear actionable and time-bound objectives (Hawkins *et al.,* 2023). Without this, a disconnect remains between global goals, national policies and project requirements to mitigate impacts on biodiversity and nature's contributions to people.

Finally, regardless of how much each business acts, they can also make efforts to ensure that any action they take has fair and equitable outcomes that align with the objectives of the Convention on Biological Diversity, including benefit sharing and sustainable use of natural resources, for example, when taking actions to improve biodiversity on lands and seas, including freshwater ecosystems, under the custodianship of IPLCs, whose livelihoods and cultural heritage are often deeply connected to their natural environments. This includes recognizing, respecting and upholding the rights, knowledge systems, leadership structures and multifaceted ways in which communities conserve and manage biodiversity, and integrating Indigenous and local knowledge and perspectives into decision-making, including those related to building local resilience against future risks to biodiversity loss (Dawson *et al.,* 2021, Kennedy *et al.,* 2023). To integrate responsibility measures, businesses can also uphold free, prior and informed consent and the rights granted to Indigenous Peoples, as recognized in the United Nations Declaration on the Rights of Indigenous Peoples (United Nations, 2008).

5.3 MOTIVATIONS AND BARRIERS

Motivations and barriers to business action depend on the context in which businesses operate. While an action may be possible for one company in one country, it may be impossible in others. For example, small and medium-sized enterprises operating in developing countries might be particularly constrained by access to capital, internal capacity and regulatory uncertainties (Durrani *et al.,* 2024). Regardless of the context, businesses are driven to act by a mix of internal and external motivations (Graafland & Van De Ven, 2006). Internal motivations can be both intrinsic, stemming from moral norms, values and ethics, and instrumental, based on perceived business benefits. Chapter 5 organizes barriers according to the enabling conditions for transformative change, described in **Chapter 6**: legal and regulatory; economic and financial, norms and values; technology and data; and capacity and knowledge. This section includes examples of how motivations and barriers differ among business types, sectors and geographies. **Sections 5.4** and **5.7** include options for businesses to address barriers, through individual and collective action.

5.3.1 Internal and external factors driving business action

Intrinsic motivations stem from the moral norms, personal experiences and environmental values of individual staff, as well as broader corporate culture. They often reflect a collective sense of social responsibility to address biodiversity loss (Jia *et al.,* 2018; Krause *et al.,* 2021). For example, individuals' views on conservation have informed and shaped decision-making within the Chilean wine industry (Márquez-García *et al.,* 2018).

Instrumental motivations are linked to the expected organizational benefit of acting on biodiversity. These include improved company attractiveness, higher productivity and stronger employee retention (Bauer & Aiman-Smith, 1996; Bhattacharya *et al.,* 2008; Greening & Turban, 2000; Gully *et al.,* 2013; Hedblom *et al.,* 2019). Action can deliver financial returns in several ways. They can enable businesses to enter new markets with innovative products and services, as demonstrated by examples from the cosmetics sector in Europe and South America (Kolenova *et al.,* 2025; Turconi *et al.,* 2021). Businesses may also improve their market share by greening existing offerings and positioning themselves ahead of less sustainable competitors (Lambooy & Levashova, 2011). Operational efficiencies can also be enhanced; regenerative agriculture in California's almond industry, for example, has reduced costs while improving productivity (Fenster *et al.,* 2021). Further, pro-environmental practices can lead to lower payroll costs for equivalent work and contribute to stronger employee engagement and retention (Burbano, 2016; Cassar, 2019; Cassar & Meier, 2018; Krueger *et al.,* 2020; Lozano, 2015; Non *et al.,* 2022; Nyborg & Zhang, 2013). Some businesses also see talent attraction as a benefit (Aladağ, 2023; Krause *et al.,* 2021); 77 per cent of sustainability leaders cite this as a driver for sustainable strategy development (SpencerStuart, 2023). Additional incentives include preferential access to finance and markets (Flammer *et al.,* 2025) and, in some cases, biodiversity disclosure itself can improve financial performance (Elsayed, 2023). For businesses that directly depend on biodiversity and nature's contributions to people, acting can serve to mitigate material financial risks associated with biodiversity loss **(Box 5.2)**.

Many of these motivations are shaped by factors external to the business. Regulatory obligations are a major driver. Biodiversity-related laws and policies in, e.g., the United Kingdom of Great Britain and Northern Ireland (UK

Box 5 2 **Risks for businesses and financial institutions related to biodiversity and nature's contributions to people.**

Biodiversity loss presents a range of material risks for businesses. These include physical risks, such as disruptions to value chains caused by ecosystem degradation, and transition risks, such as increased compliance costs due to stricter environmental regulations. These risks can, in turn, translate into risks for financial institutions that lend to, invest or insure businesses, manifesting as loan defaults, asset devaluation, or insurance losses (NGFS, 2024).

Many of these risks are endogenous, meaning that they originate from the businesses' own activities. Others are exogenous, arising from broader socio-political, climatic or macroeconomic shocks (Danielsson & Shin, 2003). Under the principle of double materiality, which considers both the impact of financial activities on biodiversity and the implications of biodiversity loss for a business's financial performance, managing endogenous risks becomes a strategic imperative.

Addressing these risks requires robust assessment, measurement and disclosure. While an increasing number of voluntary frameworks offer guidance **(Section 5.4)**, the current landscape remains fragmented. There is an urgent need to harmonize frameworks and move toward mandatory requirements to measuring, managing and disclosing biodiversity-related impacts, dependencies, risks and opportunities.

Government, 2023), the European Union and Latin America (Villarroya *et al.,* 2014) require businesses to address their impacts on biodiversity. Non-compliance can result in significant penalties, including fines, restricted market access, operational delays and refusal of permits (J. W. Bull & Strange, 2018; Smith *et al.*, 2019). Businesses may also be motivated by the conditions placed on access to finance, supplier agreements or procurement contracts. Meeting the safeguard requirements of financial institutions and the sustainability criteria of consumers and investors has become increasingly important (Adler *et al.,* 2017; Jia *et al.,* 2018). Adoption of voluntary frameworks for biodiversity risk disclosure and target setting can help reduce legal and reputational risks (Aladağ, 2023) and maintain a social licence to operate (Vanclay, 2017), particularly as businesses expand their view of stakeholders to include communities, civil society and the general public (Freeman *et al.,* 2007). Businesses that are trusted by local communities and have established partnerships often experience fewer operational disruptions, while protecting the livelihood options of those affected by their activities (Gehman *et al.,* 2017). Businesses with consumer-facing brands are also motivated to introduce sustainability policies to enhance their brand value and obtain a green premium for marketed products (Coqueret *et al.,* 2025; Gomez-Trujillo *et al.,* 2020; Mayer & Gereffi, 2010). These businesses are particularly attuned to shifts in public expectations and the risks of perceived inaction on environmental issues.

5.3.2 Barriers to business action

Existing business models remain one of the most significant barriers to transformative change. The prevailing emphasis on short-term profit maximization, reinforced by the fiduciary duty of executives to deliver financial returns to shareholders, has historically impeded action on biodiversity (Krause *et al.,* 2021; Panwar, 2023; Schaltegger *et al.,* 2023). Publicly listed businesses are less likely to act than private businesses, likely due to shareholder pressures and short-term reporting cycles (Gartenberg & Serafeim, 2023; Li & Wu, 2020). This is particularly true for actions requiring significant upfront investment with limited immediate return (Chen *et al.,* 2025). Quarterly and annual financial reporting can discourage planning over periods that are compatible with ecological timeframes and, while there is some movement toward incorporating broader societal value into corporate mandates, fiduciary duty rarely extends to environmental or social impacts in practice (Treepongkaruna, 2024).

Short-termism, however, is not the only obstacle to taking action to halt and reverse biodiversity loss and enable its sustainable use and fair benefit sharing. Businesses also face complex and interrelated financial, regulatory, technological and organizational barriers, many of which are particularly acute for small enterprises and businesses operating in developing economies. Access to capital for biodiversity-related investment remains limited and, even when financing is available, biodiversity actions often compete with other sustainability priorities (Mammen, 2024; WEF, 2025). While nature-based solutions offer strong economic and ecological returns, current global investment (around $220 billion in 2023, with just 10 per cent from the private sector) falls far short of the $571 billion needed per year by 2030 (UNEP, 2026). Meanwhile, approximately $7.3 trillion was directed in 2023 towards activities that have negative impacts on nature (UNEP, 2026). Of this total, public finance flows through environmentally harmful subsidies accounted for approximately $2.4 trillion, directed primarily towards fossil fuels ($1.13 trillion), agriculture ($0.41 trillion), water ($0.40 trillion), transport ($0.18 trillion), construction ($0.15 trillion) and fisheries ($0.06 trillion) (UNEP, 2026). The private sector was responsible for the majority of the nature-negative finance flows in 2023, estimated at $4.9 trillion and concentrated on utilities ($1.6 trillion), industrials ($1.4 trillion), energy ($0.7 trillion) and basic materials, including fertilizers and agricultural inputs ($0.7 trillion) (UNEP, 2026).

Financial barriers are even greater for smaller businesses and those operating in emerging markets (World Bank, 2019). As of 2020, the credit gap for formal micro, small, and medium-sized enterprises in these regions was approximately $5.7 trillion (19 per cent of gross domestic product), limiting their growth and resilience to economic shocks (Carvajal & Didier, 2024; World Bank, 2019). Businesses without a proven track record find it especially difficult to secure funding and high transaction costs – linked to due diligence, legal title issues or community engagement – can deter investors (Lambooy & Levashova, 2011; McQuaid *et al.,* 2021). Externally, market pressures and consumer behaviour can also limit action (Makepa & Chihobo, 2024). While stakeholder expectations, such as green consumerism, can drive action, their influence on outcomes depends heavily on stakeholder values (Krause *et al.,* 2021). In many cases, consumer preferences for affordability and convenience outweigh environmental concerns, particularly in sectors such as food and transport (OECD, 2023).

Regulatory and policy barriers constrain business action. National Biodiversity Strategies and Action Plans (NBSAPs) often lack the ambition and specificity needed to guide or incentivize private sector contributions to global goals (Bell-James & Watson, 2025). Although some countries directly reference business action – for instance, Malaysia's National Policy on Biological Diversity (Ministry of Natural Resources and Environment, 2016) – policies vary widely across jurisdictions. This creates legal uncertainty and complexity, particularly for multinational businesses (Clift *et al.,* 2017; Heinrich *et al.,* 2020; Krause *et al.,* 2021).

Weak enforcement, particularly in jurisdictions with limited governance capacity, further undermines policy effectiveness (Jia *et al.,* 2018; Karlsson-Vinkhuyzen *et al.,* 2018; Krause *et al.,* 2021). In some cases, government incentives or subsidies can also drive business behaviour that contradicts biodiversity goals and targets, promoting unsustainable practices or excluding opportunities for Indigenous and informal sector businesses (Myers, n.d.) **(Box 5.3)**. Even when regulations exist, high compliance costs may lead businesses to treat them as procedural requirements rather than taking meaningful biodiversity action.

Data and technology gaps pose challenges. Businesses require data on biodiversity impacts, dependencies, risks and opportunities to set targets, prioritize actions and track performance (Panwar, 2023; Schaltegger *et al.,* 2023). However, data needs and availability vary by decision-making levels and business context (see **Chapter 4**). Financial institutions often need standardized metrics for portfolio-wide assessments (Clément & Grenon, 2025) while site-specific data – sometimes down to species-level information – is essential for planning at the level of operations (zu Ermgassen, *et al.,* 2022). While in some cases these data do not exist, in others they are simply not obtainable from a company's internal tracking and data management systems. Lack of data transparency can particularly constrain businesses with value chains across multiple countries (Salmi *et al.,* 2023) and the proliferation of biodiversity metrics can create confusion, inconsistent reporting and inefficiencies in external monitoring (Zhu *et al.,* 2024). In many cases, essential biodiversity data is not accessible because of paywalls or weak data-sharing practices, both resulting from insufficient funding (McKenzie *et al.,* 2025; White *et al.,* 2023). Acknowledging and interweaving Indigenous and local knowledge is also essential yet often overlooked (Heinrich *et al.,* 2020; Krause *et al.,* 2021). Emerging technologies, such as artificial intelligence and remote sensing, can improve precision and scalability, but immature or inaccessible tools may also introduce ethical risks and widen capacity gaps, especially for resource-constrained businesses (Chang & Slaubaugh, 2017; Purwandani & Michaud, 2021; Ullah *et al.,* 2024).

Capacity constraints also create barriers. Many businesses lack the internal knowledge and skills to understand or act on biodiversity impacts, particularly at the executive level (Boiral *et al.,* 2019; Krause *et al.,* 2021; zu Ermgassen, Drewniok, *et al.,* 2022; Lambooy & Levashova, 2011; Panwar, 2023; White *et al.,* 2023). Externally, investors

Box 5.3 Regulatory barriers for Indigenous Peoples and local community-led businesses – The Tendu Leaf Trade, India.

Tendu leaves *(Diospyros melanoxylon L.)*, known as 'green gold', are a valuable non-timber forest product in India, primarily used to roll *bidis* – a traditional Indian cigarette. India produces between 300 billion and 1 trillion bidi sticks annually, with 61,000 tonnes of bidi tobacco exported globally (Jain *et al.,* 2024). The leaves are harvested across several Indian states, including Madhya Pradesh (the largest producer (Lele *et al.,* 2015)), Maharashtra, Bihar, Odisha, Andhra Pradesh, Gujarat, West Bengal, Kerala, and Tamil Nadu. For many Indigenous communities in these regions, tendu leaves represent a major source of income – contributing 20 – 40 per cent of annual earnings among tribal households (Guleria & Gautam, 2021).

Millions of tribal workers, particularly women, are engaged in tendu leaf collection in Central India. The process is labour-intensive, requiring careful plucking, bundling and drying. Historically, the trade has been unorganized and largely tax-exempt, resulting in significant volumes of unaccounted *bidi* production (Jain *et al.,* 2024). Collection was previously controlled by the Forest Department, with tribal workers forced to negotiate with private contractors who frequently exploited them through low wages, delayed payments and poor record-keeping (Sharma, 2003). Collectors often received as little as INR 5,000 per 1,000 bundles, with payments and bonuses delayed for up to two years (Yadav & Prajapati, 2023).

The enactment of India's Forest Rights Act (FRA) in 2006 marked a turning point, granting tribal communities Community Forest Resource (CFR) rights over minor forest products, including tendu leaves. In Maharashtra's Korchi block (Gadchiroli district), more than 90 *gram sabhas* (village assemblies) united to form the Mahagramsabha federation, securing direct ownership of the tendu leaf trade (Srivastava, 2024). This governance model has empowered local communities to negotiate higher prices – raising earnings from INR 4,500 in 2013 to INR 11,000 in 2022 per standard bag (Yadav & Prajapati, 2023).

Recognizing and supporting tribal rights over forest resources has not only improved livelihoods but also enhanced environmental outcomes. By eliminating the role of exploitative contractors, community-led governance has reduced forest degradation and promoted more sustainable harvesting practices. The result is greater biodiversity protection, improved carbon sequestration and enhanced ecosystem resilience (Lele *et al.,* 2015). This model potentially secures sustainable livelihoods for over 32 million hectares of forest-dependent communities in India (Yadav & Prajapati, 2023).

and financial institutions often lack awareness of biodiversity-related risks and opportunities (Lambooy & Levashova, 2011). While some pension funds have begun to acknowledge the long-term value of environmental, social and governance issues (Clark & Hebb, 2004; Tilba & McNulty, 2013), their reliance on external service providers and limited in-house expertise remain barriers (Tilba & McNulty, 2013; Yamahaki & Marchewitz, 2024). Tools such as natural capital accounting could help bridge these gaps by linking biodiversity condition and ecosystem service flows to business and financial risk (Ingram *et al.,* 2024), but uptake and integration remain limited across sectors (Parkhurst *et al.,* 2025).

Within businesses, organizational structures and cultures present additional barriers. Biodiversity-related responsibilities are frequently siloed within sustainability or compliance teams, limiting coordination with core business functions, such as procurement, operations and strategy design (Schaltegger *et al.,* 2023). Although guidance to build internal capacity is increasing, many businesses (especially small to medium-sized enterprises) receive little support. Smaller businesses typically lack personnel, access to relevant data and tools, and tailored sustainability reporting guidance (Van Tulder & Da Rosa, 2014). Capacity constraints also vary by sector; for example, industries with fragmented value chains may struggle to coordinate action between upstream extraction and downstream processing. Organizational culture can also limit action. Traditional leadership styles and a preference for the status quo can entrench existing business models, especially in the absence of strong external pressures (Krause *et al.,* 2021). Path dependencies and legacy systems may discourage innovation or delay necessary changes (Chesbrough, 2002). Many businesses continue to view biodiversity as immaterial to their operations (Addison *et al.,* 2019; zu Ermgassen, Drewniok, *et al.,* 2022).

5.4 BUSINESS-LED INITIATIVES GUIDING BUSINESS ACTION

A diverse and rapidly growing set of business-led initiatives has emerged to support corporate action on biodiversity, offering performance standards, disclosure frameworks and guidance on assessing impacts and dependencies, setting targets and planning actions. These initiatives aim to address barriers to action **(Section 5.3.2)** and provide guidance to help businesses identify impacts (SBTN, 2020), define roadmaps and prioritize actions (TNFD, 2023b), including for different sectors (Business for Nature, n.d.-b; WBCSD, 2023b), and apply good practice (Baggaley *et al.,* 2023; Locke *et al.,* 2021). However, requirements vary considerably, most remain weighted toward risk disclosure and reporting, and uptake across the wider business sector is insufficient to deliver the necessary scale and speed of action. Some initiatives apply universally, while others are sector- or region-specific. Voluntary disclosure frameworks show the greatest alignment, yet important differences remain on concepts such as materiality and "nature positive" (Milner-Gulland, 2022; UNEP-WCMC & UNEP FI, 2024). Greater harmonisation of standards, metrics and methods across sectors and countries could enable more systematic tracking of business actions and biodiversity outcomes. The needs of small and medium-sized enterprises, particularly in the global South, are also often overlooked (Mukherjee *et al.,* 2024), despite some targeted efforts (Business and Biodiversity, 2022; EFRAG, 2022). Many initiatives have also outpaced the science needed to support them (White *et al.* 2024) and poorly standardized or voluntary approaches risk delivering limited or counterproductive outcomes (Mair *et al.,* 2024). While IPBES provides science-based recommendations for all stakeholder groups, including business, these have not yet been consistently framed or communicated to define a clear, cohesive role for business and finance in enabling transformative change (IPBES, 2024a; Pörtner *et al.,* 2021).

5.5 OPTIONS FOR BUSINESS ACTION: A TYPOLOGY

A broad range of options for business action exists, which can be organized into the three roles businesses play in driving transformative change: (1) private actions to address a business's own impacts on biodiversity and nature's contributions to people; (2) directly changing and creating the enabling conditions for transformative change; and (3) signalling these actions and their outcomes to influence and inspire actions taken by other businesses and non-business actors **(Section 5.2.1; Chapter 6)**. These actions can be implemented at the four business decision-making levels at which biodiversity impacts and dependencies are measured – corporate, operations, value chains and portfolio **(Table 5.1)** – using the tools for measurement described in **Chapter 4**.

Chapter 5 highlights options for business actions from the perspective of an individual business, first focusing on private actions taken at each decision-making level **(Section 5.6)** and then expanding to include system-changing actions and social signalling **(Section 5.7)**. A range of illustrative options for action are provided, rather than a comprehensive suite tailored to specific business types, sectors or geographic contexts, and the types of actions that can be taken at different decision-making

levels are summarized in **Table 5.1**. Actions are needed at all decision-making levels and by all businesses, including financial institutions, although priorities on where and how to act first will differ depending on their size, sector, value chain role and impact distribution, where outcomes can be achieved most effectively, and their degree of control and influence over stakeholders. For example, a mining company may prioritize action first at the operational level, while a retailer selling forestry or food products may need to focus first on value chain-related actions. Example actions taken or reported in practice are provided in **Annex 5.1**. However, the evidence base for these examples is limited, and inclusion does not imply endorsement or verification of performance.

Close links exist between actions implemented across decision-making levels **(Figure 5.3)**. For instance, targets set at the corporate level drive actions and outcomes at the operational and value chain levels. These levels also reflect a flow of information: from the operational, where impacts and dependencies occur and outcomes are delivered, to the corporate and portfolio levels, where strategic decisions can reshape business models. Many actions also have multiple effects – for example, changes to corporate strategy can influence procurement practices and advocacy positions, which in turn can drive broader system change. Similarly, enabling conditions influenced by pro-biodiversity advocacy may create the need for revised strategies or changes to operational or value chain decisions (T. Smith *et al.,* 2020). A key intended outcome of value chain actions is for suppliers to implement their own on-the-ground activities to deliver outcomes (Maron *et al.,* 2023).

All actions need to form part of a due diligence process (Lumme *et al.,* 2023). Many actions can be taken immediately, even before detailed assessments are completed, particularly those related to strategy, policy, resourcing or product design (Addison *et al.,*



Figure 5 3 **Decision-making levels included in the Chapter 5 private action typology** (represented as boxes)**, the goals of actions taken at each level** (described in text) **and links in actions among levels** (shown with arrows).

For example, action to transform the business can enable actions by operations to achieve outcomes at sites.

2019). However, all should be informed by appropriate measurement, which is also essential for tracking performance and outcomes **(Chapter 4)** (Smith *et al.,* 2020). Important is also to note the overwhelming lack of verified evidence on the scale of implementation of actions by businesses and on the outcomes of these actions for biodiversity and nature's contributions to people.

Table 5 1 **Business actions organized by their roles in transformative change, the decision-making levels at which they occur, and where impacts and dependencies on biodiversity and nature's contributions to people are measured.**

	Corporate (Section 5.6.1)	**Operations (Section 5.6.2)**	**Value chain (Section 5.6.3)**	**Portfolio (financial institutions: greening finance) (Section 5.6.4.2–4)**
Private actions to address impacts and dependencies (Section 5.6)	• Set ambition and integrate biodiversity in corporate strategy • Create policies, develop management systems and clarify requirements for engagement, measurement, monitoring, reporting, disclosures and assurance • Transition the business, build capacity and ensure adequate resourcing to implement policies and achieve targets • Innovate in processes, products and services • Explore and adopt alternative business models ***Additional actions for financial institutions:*** **– *Greening finance* (Section 5.6.4.1)** • Set requirements for clients to take private actions **– *Financing green* (Section 5.6.4.5–7)** • Blended Finance • Green or sustainability-linked bonds • Impact investing	• Conduct environmental and social impact assessments • Apply the mitigation hierarchy to achieve no net loss of biodiversity or better • Measure and monitor biodiversity impacts and outcomes of actions • Identify and meaningfully engage with stakeholders	• Map value chain actors and ensure traceability to prioritize and inform action • Use supplier management systems to set expectations, monitor performance and address non-compliance • Build relationships and partnerships to build capacity and drive improved performance • Engage, educate and incentivize downstream customers, clients and consumers	• Assess biodiversity impacts and dependencies • Manage biodiversity risk and impacts through stewardship, divestment and/or exclusion
Actions to change the system and influence others (Section 5.7)	• Deliver conservation outcomes beyond impact mitigation • System changing actions: - Engage responsibly in policy and advocacy - Contribute to standard-setting and guidance across and within sectors, and collaborate on chain-of-custody initiatives - Innovate and share data, technology, and research openly to improve biodiversity outcomes - Build capacity and exchange knowledge, including through industry associations - Advocate for and collaborate on coordinated biodiversity disclosure for consumer products - Educate consumers on biodiversity impacts and sustainable choices • Collaborate and form partnerships to drive collective action • Signal leadership to inspire action by others: - Report externally on biodiversity impacts, dependencies, risks and opportunities - Publicize participation in biodiversity-related initiatives and industry associations - Promote the use of credible voluntary standards and certification schemes - Disclose actions and outcomes to demonstrate biodiversity performance			

5.6 PRIVATE ACTIONS TO ADDRESS A BUSINESS'S OWN IMPACTS AND DEPENDENCIES

5.6.1 Corporate: actions to transform the business

Corporate-level actions involve strategic decisions that shape a company's overall direction and long-term performance. These decisions are needed to implement private actions at the operations and value chain levels **(Section 5.6.2** and **5.6.3)** and enable system changing actions **(Section 5.7)**; they also drive the need for measurement and monitoring of biodiversity to further inform decisions and action. Corporate actions include: (1) setting ambition and integrating biodiversity in corporate strategy; (2) creating policies and standards to implement those strategies, including systems for measurement, monitoring and reporting; (3) transitioning the business in line with those policies, including shifts in governance and organizational structures, capacity-building and management, and incentives; (4) innovating in processes, products and services; and (5) exploring alternative business models and adopting these when appropriate.

5.6.1.1 Setting ambition and integrating biodiversity in corporate strategy

Biodiversity strategies reflect business motivations, ethos and ambitions, while addressing dependencies and impacts, regulatory requirements and stakeholder expectations (Macellari *et al.,* 2018). Such strategies define: i) the organization's objective with respect to biodiversity and nature's contributions to people and its scope; ii) the organizational structures needed to achieve it; iii) the necessary allocation of financial, human and technical resources; and iv) the role of business-unit management in coordinating activities to deliver desired outcomes. Objectives are commonly expressed as targets, which include environmental and social outcomes alongside financial performance targets. To track progress, key performance indicators are formulated. In some cases, these follow the 'SMART framework' – specific, measurable, accepted, realistic and time-bound targets – although many businesses adopt only some of these principles (Addison *et al.,* 2019; 2024). Targets and indicators can be set independently (e.g., committing to protect a defined number of hectares in the headwaters of a business's key water supply) or aligned with collective initiatives and international goals (Haffar & Searcy, 2018).

While the number of businesses setting biodiversity targets is increasing, substantial variation exists among them and evidence of effectiveness in delivering outcomes for biodiversity is limited (Hawkins *et al.,* 2023; Mair *et al.,* 2024; zu Ermgassen, Drewniok, *et al.,* 2022). Targets can encompass specific net outcomes, such as no net loss, net positive impact, net gain of biodiversity or zero deforestation (PBAF, 2022, Global Canopy & UNEP FI, 2020). For instance, mining company Anglo American has a corporate-level net positive impact target to leave biodiversity within their operational area in a better condition than before the business arrived **(Annex 5.1)**. Such commitments can be framed explicitly to align with overarching global or national goals (e.g., Hermes, a French luxury apparel and fashion business, states alignment of its biodiversity targets with the Kunming-Montreal Global Biodiversity Framework and France's National Biodiversity Strategy for 2030; **Annex 5.1**), although doing this is uncommon and if done, it is rarely done in a quantitative way (Haffar & Searcy, 2018) and with a limited scope. Evidence from Fortune 100 businesses shows that by 2021, 46 had some biodiversity commitments, skewed towards sectors with significant operational impacts such as energy, compared with service-based sectors, and that only nine had defined SMART targets – a small increase from 2016 (zu Ermgassen, Drewniok, *et al.,* 2022). Further, many service-based businesses appear to consider biodiversity of limited materiality to their core operations (Addison *et al.,* 2019), although significant biodiversity impacts remain in their value chains (J. W. Bull *et al.,* 2022).

Identification and assessment of a business's impacts and dependencies on biodiversity and nature's contributions to people is an important early step to take. Findings can help inform and refine targets, strategies and action (Schaltegger *et al.,* 2022), with much emerging guidance focused on corporate biodiversity measurement (see **Chapter 4**). High-level work on this can correct misconceptions by managers and others that a business does not interface with biodiversity and nature's contributions to people at all (Schaltegger *et al.,* 2022).

For financial institutions, biodiversity strategies can include plans to shift private capital towards outcomes consistent with halting and reversing biodiversity loss. This reflects the growing recognition that the finance sector needs to commit resources to restoration and conservation to close the global biodiversity financing gap (see **Sections 5.6.4.5–5.6.4.7**). One example is the AGRI3 Fund, established by Rabobank and the United Nations Environment Programme (UNEP), which uses blended finance instruments – including de-risking mechanisms, such as first-loss guarantees – to enable commercial banks to invest in deforestation-free agriculture, forest conservation and rural development **(Annex 5.1)**. Target-setting for biodiversity within financial institutions typically begins with identifying sectors and industries with significant biodiversity exposure, as these represent potential sources of financially material

risks. Target-setting can also be guided by alignment with sustainable finance frameworks, such as the Equator Principles, the Principles for Responsible Banking, the Principles for Sustainable Insurance, or the UN-supported Principles for Responsible Investment, to which organizations may be signatories (Global Canopy & UNEP FI, 2020).

Biodiversity strategies, including targets, can be informed and strengthened through internal and external stakeholder engagement, including employees, investors, policymakers, suppliers and consumers, academia, other businesses operating within the same landscapes and IPLCs (Schaltegger *et al.,* 2023; TNFD, 2023a; UN Global Compact and IUCN, 2012). Each business will have a unique set of stakeholders, with specific needs, interests and expectations, and with whom a dialogue is needed to manage relations. Approaches exist to identify and appropriately engage with these groups (Human Rights and Biodiversity Working Group, 2024; IFC, 2007; Kvam, 2019; Vanclay & Esteves, 2024; World Bank, 2017). Engagement also provides an opportunity to recognize diverse values of biodiversity in strategies and target setting (IPBES, 2022). Strategies based on employee involvement, for example, are more effective and can be implemented without comprehensive measurement, drawing on tacit knowledge on biodiversity issues held among employees (Boiral *et al.* 2019). Engagement and communication with internal stakeholders can also help build stronger relationships, aligning on goals, working more efficiently, sharing resources, exchanging ideas and improving support for proposed strategies, policies and action on biodiversity (Dzhengiz & Niesten, 2020a; Singh *et al.,* 2019).

When a business's biodiversity strategy is integrated with other sustainability goals and into the broader corporate strategy, it becomes more prominent to managers and employees which can lead to better outcomes. For example, businesses with greater climate-risk awareness tend to have higher quality biodiversity reporting (Bassen *et al.,* 2025); however, this awareness may not translate to improved material risk management for businesses and their investors. Four key elements have been proposed for integrating biodiversity into broader corporate strategy (zu Ermgassen, *et al.,* 2022). These include: defining the scope to demonstrate biodiversity outcomes across the organization's full value chain; mainstreaming biodiversity throughout corporate strategies, including through securing organization-wide buy-in; recognizing and amplifying interlinkages between biodiversity and other sustainability ambitions, including climate change; and ensuring that measurable outcomes are made against a fixed baseline and aligned with broader societal goals.

Once strategies are defined, businesses can undertake a series of actions to implement these. Strategy and implementation will evolve and be refined over time, as assumptions are tested, ambition grows and external factors come into play.

5.6.1.2 Creating policies, developing management systems and clarifying requirements for engagement, measurement, monitoring, reporting, disclosures and assurance

The first step in implementing a biodiversity strategy is to establish policies that guide actions across operations and value chains. Policies, standards and protocols clarify expectations for internal and external actors, and may draw on international standards (International Organization for Standardization (ISO), n.d., 2025), voluntary sustainability standards developed by industry associations or third parties (e.g., by the Global Reporting Initiative) or bespoke company approaches.

Effective integration requires both top-down measures (corporate strategy, policy, governance) and bottom-up engagement (employees, value chains), supported by indicators and regular reporting **(Section 5.6.1.1)**. While businesses often prioritize operational interventions, systemic solutions are critical to avoid negative biodiversity impacts and promote lasting change (Addison *et al.,* 2020; Panwar, 2023; T. Smith *et al.,* 2019). Embedding biodiversity across all business functions – procurement, operations, finance, marketing, human resources, governance and strategy – can shift companies from piecemeal actions to coordinated approaches that address root causes of biodiversity loss.

Corporate policies and management systems help align commitments with ambition and targets. They typically cover resource efficiency, waste, water and energy use (including climate action), governance and risk management, performance incentives, procurement and sourcing, due diligence, stakeholder engagement and grievance mechanisms, marketing and auditing. To be effective, policies must be actionable across operations and value chains and adaptable to diverse contexts (WBCSD, 2023; zu Ermgassen *et al.,* 2022).

Corporate commitments such as avoiding ecosystem conversion or respecting Indigenous Peoples and local community rights cascade into procurement and product policies. These commitments shape acceptable practices, including redesigning products to increase recycled content, excluding harmful materials, applying geographic sourcing strategies for traceability, embedding supplier codes of conduct into contracts, and extending product lifespans through repair, repurchase and recycling **(Section 5.6.4)**. For example, food retailers can reinforce zero-deforestation commitments by excluding products linked to ecosystem

conversion or endangered species (Beck-O'Brien & Bringezu, 2021). Similarly, financial institutions also apply exclusion policies to direct capital away from harmful activities **(Section 5.6.4)**.

Disclosure of biodiversity strategies, policies, and outcomes can be made internally and externally through annual reports and public statements, covering impacts, dependencies, risks and opportunities (CSRD, 2024; EFRAG, 2022 & TNFD recommendations, 2023). Independent third-party audits enhance credibility and accountability compared to self-reporting (OECD, 2024). However, biodiversity-related reporting remains limited and fragmented. Only 19 per cent of businesses sampled in the United States of America reported on biodiversity (Treepongkaruna, 2024). In megadiverse countries, reporting is highly variable across sectors, with stronger disclosure in materials, energy and industrials, and weaker in healthcare and information technology. Many statements remain vague and lack quantitative data (Skouloudis *et al.,* 2019). A review of over 2,000 environmental, social and governance reports from 43 countries (2010–2019) found biodiversity reporting has declined since 2015, coinciding with increased focus on climate change following the adoption of the Paris Agreement (Bassen *et al.,* 2025). Perceptions can also differ: investors may see detailed disclosure as indicating higher risk, while other stakeholders reward transparency, with quantitative reporting strengthening credibility (Bassen *et al.,* 2025).

Although disclosure frameworks are welcomed by the business community, concerns remain that reporting and quantitative risk assessments alone cannot manage nature-related financial risks. Complementary approaches are needed, including precautionary policies and qualitative methods to redirect capital away from unsustainable activities (Irvine-Broque & Dempsey, 2023), as well as outcome-based frameworks and regulation to drive systemic change (Kedward *et al.,* 2020; Mair *et al.,* 2024). Reporting alone rarely delivers substantive outcomes: meaningful change requires integrating stakeholder perspectives and local contexts (Smith *et al.,* 2019), elevating biodiversity to the same level as climate change in corporate practice, and stronger external pressure from governments and civil society (Bassen *et al.,* 2025). Improved frameworks should address both impacts and dependencies, supported by leadership, capacity-building and integration into wider sustainability strategies. Investors also need a deeper understanding of biodiversity risks to allocate capital responsibly. While credible reporting can enhance reputation and support global goals, including those of the Kunming-Montreal Global Biodiversity Framework, it must be combined with stronger regulatory, policy and outcomes-focused measures to align business practice with biodiversity objectives (Bassen *et al.,* 2025).

5.6.1.3 Transitioning the business, building capacity and ensuring adequate resourcing to implement policies and achieve targets

The successful execution of biodiversity strategies, transition plans and policies requires businesses to build up adequate, and often new, internal capacities and allocate sufficient resources, including financial investment and time. Governance reform may also be needed. Yet many businesses face constraints on their ability for effective action on biodiversity and nature's contributions to people, such as expertise gaps, siloed responsibilities and resource shortages **(Section 5.3.2)**. These challenges mirror broader findings on corporate sustainability transitions, which emphasize the need for organizational learning, leadership commitment and allocation of sufficient resources to enable contributions towards transformative change (Schaltegger *et al.,* 2022; Wicki & Hansen, 2019).

Governance structures play a key role in embedding biodiversity and nature's contributions to people into core decision-making. Despite 66 per cent of Fortune 500 businesses placing sustainability within the board's remit, only 2 per cent have directors with sufficient biodiversity expertise to provide meaningful oversight (World Benchmarking Alliance, 2023). Strengthening awareness and competencies at senior leadership level, including board (where relevant) and top management, can ensure leadership is better positioned to understand and manage biodiversity related risks, impacts and opportunities. board diversity and expertise can be positively associated with the quality of sustainability governance and the consideration of biodiversity in business strategy (Mutua *et al.,* 2025; Nguyen & Kanbach, 2024; Whelan, 2024). Integrating biodiversity into corporate governance frameworks can further ensure it becomes a strategic priority rather than an adjunct consideration (Ludwig & Sassen, 2022). Within organizations, responsibility for biodiversity and nature's contributions to people is often fragmented across departments or confined to specific functions. Creating synergies and points of integration across sustainability, operations, risk management and stakeholder engagement functions is critical to overcoming silos and aligning efforts towards shared biodiversity goals.

Recruiting and training employees with biodiversity-related expertise is also important, as environmental competencies are directly related to businesses' environmental performance (Dzhengiz & Niesten, 2020b). Some businesses, such as Natura, require biodiversity training for all associates, including senior leadership and new employees, to ensure familiarity with the business's Global Code of Conduct **(Annex 5.1)**. A business's investment in training and capacity-building also needs to extend to operations and value chain actors, for example to support

suppliers' capacity to understand and align practices with corporate commitments and requirements **(Section 5.6.3.3)**. Developing the necessary internal capacity that can enable a business to support transformative change requires multiple skill sets and may range from technical biodiversity knowledge and information management to engagement with a wide variety of rights-holders and stakeholders, including IPLCs. Employee knowledge and initiatives can be harnessed to transform voluntary pro-environmental behaviours into formalized responsibilities that directly support biodiversity outcomes tasks (Boiral *et al.,* 2019). Structured training on biodiversity and internal reporting on implemented, successful actions can also help embed a biodiversity-conscious culture, encouraging employees to take further action (Boiral *et al.,* 2019; Chaudhary & Klug, 2023; The Confederation of Swedes Enterprises, 2023). Encouraging experiential approaches, such as workplace exposure, field visits or collaborations with local conservation actors, can further strengthen biodiversity-friendly norms across the workforce (Panwar, 2023).

Resource constraints remain a central barrier for businesses, particularly for small and medium-sized enterprises (Torelli & Balluchi, 2023). The clear link between financial capacity and biodiversity action underscores the need for dedicated investment and financial planning to ensure that strategies can be effectively implemented (Mutua *et al.,* 2025; Nguyen & Kanbach, 2024). Incentive structures are vital, as both monetary and non-monetary rewards can drive behavioural change (Ludwig & Sassen, 2022). Aligning sustainability objectives with financial goals and performance metrics can strengthen employee engagement and sustain organizational transformation (Merriman *et al.,* 2016).

5.6.1.4 Innovating in processes, products and services

Businesses can (re-)design products, services and processes to limit negative impacts, promote positive impacts and sustainably manage dependencies on biodiversity. Circular economy approaches, moving away from linear "take-make-waste" models, are gaining traction in business and policy spheres (Bocken *et al.,* 2022; Ellen MacArthur Foundation, n.d.-b). They emphasize reuse, repair, recycling, sharing of assets and regeneration of natural ecosystems to minimize resource extraction, landfill and pollution (Bocken & Short, 2016; Konietzko *et al.,* 2020).

One focus is on durability and extending product lifespans. Businesses are redesigning products and packaging to be more durable, easier to repair or produced from recyclable or biodegradable materials such as cornstarch or seaweed (Ellen MacArthur Foundation, 2021). In electronics, modular devices that allow for repair and upgrades reduce e-waste and reliance on rare earth elements sourced from biodiversity-rich areas (Fairphone, 2024). In the fashion industry, durable and reusable items made with sustainably sourced materials reduce the frequency of resource-intensive production cycles. For example, Patagonia, a retailer spatialized in outdoor clothing and equipment has a 'Worn Wear' program that encourages consumers to trade or buy its products second-hand, extending product lifecycle (see **Annex 5.1**). Online resale platforms such as Vinted have grown rapidly, now accounting for around 11 per cent of clothing sales in France, with the global second-hand apparel market projected to grow by more than 30 per cent between 2025 and 2029 (Innovation Forum, 2025; Statista, 2025). Vaude also offers rental services as an alternative to ownership of outdoor gear (Vaude, n.d.).

A second area is resource efficiency and recycling. More resource-efficient manufacturing and operational processes can reduce consumption and waste. In agriculture, precision farming technologies such as drones and artificial intelligence-powered monitoring systems optimize water use and reduce pesticide applications, limiting runoff harmful to nearby ecosystems (Getahun *et al.,* 2024). Businesses are also adopting take-back and recycling schemes to keep materials in circulation. Interface, for instance, collects and recycles used carpet tiles (Ellen MacArthur Foundation, n.d.-b), while Pandora has shifted to 100 per cent recycled silver and gold since 2024, sourced from suppliers audited against Responsible Jewellery Council Chain of Custody standards (Pandora Group, n.d.; The Responsible Jewellery Council, 2024). Mining companies have piloted innovative by-product use, such as producing sand from mined ore (Franks *et al.,* 2025), which can reduce pressure on natural ecosystems from sand extraction (UN Environment Programme, 2022). Holcim has been among those trialling ore-sand technologies **(Annex 5.1)**, which could scale significantly with enabling conditions such as industry buy-in, policy support and market acceptance (Franks *et al.,* 2025).

A third priority is sustainable sourcing and alternative materials. The use of alternative materials can significantly reduce biodiversity impacts by eliminating reliance on harmful or unsustainable resources (Ellen MacArthur Foundation, n.d.-a). For example, INVERSA sources leather from harmful non-native species, benefitting ecosystems by removing invasive populations (Harrell, 2025; Inversa, n.d.). Replacing palm oil with sustainably sourced or alternative oils, such as algae-based products, can reduce deforestation and protect habitats of species such as orangutans. Similarly, sourcing certified or recycled materials (e.g., certified timber) reduces the need for raw extraction, though businesses also require working with suppliers to shift practices rather than simply switch suppliers **(Section 5.6.3.3)**.

Finally, businesses are exploring models that influence consumption patterns. These circular economy-focused approaches not only make business sense and create innovation opportunities but also help address dependencies on biodiversity. However, limitations have been noted: recycling is not viable for all products, and circularity alone does not resolve continually rising demand for materials driven by resource-intensive lifestyles and population growth (Bocken *et al.,* 2022). Experts highlight the importance of sufficiency – 'making do with less' – and prioritizing *refuse, reduce and rethink* over recycling (Alexander, 2012; Gossen *et al.,* 2019; Niessen & Bocken, 2021). However, a minority of businesses are already pursuing models explicitly aligned with moderating consumer demand, integrating sufficiency into their offerings, customer engagement and marketing (Bocken *et al.,* 2022; Niessen & Bocken, 2021). Common features of these businesses include stated purposes aligned with environmental and social objectives, B-Corp certification (see **Section 5.6.1.5**), governance structures that enable autonomy and flexibility, alternative financing (e.g., "slow finance") and partnerships with NGOs that provide credibility and biodiversity expertise (Bocken *et al.,* 2022).

5.6.1.5 Exploring alternative business models and adopting these, where appropriate

New business models are needed to enable progress on global biodiversity goals (Feger & Mermet, 2020; Hahn & Tampe, 2021). Available options emphasize systems thinking, include a shift towards the restoration, preservation and enhancement of ecosystems, and alignment with organizational, cultural and institutional values. Businesses themselves, in sectors as diverse as agriculture, tourism or the manufacturing and sales of appliances, are attempting to transform their internal business models (i.e., the way in which businesses create, distribute and appropriate value) towards regeneration (Das & Bocken, 2024), though mostly small and medium-sized enterprises. For example, over 9,000 corporations are certified by the non-for-profit network B Lab with the B-Corp certification for demonstrating high social and environmental performance, making a legal commitment to be accountable to all stakeholders, and publicly sharing their performance measured against B Lab's standards (B Lab, n.d.).

One way in which business models can be transformed is shown by alternative ownership enterprises (AOEs). These are 'firms that significantly shift economic value and decision-making power toward the non-investor stakeholders they impact, such as workers, producers, consumers, community members, or even a non-financial purpose' (Armeni *et al.,* 2023). They differ from conventional enterprise models mainly by changing economic and governance rights linked with business ownership and who can access this ownership. This can be done in various ways, for example through shifting ownership to non-investor stakeholders (e.g., producers, community members, workers or consumers, or a non-financial purpose), splitting economic and governance rights into different share classes held by different groups, thereby enabling these to influence governance; through granting decision-making power irrespective of ownership; or choosing legal forms that limit the rights typically granted to outside investors and thereby establishing legal accountability to stakeholders (Armeni *et al.,* 2023).

For example, Tony's Chocolonely, a chocolate manufacturer, has awarded a 'golden share' to an independent legal entity in perpetuity to protect its sustainability-focused mission (Hou Jones *et al.,* 2024) **(Annex 5.1)**. Cafédirect, a coffee distributor working with 25 coffee cooperatives in Latin America and Tanzania and reaching over 100,000 small-scale farmers, includes farmers in its governance and business decision-making processes: since 2004, farmers have been represented on the Board of Directors to facilitate small-scale producers' leadership role in the business. The business reinvests 50 per cent of its profits in a farmer-led charity set up by Cafédirect that implements producer support and development programmes (Hou Jones *et al.,* 2024). In 2022, Patagonia, a large outdoor apparel business, shifted to an alternative ownership model, transferring all its voting stock to a trust that safeguards the business's values and all its non-voting stock to a nonprofit entity, with annual profits (after reinvestment) distributed as dividends to support environmental protection (Patagonia, 2021) **(Annex 5.1)**.

5.6.2 Operations: actions to achieve outcomes at the site level

Businesses have direct control over their operations where actions can be taken to address their own impacts and dependencies to deliver outcomes for biodiversity and nature's contributions to people at the site level. These actions include: (1) conducting environmental and social impact assessments; (2) applying the mitigation hierarchy to address negative impacts on biodiversity; (3) monitoring biodiversity impacts and outcomes for biodiversity; and (4) meaningful stakeholder engagement. Actions at this level must be supported by measures at the corporate level **(Section 5.6.1)**, such as establishing environmental and social management systems, and ensuring sufficient capacity, systems, and processes are in place at the operational level to support implementation and compliance with auditing and assurance requirements. While the operationalization of these corporate systems is not detailed here – such as how staff and contractor capacity is built and performance assessed, or how systems are embedded in day-to-day operations – their importance for effective

delivery of outcomes is underscored. Further, **Section 5.7** describes additional actions that can be taken at the level of operations, including collaborative efforts with other businesses and non-business actors. These fall outside the scope of private actions and are instead aimed at influencing wider system conditions and achieving positive outcomes for biodiversity and nature's contributions to people.

5.6.2.1 Conducting environmental and social impact assessments

Environmental and social impact assessments aim to identify and evaluate the occurrence and significance of potential environmental and social impacts of proposed actions (Jay *et al.,* 2007). The environmental and social impact assessment process involves screening to determine the need for assessment, followed by scoping to identify key issues, stakeholders and baseline information. An examination of alternatives is then undertaken to establish options. Finally, impact assessment evaluates the significance of predicted effects and informs the design of mitigation and monitoring measures. Findings are compiled in an environmental and social impact assessment report, which undergoes review and decision-making by a competent authority, leading to project approval (often with conditions) or rejection (IAIA IEA, 1999). Principles have been developed to help ensure environmental and social impact assessments contribute to sustainable development outcomes, aligning decision-making and conditions of approval with broader sustainability goals (Brownlie & Treweek, 2018; IAIA IEA, 1999). Leading practice includes applying an ecosystem perspective to screening and scoping assessments and conducting analyses at ecologically appropriate spatial and temporal scales – for example, by using the 'ecologically appropriate area of analysis' concept (IFC, 2019). Best practice also involves assessing not only nature-related impacts but also dependencies and trade-offs (Morrison-Saunders & Pope, 2013; Sousa *et al.,* 2020), conducting meaningful stakeholder engagement throughout the entire process (Hundloe, 2021) (see **Section 5.6.2.4**), identifying mitigation measures that support local and national biodiversity and ecosystem service goals (Tallis *et al.,* 2015), and planning for ongoing monitoring, evaluation and adaptation over the life of the project (Morrison-Saunders *et al.,* 2024).

Most environmental and social impact assessments for operations are carried out in accordance with regulatory frameworks (Morgan, 2012). Hundreds of national, regional and international governing bodies now require environmental and social impact assessments (Hundloe, 2021), including in regions with significant infrastructure development expected in future (zu Ermgassen *et al.,* 2019). However, requirements vary widely in scope, rigour and ecological relevance, which can limit their ultimate contribution to broader biodiversity goals (Retief *et al.,* 2016). Issues with environmental and social impact assessments include limited scope of activities, omission of ecologically significant yet under-protected components of biodiversity (e.g., common species of least concern) (Simmonds *et al.,* 2020), unclear definition of and thresholds for what constitutes a 'significant' impact (e.g., whether small or cumulative impacts, or impacts on already degraded systems are captured) (Reside *et al.,* 2019; Simmonds & Watson, 2019), inadequate alternatives analysis, inadequate treatment of uncertainty and assumptions (Cardenas & Halman, 2016; Johnston *et al.,* 2015), insufficient clarity about the distinction between mitigation and offset actions (Bigard *et al.,* 2017) (see also **Section 5.6.2.2**), and no clarity on the desired outcome (such as no net loss or net gain) from applying all steps in the mitigation hierarchy.

While environmental and social impact assessments typically assess direct and indirect impacts of a project, including landscape-level effects such as habitat fragmentation (Gontier *et al.,* 2006), there is growing recognition of the need to evaluate cumulative impacts. This includes, for instance, the combined effects of multiple projects across migratory corridors or biodiversity hotspots (Piet *et al.,* 2021; Reside *et al.,* 2019). Although individual projects can include cumulative impact assessments within their environmental and social impact assessment processes, cumulative impact assessments are generally more effective when coordinated through strategic environmental assessments (Declerck *et al.,* 2023). Actions by individual businesses at the operational level can still contribute to or catalyse these broader assessments, although this typically requires collaboration with other stakeholders across the landscape, beyond the site boundary **(Section 5.7)**. Some methods and biodiversity metrics are now available to support businesses in conducting or contributing to cumulative impact assessments (Bennun *et al.,* 2024) and some business-led initiatives, such as the Nature Positive Initiative (Nature Positive Initiative, 2025) and the World Business Council on Sustainable Development (WBCSD, 2025), are working to harmonise data inputs and methodological approaches to support consistent reporting and tracking of biodiversity outcomes across sectors and geographies.

In contexts where regulatory frameworks are weak or misaligned with best practice, businesses can voluntarily align their environmental and social impact assessment processes with internationally recognized standards. Two essential elements of such alignment are: (1) ensuring that environmental and social impact assessments capture a broad range of business sectors and activities that cause impacts and biodiversity features that are impacted, including those not explicitly required by law; and (2) designing environmental and social impact assessment processes to inform application of the mitigation hierarchy and deliver specific biodiversity outcomes, such as no net

loss or net gain in biodiversity and nature's contributions to people. Ultimately, the scope of projects, the features assessed and the quality of baseline data collected determine the extent to which planning, implementation and long-term performance can be aligned with biodiversity targets.

5.6.2.2 Applying the mitigation hierarchy to achieve no net loss of biodiversity or better

The mitigation hierarchy is a framework that outlines a sequential approach for managing biodiversity and nature-related impacts. It begins with avoiding negative impacts, followed by minimizing and reducing impacts through controls, restoring affected biodiversity and finally, where appropriate and feasible, offsetting any residual impacts through biodiversity offsets **(Figure 5.4)**. The intended outcome of applying this hierarchy is to achieve no net loss and ideally a net gain in biodiversity (BBOP, 2012; J. Bull *et al.,* 2018). For this to be achieved, any biodiversity gains resulting from mitigation measures should be of the same type and magnitude as those lost to business activities and sustained for at least the duration of project impacts (BBOP, 2018; IFC, 2019; Milner-Gulland *et al.,* 2021).

While the mitigation hierarchy is widely recognized and referenced across many business sectors, particularly those subject to environmental and social impact assessment requirements (IPIECA, 2015; Rainey *et al.,* 2015), its rigorous implementation remains limited and inconsistent. There are several contributing factors at play. First, environmental and social impact assessments and mitigation requirements are only legally required for a subset of business activities (see **Section 5.6.2.1**), meaning many businesses fall outside these regulatory frameworks and only apply the mitigation hierarchy voluntarily, if at all. Second, even where the mitigation hierarchy is required, there is limited guidance on how much of any given action is enough. For example, how much impact avoidance is required before moving on to minimization. In many risk assessment frameworks, management requirements are often interpreted using the principle of "as low as reasonably practicable", which is inherently subjective (Kletz, 2005). Because there is no agreed threshold or performance standard for what constitutes sufficient avoidance, minimization or offsetting, its implementation cannot be enforced or assured in a credible way (Phalan *et al.,* 2018). As a result, very few projects successfully achieve their stated or implied net outcome targets, and the continued global decline in biodiversity suggests that current application of the mitigation hierarchy is falling short (Thomas *et al.,* 2025). Stronger regulatory frameworks with clearer expectations, measurable thresholds, and consequences for non-delivery would help drive more consistent and effective application, particularly by encouraging greater emphasis on impact avoidance as the first and most critical step.

The early stages of the mitigation hierarchy – avoidance and minimization – are considered the most reliable for achieving positive biodiversity outcomes (Phalan *et al.,* 2018). A broad range of avoidance measures exists, from cancelling or reconfiguring projects entirely to alternative siting, routing and scheduling of operations. Some tools and methods are available to support the identification, prioritization and measurement of avoidance actions (Cook *et al.,* 2018). However, demonstrating that impacts have been credibly avoided and justifying that enough avoidance has been achieved, remains a major challenge (J. W. Bull *et al.,* 2022). As mentioned above, businesses would benefit from clarity on a minimum set of biodiversity features that should be avoided (i.e., no-go zones) where societal demand for impact avoidance is clear. Minimization measures, in contrast, are typically easier to document, as they involve applying physical, operational or abatement controls to reduce the duration, intensity or significance of residual impacts. For example, "shutdown on demand" protocols have been used to reduce bird mortality from collision and trauma in wind energy operations (Marques *et al.,* 2014). However, best practice minimization is not a one-time effort. It requires continuous review and integration of improved technologies and practices over the life of a project, rather than locking in controls during initial planning phases, which in turn demands ongoing, adaptive environmental impact assessment (IPIECA, 2015). Notably, while documentation of minimization actions is relatively common, demonstrating the effectiveness of those actions in terms of actual outcomes for biodiversity is far less routine and presents an ongoing gap in both assurance and accountability.

Later stages of the mitigation hierarchy – restoration and offsetting – are typically more expensive, often more uncertain and pose greater risks to achieving impact mitigation goals, compared to earlier steps such as avoidance and minimization (IPIECA, 2015). These stages can include a range of actions including remediation, rehabilitation, restoration and offsetting. Remediation refers to actions that address pollution or other environmental hazards to make a site safe for use. Rehabilitation focuses on stabilizing and revegetating a disturbed site, often for a different land use (e.g., post-mining landscapes), whereas restoration aims to return an ecosystem to its pre-disturbance condition or trajectory. Biodiversity offsets are measurable conservation outcomes designed to compensate for residual impacts after all other mitigation measures have been applied, with the goal of achieving no net loss or a net gain in biodiversity (Gann *et al.,* 2019; Poulton & Maron, 2025). While rehabilitation may be feasible in some contexts, particularly in sectors like mining where land disturbance is concentrated, its effectiveness is limited. Despite significant progress in the development

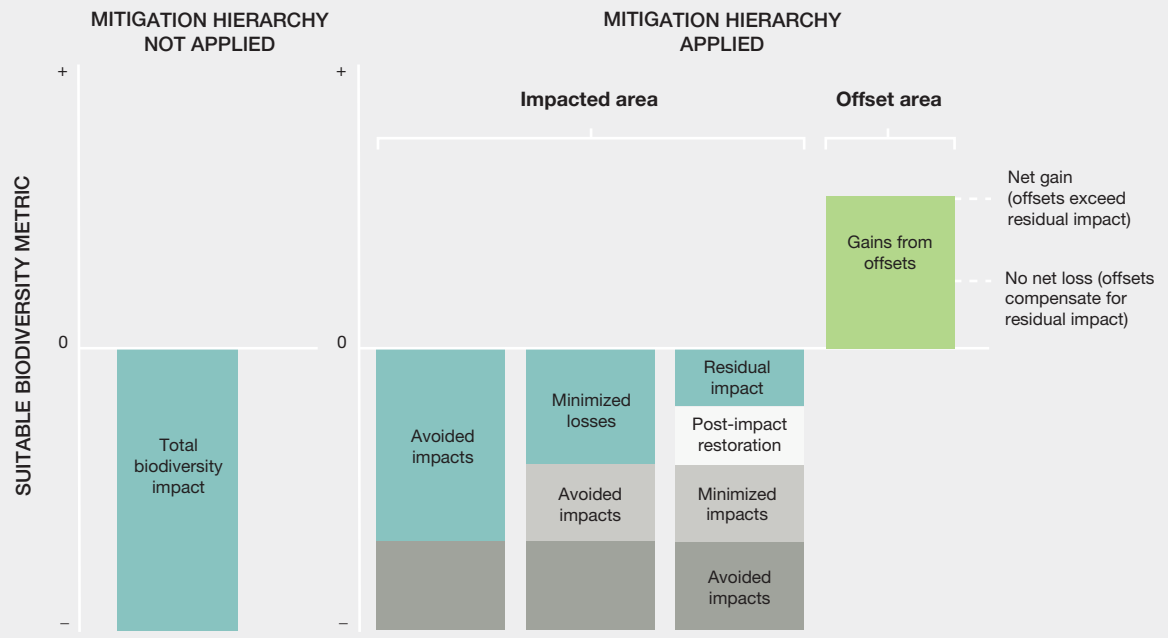


Figure 5 4 **The mitigation hierarchy, including actions to avoid, minimize, restore and offset.**

Note that conservation outcomes that contribute to renewing and regenerating biodiversity over and above a business's mitigation measures aimed at achieving no net loss outcomes would contribute to reversing biodiversity losses. Adapted from Maron *et al.,* (2025).

of best practice principles (Young *et al.,* 2022) and technical innovations in ecological restoration (Dixon *et al.,*) rehabilitated areas rarely return to pre-development (baseline) biodiversity conditions within a reasonable and defined timeframe (Campbell *et al.,* 2024). Moreover, outcomes are often shaped by broader, uncontrollable pressures such as climate change, altered fire regimes and invasive species, which can undermine even well-designed rehabilitation and restoration efforts.

Biodiversity offsetting is the final step in the mitigation hierarchy, reserved to addressing truly residual impacts that remain after all efforts to avoid, minimize and restore have been exhausted. As the riskiest and most uncertain mitigation measure, offsetting should be initiated as early as possible to allow adequate time for monitoring, stakeholder engagement and adaptive management (BBOP, 2012; IPIECA, 2015). To support transparency and accountability, offset design, including the type and amount of expected biodiversity gains, feasibility assessments and long-term management plans, should be clearly documented (BBOP, 2012). Effective offsetting measures are accompanied by regular audits, public disclosure of performance and contingency plans to address shortfalls, as required under standards such as those of the International Finance Corporation (IFC, 2012a). Some operations, such as Ambatovy, use biodiversity management plans to include measures consistent with applying the mitigation hierarchy, with the aim of achieving at least no net loss outcomes and commitments to restoration **(Annex 5.1)**. In principle, offsets should deliver biodiversity gains that are equivalent in type, amount and duration to the biodiversity lost through business activity (Gardner *et al.,* 2013). Offset planning should also address potential trade-offs between biodiversity, nature's contributions to people, and the good quality of life of people affected by offset activities (Griffiths *et al.,* 2019; Ma *et al.,* 2023; Sonter *et al.,* 2020). Although there is substantial knowledge, experience and guidance on offsetting (see **Section 5.6.2.3**), evidence of successful, outcome-based implementation remains limited. Maron *et al.* (2025) highlight common pitfalls, including weak governance, poor enforcement and insufficient long-term commitment.

For businesses, early and sustained planning to achieve no net loss or net gain outcomes at the level of operations is critical. Success depends on establishing strong governance arrangements, engaging relevant rights- and stakeholders from the outset, ensuring public disclosure of intended and actual outcomes, and applying an adaptive management approach. Notably, while these practices are essential to biodiversity offsetting, they are also critical for other mitigation measures yet are often underperformed or overlooked. Strengthening these foundational elements could improve the effectiveness and credibility of mitigation actions across the entire mitigation hierarchy (Ghijselinck *et al.,* 2026).

5.6.2.3 Measuring and monitoring biodiversity impacts and outcomes of actions

Many methods are available to support businesses in measuring biodiversity at the site level (see **Chapter 4**), including specific approaches tailored to environmental and social impact assessments and application of the mitigation hierarchy (Burgess *et al.,* 2024). For example, critical habitat assessments are widely used in infrastructure projects to identify species and ecosystems requiring special assessment and mitigation (IFC, 2019) while similar approaches – such as the High Conservation Value (HCV) framework – are used in agriculture and forestry (High Conservation Value (HCV) Network, n.d.). Guidance also exists for using biodiversity metrics to estimate and account for losses and gains over time (Mayfield *et al.,* 2022; SEEA, n.d.). Numerous tools exist to support the design and implementation of mitigation projects. These include tools for aligning site-level actions with broader biodiversity targets (e.g., jurisdictional goals (Simmonds *et al.,* 2020)), selecting suitable delivery mechanisms (e.g., biodiversity credit systems; see **Box 5.4**), ensuring robust safeguards (Narain *et al.,* 2022), and designing interventions to maximize additional benefits to biodiversity and nature's contributions to people (Bull *et al.,* 2018; Tallis *et al.,* 2015). Policy- and sector-specific tools are also available to support tracking progress toward no net loss targets throughout the project life cycle (Gibbons *et al.,* 2016).

A growing body of research has focused on evaluating the effectiveness of environmental and social impact assessments and mitigation measures in achieving biodiversity outcomes. Effective evaluation requires clearly stated net outcome targets, appropriate metrics and a counterfactual comparison – i.e., measuring biodiversity changes attributable to the project against what would have occurred in its absence (Maron *et al.,* 2018). In some cases, businesses are required to conduct and publish this information. For example, the International Finance Corporation and several other lenders require regular audits on biodiversity action plan implementation from clients receiving project financing. For example, Compagnie des Bauxites de Guinée (CBG) has developed biodiversity action plans as part of its mining operations in Guinea **(Annex 5.1)**. However, such reporting often focuses on barriers to action rather than outcomes, and the data made public is frequently insufficient for third-party evaluation. For instance, while one-third of biodiversity offset projects reported success, most used inadequate metrics or evaluation methods to support their no net loss claims (zu Ermgassen *et al.,* 2019). This is beginning to shift. Some frameworks now require the publication of essential project information, such as location, size and methodologies used,

Box 5.4 Use and misuse of biodiversity credits in addressing business impacts on biodiversity.

While businesses can take direct actions to manage their biodiversity-related impacts, market-based mechanisms, such as the purchase of biodiversity credits, have also been proposed. The Kunming-Montreal Global Biodiversity Framework highlights biodiversity credits as one of several innovative finance mechanisms to mobilize private sector investment in biodiversity recovery (CBD, 2022). A biodiversity credit is defined as "a certificate that represents a measured and evidence-based unit of positive biodiversity outcome that is durable and additional to what would have otherwise occurred" (Biodiversity Credit Alliance, 2024). Several initiatives, including the International Advisory Panel on Biodiversity Credits, the Biodiversity Credit Alliance, and the World Economic Forum Biodiversity Credits Initiative, are working to explore the development, scaling and appropriate use cases for such credits.

However, significant challenges remain. There is currently no standardized methodology for assessing, verifying or reporting biodiversity outcomes, nor a consensus on how to define or trade units of biodiversity gain or loss. The creation of a high-integrity supply of credits at sufficient scale, and demand from buyers with credible biodiversity claims, is still in early stages. The relationship between biodiversity credits and biodiversity offsets remains contested. A key concern is whether credits could be misused as a substitute for real, site-level mitigation. Many stakeholders advocate for a clear distinction between credits used for voluntary biodiversity contributions and units used to compensate for biodiversity losses elsewhere (Pollination & Taskforce on Nature Markets, 2023; Wunder *et al.,* 2024). Ideally, credits should only be purchased after a business has demonstrated it has achieved no net loss across its operations and value chains (Maron *et al.,* 2023).

Progress has been made through the International Panel on Biodiversity Credits (IAPB), which developed a Framework for High Integrity Biodiversity Credit Markets. This framework builds on the Biodiversity Credit Alliance definition, outlines three use cases for biodiversity credits, proposes 21 high-level principles for credit quality, and does not endorse international offsetting, instead emphasizing the need for local-to-local, like-for-like compensation. As the concept and implementation of biodiversity credit markets continue to evolve, it will be critical to draw from lessons learned in other conservation incentive schemes (Shrikanth *et al.,* 2025; Swinfield *et al.,* 2024; Wunder *et al.,* 2024), to ensure biodiversity credits complement, rather than undermine, core principles of the mitigation hierarchy.

which would enable independent evaluation (GRI, 2024). To date, most evaluations highlight the underperformance of biodiversity offsetting projects, although isolated cases suggest that well-designed mitigation measures can achieve no net loss (Devenish *et al.,* 2022). However, a major gap remains that there are currently no tools or frameworks to assess whether the cumulative outcomes of individual project-level mitigation actions are sufficiently large or strategic to support claims that a business is contributing meaningfully to global biodiversity goals.

5.6.2.4 Identifying and meaningfully engaging with stakeholders

Effective engagement with local communities, rights- and stakeholders is essential to building trust, understanding and assessing site-specific impacts and their significance, and prioritizing and achieving mitigation actions to deliver meaningful and lasting biodiversity outcomes (TNFD, 2023a).

When operations require acquisition or modification of land or resource rights, the undertaking of environmental and social impact assessments and other related studies is key to understand the context and uphold Indigenous rights, and other applicable rights of local communities related to property, governance, culture, livelihoods and food security. These studies entail assessing social baselines, land tenure and land use to identify formal or customary rights and potential impacts. Where rights or livelihoods may be affected, business engagement with rightsholders and stakeholders is necessary to obtain free, prior and informed consent in culturally appropriate ways, clarifying access rights, compensation and benefit-sharing. If free, prior and informed consent is not secured, best practice is for the business not to pursue its plans. These requirements reflect international law and standards, such as the Accountability Framework, Roundtable on Sustainable Palm Oil standards, International Finance Corporation's Performance Standards, High Conservation Value and High Carbon Stock Approaches (Accountability Framework initiative (AFi), 2019; Brown *et al.,* 2013; Hoyle *et al.,* 2018; IFC, 2012b; Roundtable on Sustainable Palm Oil (RSPO), 2022). Using study insights, businesses can define, implement, monitor and verify measures to protect Indigenous rights, and other applicable rights of local communities, with grievance mechanisms in place to address risks and impacts.

Broader engagement supports transparent and accountable decision-making, helps balance diverse expectations and can increase the efficiency and legitimacy of mitigation actions (IFC, 2007). This is particularly true when business operations contribute to cumulative impacts, as engagement enables coordination with other land users and institutions to support landscape-scale planning and mitigation (Fauna and Flora International, 2021).

Collaborative efforts can improve the information base for impact assessments and help broker partnerships that align conservation and development goals (see **Section 5.7.3**).

5.6.3 Value chain: actions to influence suppliers and customers

Tracing materials and products is a crucial step to measuring and addressing biodiversity impacts that occur upstream (through suppliers) and downstream (through clients and consumers) of a business's operations. Value chains – and the most suitable actions to address their biodiversity loss and secure their affected nature's contributions to people – differ from business to business and from sector to sector. Different businesses can also occupy different positions within the same value chain (i.e., be suppliers for some businesses and clients for others), meaning that actions taken by a company upstream to address downstream impacts will have implications for the actions required by downstream businesses. **Figure 5.5** provides an example, illustrating different parts and activities in a typical value chain for an agricultural commodity.

Value-chain actions are shaped by commitments made at the corporate level, which are embedded in associated policies and strategies. These commitments cascade into procurement practices and into protocols for product and service use and disposal (see **Section 5.6.1**). In doing so, they influence what businesses consider acceptable practice in areas such as product design and marketing and affect multiple actors both upstream and downstream. Examples include redesigning products to increase recycled content, substituting inputs to exclude environmentally harmful materials, and applying geographic sourcing strategies to improve traceability. They may involve integrating due diligence and supplier codes of conduct into contractual negotiations or extending product lifespan through post-sale services such as repair, repurchase or the collection of end-of-life goods for recycling and remanufacturing. Other instruments, beyond direct responses to corporate biodiversity actions, also drive supply chain actions. For example, internal codes of conduct and discretionary investments in supplier support aim to improve conditions on site and encourage gradual supplier compliance, but do not exclude providers from entering the value chain (Zadek, 2007). Third-party certifications (e.g., Fair Trade, Rainforest Alliance) and bans or moratoria (Gibbs *et al.,* 2015) are also designed to ensure that only compliant suppliers participate in value chains (Rueda *et al.,* 2017).

Regardless of the driver, implementation requires businesses to assign responsibility within teams, allocate resources and develop robust systems to assess supplier and customer impacts and dependencies, verify compliance and report progress (see **Section 5.6.1**). Collaborative initiatives

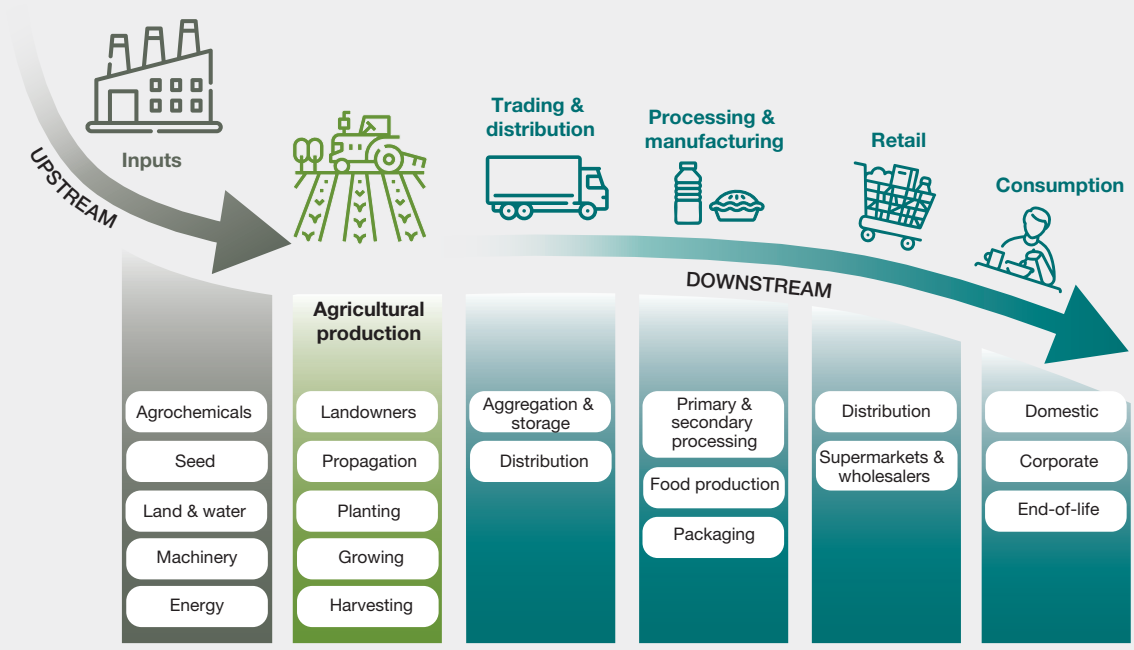


Figure 5 5 **Typical agricultural commodity value chain (e.g., olives, olive oil) with six interconnected stages from production to end-use.**

It includes: 1) provision of essential agricultural inputs (e.g., seeds, fertilizers, pesticides, and machinery for cultivation); 2) production, involving farmers cultivating olive trees; 3) post-harvest aggregation and storage of olives in facilities to maintain quality before processing; 4) processing and manufacturing of products (e.g., olives, olive oil, ingredients for food products); 5) distribution and retail of processed products for consumers; and 6) the consumption by end-users, including consumers and industries. Each stage has distinct environmental impacts and dependencies, particularly concerning land use, biodiversity and nature's contributions to people. The diagram illustrates agricultural production as the primary land-use stage with other stages shown as upstream and downstream activities (adapted from WBCSD, 2023b).

involving multiple businesses and non-governmental organizations can further scale sustainable practices across value chains and sectors, promoting system-level change (Pagell & Wu, 2009) **(Section 5.7)**. Businesses may also disclose value chain actions to their clients and consumers through marketing campaigns or other communication tools; however, decisions to do so relate to assessments of reputational risks and brand equity (Mayer & Gereffi, 2010; Rueda *et al.,* 2017).

Biodiversity loss has received limited attention in the supply chain management literature (Quarshie *et al.,* 2016; Salmi *et al.,* 2023). Addressing biodiversity loss beyond tier one suppliers remains difficult due to limited traceability, greater geographical separation and reduced influence over drivers of biodiversity loss at these broader scales (Marttinen & Kähkönen, 2022; Villena & Gioia, 2018). Several major disclosure frameworks and standards now provide guidance to businesses to inform value chain actions to address these barriers. They include the Science Based Targets Network (SBTN, n.d.-a); the World Business Council for Sustainable Development (WBCSD), n.d.) and the Taskforce on Nature-related Financial Disclosures (TNFD, n.d.), alongside sector-specific principles and operational guidance, such as those published by the Accountability Framework Initiative (Accountability Framework Initiative, n.d.-a) for agriculture and forestry supply chains. Key business actions identified in such guidance can be grouped into cooperative and coercive practices (Hoejmose *et al.,* 2014) and are organized below as: (1) mapping the value chain to prioritize and inform action; (2) using supplier management systems to set expectations and address non-compliance; (3) building relationships and partnerships with suppliers to build capacity and drive performance; and (4) engaging with downstream customers, clients and consumers, including educational programmes.

5.6.3.1 Mapping value chain actors and ensuring traceability to prioritize and inform action

Traceability means being able to follow a product or material through various value chain stages from production, processing and manufacturing to distribution.

It allows product volumes to be linked with the specific operations of suppliers and customers, along with information on their performance. Value chain mapping complements this by identifying the actors within a business's value chain(s) and the relationships between them (Accountability Framework initiative, 2019). Businesses invest in traceability to identify, understand and address social and biodiversity-related impacts and risks in their value chain, to improve transparency and ensure compliance with environmental regulations, human rights standards and global goals for biodiversity conservation, sustainable use and equitable benefit sharing. Businesses with global or complex upstream value chains are more likely to engage in actions to improve traceability (Salmi *et al.,* 2023). The Roundtable on Sustainable Palm Oil (RSPO) requires traceability systems to demonstrate that palm oil production avoids areas of high conservation value and adheres to no-deforestation commitments (Roundtable on Sustainable Palm Oil (RSPO), n.d.). Similarly, seafood traceability systems such as those certified by the Marine Stewardship Council (MSC) aim to ensure sustainable fisheries, prevent overfishing and safeguard marine biodiversity (Marine Stewardship Council, n.d.).

Gathering sufficient information for adequate traceability is essential for supply chain management but can be particularly challenging for businesses (see also **Chapter 4**). Both value chain mapping and traceability can be applied at different levels of detail and scope. For example, assessments can be undertaken at the product level to influence a wide range of actors, or they can focus on specific components of a value chain where material impacts and dependencies are most significant, with the aim of influencing key actors in priority geographies. Mapping often begins with direct (first tier) suppliers and can expand to include second and third tier suppliers, to build a progressively more comprehensive picture of the chain. Criteria such as supplier size and span, impact and dependence of a product on biodiversity, and identification of high biodiversity risk sourcing areas can further help prioritize efforts. Products and materials may be traced back to suppliers, such as refiners, traders, cooperatives, groups of farmers or individual producers, and in some cases to specific locations at the country, province, municipal or site level.

Several approaches and levels of knowledge can be obtained and used to inform and prioritize value chain actions (Accountability Framework Initiative, n.d.-b). These include: 1) full traceability, where materials can be traced back to the production or processing unit of origin, enabling direct assessment of risks, impacts and compliance; 2) the use of supplier control mechanisms that meet relevant criteria and provide reliable, sufficient information; 3) reliance on credible assurance mechanisms, such as third-party verification under voluntary sustainability schemes; and 4) under adequate circumstances, traceability to low-risk landscapes or jurisdictions that can demonstrate acceptable performance. For example, Vietnamese chocolate manufacturer Marou, a small to medium-sized enterprise, ensures full traceability by purchasing beans directly from producers in eight regions local to its factory (Marou, n.d.) **(Annex 5.1)**.

Although full traceability is not always necessary, nor made a priority by businesses (Salmi *et al.,* 2023), some have achieved it in one or more of their value chains through dedicated effort. Technological advances, including improved data quality (e.g., remote sensing products) and digital assessment tools (e.g., mobile applications for data recording) have supported this, including the use of blockchain technology (Agrawal *et al.,* 2021). For example, Dutch chocolate manufacturer Tony's Chocolonely works with nine farmer cooperatives and supports 17,740 smallholder farmers in Ghana and Côte d'Ivoire. The company uses a digital tracking system to identify the percentage of cocoa supplied by each farmer in every shipment received, with all farms GPS-mapped and data owned and used by local cooperatives (Hou Jones *et al.,* 2024; Tony's, 2023).

Once value chains have been mapped, including upstream and downstream activities and materials, businesses can use this information to inform actions based on priority procurement categories and their impacts on biodiversity and nature's contributions to people. Several methods are available to support this process. For example, the Science Based Targets Network materiality tool and ENCORE are often used to identify categories at risk, while life cycle assessment has been used to provide measures of biodiversity impacts (see **Chapter 4**). For some businesses, tools have proven useful, provided uncertainties are recognized and addressed (Bromwich *et al.,* 2025). However, there are many reasons why these approaches often break down when applied to prioritizing actions across certain value chains, sectors, businesses and financial institutions. For instance, tools designed to identify priority procurement categories may not comprehensively capture all materials within a business's supply chain, rarely integrate with existing supplier management systems and include nature-related materiality in ways that do not align with internal risk management systems and processes. Addressing these limitations will require a more comprehensive, regionalized and forward-looking understanding of business activities, which are explicitly linked to procurement categories and their biodiversity impacts and dependencies.

5.6.3.2 Using supplier management systems to set expectations, monitoring performance and addressing non-compliance

To manage impacts and dependencies, businesses use supplier management systems applied company-wide or to specific commodity value chains (Cousins *et al.,* 2019; Vachon & Klassen, 2006). Key features of these systems include clear sourcing and procurement policies to operationalize corporate commitments to biodiversity and nature's contributions to people, robust risk assessment strategies, procedures for supplier selection and compliance, protocols for managing non-compliance, and mechanisms for supplier engagement and capacity-building. Equally important are grievance procedures, supplier reporting requirements, and senior management responsibility for implementing the system and ensuring commitments are met (Accountability Framework initiative, 2019). Stricter approaches to supply chain management are often driven by downstream customer demands (Hoejmose *et al.,* 2014).

Communicating policy commitments, sourcing requirements and expectations to suppliers across the value chain is essential, ideally with time-bound targets and milestones. For example, some buyers require beef or soy suppliers in Brazil's Amazon and Cerrado to adopt zero-deforestation policies aligned with their corporate commitments and to demonstrate progress by a set date (BNP Paribas, 2021). Requirements for biodiversity protection and respect for Indigenous rights, and other applicable rights of local communities, can be embedded in contractual agreements, supplier codes of conduct and engagement plans. Incentives, such as long-term agreements, price premiums or preferential shelf space can further encourage supplier performance (Marshall *et al.,* 2015). Supplier assessment and due diligence support monitoring and verification, through tools such as questionnaires, performance tracking, audits and certification (Marshall *et al.,* 2015; Salmi *et al.,* 2023; Sancha *et al.,* 2019; Vachon & Klassen, 2006). Supplier assessment and due diligence support monitoring and verification, through tools such as questionnaires, performance tracking, audits and certification (Marshall *et al.,* 2015; Salmi *et al.,* 2023; Sancha *et al.,* 2019; Vachon & Klassen, 2006).

Businesses use a variety of risk assessments to identify non-compliance with requirements and commitments. Good practice involves addressing the correct scope and level of disaggregation (relating to commodity, geography and commitment), using appropriate metrics and credible methodologies, qualified risk assessors and independent review (e.g., when sourcing from regions not regarded

Box 5 5 Voluntary sustainability standards.

Voluntary sustainability standards are private standards that require products to meet defined economic, social and environmental metrics. These requirements may cover product quality or attributes, production and processing methods, and even transportation. Typically designed and promoted by non-governmental organizations or private businesses, they are adopted by actors across value chains, with labelling used to signal compliance (UNCTAD, 2025).

Businesses can use voluntary sustainability standards to assess and manage biodiversity-related risks in their supply chains, enhance transparency and demonstrate progress toward sustainability goals to investors and customers. A wide variety of schemes exist. Some are biodiversity-specific and cross-sectoral, such as the French Association for Standardization's Standard NF X32-001 to help organizations structure their approach to biodiversity (AFNOR Editions, 2021) and an ISO standard on Biodiversity Net Gain is currently under development. Others are commodity- and sector-specific, particularly for high-risk commodities such as aluminium, pulp and paper, palm oil, soy, coffee and beef. The scope, quality of requirements, governance and implementation vary considerably. To support credibility and best practice, the International Social & Environmental Accreditation & Labelling Alliance (ISEAL, 2021) provides a widely recognized framework.

Despite rapid growth in recent decades, the scale of voluntary sustainability standards remains limited. Tayleur *et al.* (2017) found that the certified area across twelve major crop standards increased by 11 per cent annually between 2000 and 2012 but still covered only 1.1 per cent of global cropland (Tayleur *et al.,* 2017). O'Brien *et al.* (2024) found less than 15 per cent of forests and less than 15 per cent of global marine catch to be certified. Research on effectiveness and efficiency shows mixed results. Documented limitations include weak assurance and enforcement systems, failure to fully prohibit deforestation and forest degradation (despite zero-deforestation goals), limited measurable impact on biodiversity outcomes, governance and credibility issues linked to power imbalances between businesses and smaller non-governmental organizations, high certification costs, conflicts of interest, and risks of greenwashing (BankTrack, 2020; Cosimo *et al.,* 2024; Englund & Berndes, 2015; Moog *et al.,* 2015; O'Brien *et al.,* 2024).

Nonetheless, many sources also highlight the positive role of credible standards in improving business biodiversity performance, particularly when integrated into robust due diligence systems and used as complementary tools (Beck-O'Brien & Bringezu, 2021).

as low risk). Initial screening through a coarse-grained approach looking across all regions and value chains will highlight where more detailed assessment is necessary, for example, to focus on certain parts of a value chain, certain geographies or suppliers (Accountability Framework initiative, 2019). Transparency is increasingly promoted by publishing supplier lists online, sometimes with downloadable datasets or maps, or disclosing through platforms such as the Carbon Disclosure Project (CDP, n.d.; Salmi *et al.,* 2023).

To address non-compliance, businesses can retain or suspend suppliers, often coupling engagement with corrective support. In some cases, suppliers are excluded altogether, at least until they can demonstrate changes to fulfil requirements. The most suitable course of action depends on the severity of the non-compliance (i.e., its scale, intensity and persistence), the supplier's control over or responsibility for the non-compliance and their commitment and capability (e.g., their commitments, track record). Engagement by the business with its suppliers is essential in all cases to help rectify non-compliance, although it may sometimes be necessary to move away from certain suppliers in preference of those with stronger practices. When sourcing from smallholders or suppliers with limited capacity, alternative and more contextualized approaches to assessing and managing non-compliance are usually needed (see **Section 5.6.3.3**) (Accountability Framework Initiative, 2019).

While businesses can control their own operations and influence the actions of their direct suppliers (Sancha *et al.,* 2019), they face challenges to identify and address risks and impacts related to suppliers that are more than one tier removed from their own operations (Villena & Gioia, 2018). A common approach is to evaluate the adequacy of tier one suppliers' supplier management systems, or their adoption of voluntary sustainability standards (see **Box 5.5**). These may in turn assess performance at the supply chain level or evaluate the systems of their own direct suppliers, creating a cascading oversight process until risks can be properly addressed (Accountability Framework initiative, 2019).

5.6.3.3 Building relationships, partnerships and capacity to drive improved performance

Effective value chain management requires businesses to go beyond procurement requirements, data collection and due diligence, and to work closely with suppliers to transition their activities. These practices have been found to be more effective in driving action on biodiversity loss than actions focused only on setting internal policies and requirements for suppliers (Marshall *et al.,* 2015; Meqdadi *et al.,* 2020; Salmi *et al.,* 2023) and represent important pathways for enabling supply chains to be a lever of transformative change (Wieland, 2021). This is important for businesses with significant influence and resources, and equally critical for smaller businesses, smallholder producers and businesses operated by IPLCs, who may lack the institutional capacity and resources to implement biodiversity actions and improve outcomes (Accountability Framework Initiative, 2019).

Collaboration can foster trust, empower suppliers as change agents and build readiness to address biodiversity impacts. It also strengthens long-term relationships, improves product quality and increases buy-in for corporate action. Common practices include supplier training (Sancha *et al.,* 2019) and capacity-building, for example, improving management practices, adopting simplified due diligence processes (Lumme *et al.,* 2023) or aligning with certification processes. Businesses may also use local workforce as relationship managers or extension services to provide ongoing technical support. Mountain Hazelnuts, for instance, uses this approach in Bhutan to maintain regular contact with smallholder producers (Hou Jones *et al.,* 2024). Other businesses may use direct contact, such as monthly visits and regular phone calls, with suppliers (Mourou *et al.,* 2021).

Such engagement relies on sustained business investment in long-term relationships with suppliers and local communities (Salmi *et al.,* 2023). Integrating communities into value creation activities such as sourcing, production and distribution has been a success factor in sustainable value chain management. Natura, a multinational cosmetics company, sources babassu oil from *quebradeiras de coco do babaçu* (Babassu nut-breaking women) applying traditional knowledge within a biodiversity-based business **(Annex 5.1)**. Long-term purchasing agreements, minimum quantity commitments, price premiums and investments in training, education and infrastructure have strengthened relationships between the company and community suppliers (Puppim de Oliveira *et al.,* 2022).

Businesses can also provide direct support by promoting supplier organizations, for example through cooperatives, offering access to technology or contributing necessary resources, such as seedlings, equipment or financial assistance. For example, Cafédirect partners with 25 cooperatives in Tanzania and Latin America, reaching more than 100,000 farmers, and reinvests half its profits into Producers Direct – an independent, farmer-led charity. Producers Direct provides tailored development programs, financial services, training, producer networks and mobile apps that help farmers analyze crop data, monitor productivity, and even predict yields using artificial intelligence (Hou Jones *et al.,* 2024). Marou, for example, provides interest-free loans and harvest advances, as well as equipment, to support its producer network (Mourou *et al.,* 2021) **(Annex 5.1)**.

Box 5 6 **Chain of custody initiatives to share knowledge and align practices: the case of the Aluminium Stewardship Initiative.**

The Aluminium Stewardship Initiative's chain of custody approach ensures the responsible production and sourcing of aluminium throughout the value chain by linking sustainability and ethical standards from raw material extraction to the final product. Aluminium Stewardship Initiative's Chain of Custody Standard enables certified entities to demonstrate that their aluminium has been sourced, processed and manufactured in a way that meets rigorous environmental, social and governance criteria, such as biodiversity conservation, reducing carbon emissions and protecting Indigenous Peoples' rights. The chain of custody approach requires transparent documentation and traceability of certified aluminium, ensuring that materials meeting Aluminium Stewardship Initiative standards can be identified and tracked across every stage of production. This system supports industries like construction, packaging, and automotive in delivering responsibly sourced aluminium to customers while promoting sustainability across the value chain (ASI-Aluminium Stewardship Initiative, 2023).

Processes for joint problem-solving and co-developing solutions are equally important, as they enable knowledge exchange and continuous improvement (S. Lee & Klassen, 2008). Sectoral initiatives can help transfer knowledge from larger to smaller businesses and build supplier capacity. Chain of custody initiatives, for example, provide a network for such engagement and knowledge transfer **(Box 5.6)**. In collaborative approaches, businesses often partner with non-governmental organizations or government agencies (Jia *et al.,* 2018). Partnerships between businesses and non-governmental organizations that engage directly with suppliers in sourcing countries can be effective in overcoming barriers to sustainability – by co-developing standards with suppliers and supporting them in meeting these requirements (see **Section 5.7**).

5.6.3.4 Engaging with, educating and incentivizing action by customers, clients and consumers

Marketing and other consumer-facing strategies provide businesses with direct opportunities to influence consumer behaviour in support of biodiversity and nature's contributions to people. These include educating customers, using clear product labelling, incentivizing behaviour change and supporting post-sale engagement. In some cases, businesses are required or incentivized through environmental policy to adopt extended producer responsibility, which makes them financially or physically responsible for the end-of-life management of their products. Extended producer responsibility shifts costs and burdens from governments and taxpayers to producers and brands, with the aim of encouraging the design of more sustainable products that are easier to reuse, repair or recycle. However, such initiatives will remain limited if underlying business models continue to depend on unsustainable patterns of consumption (Purvis *et al.,* 2019; Whiteman *et al.,* 2013) and are often dependent on and driven by institutional pressures (Hoejmose *et al.,* 2014), see also **Section 5.6.1**.

Clear and credible sustainability labels and certifications can indicate that biodiversity considerations have been integrated into sourcing and production processes, enabling consumers to identify products with lower impact (Testa *et al.,* 2015). Dutch organic food company Eosta, for example, uses QR or three-digit codes to provide transparency on growers and environmental footprints (Eosta, 2018, 2025). Certification schemes such as those offered by the Forest Stewardship Council, Marine Stewardship Council and Rainforest Alliance are widely used and signal sustainability to consumers. However, the effectiveness of labels is often limited by information overload, low consumer awareness, scepticism about label credibility, and the financial and administrative burdens of certification (Taufique *et al.,* 2017; Tregidga *et al.,* 2014). Many consumers also misunderstand or mistrust labels, especially when multiple certifications compete in the same market (Thøgersen *et al.,* 2010).

Businesses can shape public understanding of biodiversity and the impact of their products through educational initiatives that aim for long-term shifts in attitudes and behaviours. Such efforts need to ensure coherence between sustainability claims and actual practices to avoid accusations of greenwashing (Delmas & Burbano, 2011) and communication strategies are most effective when there is a transparent and tangible link between the product and its biodiversity impacts (Du *et al.,* 2010). Tools such as the Union for Ethical BioTrade's Biodiversity Barometer help businesses better understand consumer expectations around biodiversity and tailor their corporate strategies and engagement accordingly (Union for Ethical BioTrade (UEBT), 2024).

Some businesses incentivize customers to adopt more sustainable behaviours by offering discounts for returned products, loyalty points for biodiversity-friendly purchases or rewards for recycling packaging. Post-purchase engagement can help address impacts at the end-of-life stage of products, an area often overlooked in traditional marketing and sustainability frameworks (Peattie &

Crane, 2005). Actions include providing guidance and infrastructure for recycling, take-back schemes and repair services to reduce downstream impacts. Several outdoor brands, for example, offer care and repair kits and instructions to extend product life, and provide platforms for second-hand gear (VAUDE, 2025). Patagonia's Worn Wear programme, for instance, rewards customers who return or repair garments, promoting reuse and reducing demand for resource-intensive new production (Armstrong *et al.,* 2015; Patagonia, 2025) **(Annex 5.1)**. Similarly, many coffee businesses provide collection and recycling points for used capsules (Nestlé Nespresso S.A., 2024). Incentive-based strategies have been shown to increase consumer engagement, though their effectiveness depends on aligning rewards with meaningful biodiversity outcomes (K. White *et al.,* 2019).

While these consumer-facing strategies can support biodiversity goals, they often sit uneasily within traditional business models. Many businesses depend on volume-based sales growth, which conflicts with encouraging reduced consumption or promoting longer-lasting products (Bocken *et al.,* 2014). Encouraging consumers to buy less, repair more or extend product life can challenge profitability and cause internal tensions between marketing, sustainability and finance teams (Hahn *et al.,* 2015). Biodiversity's complexity further complicates integration and communication compared to more easily quantified issues like carbon (Addison *et al.,* 2019; IPBES, 2019b). These tensions highlight the need for systemic shifts in how businesses conceptualize value – placing biodiversity, social and ecological wellbeing, at the centre of corporate governance **(Section 5.6.1)**.

5.6.4 Additional private actions for financial institutions

Almost $7.3 trillion (from both public and private sources) is invested annually in activities that have a direct negative impact on biodiversity and nature's contributions to people (UNEP, 2026). Addressing biodiversity loss requires not only halting these harmful financial flows but actively redirecting them toward initiatives that enhance biodiversity. Financial institutions are key actors in supporting transformative change. They influence biodiversity outcomes primarily through the businesses they finance or invest in, with the degree of influence varying by institution type. Investors, due to their equity ownership, also hold significant leverage to engage with businesses on biodiversity, with influence generally increasing in proportion to the size of their stake. Lenders, in turn, exert influence mainly through the terms of their financing, which may include exclusion policies targeting certain activities, businesses or sectors, biodiversity mitigation measures tied to financing, and capital allocation decisions.

Nature-related actions by financial institutions fall into two categories: "greening finance" and "financing green" (World Bank, 2022a). *Greening finance* redirects financial flows away from activities that have negative impacts on biodiversity, minimizing harm and addressing drivers of loss. *Financing green* channels capital toward initiatives that conserve, restore and sustainably use biodiversity and nature's contributions to people. Both approaches are necessary to catalyze transformative change and involve actions taken by financial institutions (lenders, investors and insurers) at the corporate and portfolio levels of decision-making. This **Section 5.6.4** highlights actions that are additional to and complement the actions listed earlier **(5.6.1-3)** for all businesses, including financial institutions.

5.6.5 Greening finance

5.6.5.1 Setting corporate-level requirements for clients to take private action

Financial institutions providing project finance (loans or equity investment meant for a specific project (OECD, 2014)) to clients with operations, such as those within extractive, infrastructure, energy or livestock sectors, often require them to carry out biodiversity impact assessments of the operations and to apply the mitigation hierarchy. Decisions to set client requirements and integrate them in the financial institution's environmental and social safeguard system, are made at the corporate level. Pioneered by development banks, environmental and social safeguards are now also widely applied by private commercial banks. For example, the International Finance Corporation's Performance Standards, including Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (OECD, 2014) are used by over 130 mostly private financial institutions that have signed up to the Equator Principles (Equator Principles Association, 2024; Narain *et al.,* 2022). Biodiversity requirements embedded within the safeguards involve preliminary risk screening to identify biodiversity affected by a proposed project, followed by a detailed environmental and social impact assessment to identify direct, indirect and cumulative impacts of the operations. The requirements to address these impacts are usually structured around the mitigation hierarchy (see actions in **Section 5.6.2**), applied to avoid and minimize impacts to the greatest extent possible, restore damaged biodiversity and offset residual impacts, often with the explicit goal of achieving at least 'no net loss' of biodiversity (IFC, 2012a).

To detect and address biodiversity impacts within their clients' value chains, financial institutions can require clients to implement traceability measures. Once it is known where in the value chain the impacts lie, clients

can be required to engage with high-biodiversity footprint suppliers (to help them avoid or otherwise address any impacts) or to shift away from such suppliers entirely (see actions in **Section 5.6.3**). For example, Barclays' Forestry and Agricultural Commodities Statement, which came into effect on 1 July 2023 prohibits clients from sourcing beef produced or processed on areas in the Amazon cleared or converted after 2008. Clients that source from high-deforestation-risk countries in South America are required to achieve full traceability and deforestation-free status for their value chains by December 2025 (UNEPFI, 2023).

5.6.5.2 Assessing portfolio-level biodiversity impacts and dependencies

To inform a financial institution's actions in redirecting financial flows away from high-biodiversity-impact sectors, the biodiversity 'footprint' (see **Section 4.4.1**, **Chapter 4**) of its lending and investment activities can be estimated. Tools drawing from environmental-economic models and life-cycle approaches **(Table 4.2, Chapter 4)** have been developed to support these portfolio-level footprinting efforts.

Despite these advances, the availability of tools remains limited, and there are few well-documented examples of their application at the portfolio level. As a result, financial institutions continue to face challenges in reliably quantifying biodiversity impacts and dependencies across their investments, though these tools provide a foundation for identifying high-impact sectors, monitoring changes over time, and aligning portfolios with emerging frameworks such as the Partnership for Biodiversity Accounting Financials (PBAF), Science-Based Targets for Nature (SBTN), and the Taskforce on Nature-related Financial Disclosures (TNFD). In practice, particularly for large portfolios, footprint estimates are often derived from modelled or self-reported client data rather than direct measurements of on-the-ground change (see **Chapter 4**).

5.6.5.3 Managing biodiversity risk and impacts across portfolios through stewardship

Identifying biodiversity-related risk and impact hotspots (sectors, businesses or projects) within a financial institution's portfolios then enables the deployment of various mitigation actions. These fall into two broad categories: 1) stewardship and 2) divestment and exclusion. These actions can take different forms for different types of financial institutions, i.e., investors and lenders. For investors, stewardship involves using their influence over current or prospective investee businesses to drive improvements in addressing environmental, social and governance issues, including biodiversity. This influence is typically exercised through direct engagement with investees and through participation in shareholder voting processes.

A key stewardship tool available to investors is engagement, which involves establishing a dialogue with investee businesses on biodiversity-related matters. This may include articulating biodiversity policies, urging clients to disclose biodiversity-related risks and pressing for a shift in business practices. Engagement is commonly conducted through meetings, calls, written correspondence or emails. For example, Aviva, a British multinational insurance company, sends an annual letter each January to the chairs of companies in which it invests – and some other companies in which it does not invest – to outline its stewardship priorities. In 2022, Aviva contacted over 1,600 global companies, urging them to develop biodiversity action plans that assess impacts and dependencies, establish interim and comprehensive targets aligned with the Science-Based Targets for Nature (SBTN) and publicly report on their progress (Aviva, 2021).

Investors may undertake such efforts individually or as part of a collaborative initiative – whether through informal alliances or formal investor networks – thereby increasing their influence, legitimacy and operational efficiency. In some cases, investors may also delegate engagement responsibilities to specialized service providers (Principles for Responsible Investment (PRI), 2021). Lenders (banks) can also engage with their clients (borrowers) on biodiversity-related issues. This may involve general awareness initiatives, dialogue on clients' transition plans and provision of biodiversity-focused financial products. Such engagement also provides banks with a platform to convey their responsible financing policies and to prompt clients to disclose biodiversity-related impacts and risks. Evidence also points to forms of stewardship by bondholders, who can express environmental expectations to issuers (H. S. Lee *et al.,* 2024). However, the influence of lenders is typically more limited than that of investors, given the absence of ownership stakes and the competitive dynamics of lending markets, where some financial institutions may apply less rigorous environmental, social and governance (ESG) standards.

Voting on shareholder resolutions, a mechanism exclusive to listed equity investors, enables shareholders to express positions on corporate decisions, including those related to biodiversity. This process typically involves issue-specific research, the formulation of a voting policy, and engagement with investee businesses before and after votes are cast. Large investors may delegate voting to proxy advisors (Principles for Responsible Investment (PRI), 2021). While in theory, voting is a key lever for biodiversity action, recent studies indicate that major asset managers frequently vote against biodiversity-focused resolutions (Baldock *et al.,* 2023). When engagement or voting fails to deliver meaningful progress on biodiversity-related objectives – or where there is a demonstrated lack of effectiveness in similar efforts by other investors – investors may adopt

escalation measures. These can include filing shareholder resolutions, opposing the reappointment of unresponsive board members, making public statements or pursuing shareholder litigation (Principles for Responsible Investment (PRI), 2021). Escalation strategies may also encompass divestment or the exclusion of certain businesses or sectors from investment portfolios.

5.6.5.4 Managing biodiversity risk and impacts through divestment and exclusion

Divestment and exclusion represent key strategies through which financial institutions can address biodiversity-related risks and impacts within their investment and lending portfolios. For investors, this may involve selling holdings in (divestment) or refraining from investing in (exclusion) businesses or sectors with significant biodiversity footprints. Lenders similarly apply exclusion policies to avoid extending credit to high-footprint business or industries. For instance, Standard Chartered has committed to withholding financial services from clients whose operations may affect UNESCO World Heritage Sites, involve trade in CITES-listed species, or contribute to the degradation of Ramsar wetlands, high conservation value and high carbon stock forests, or peatlands (Standard Chartered, 2024). The European bank ABN AMRO, for example, has general and sector-specific activities on its exclusion list, including those that lead to the conversion or degradation of protected areas or critical habitats, or infringe on the rights of Indigenous and/or vulnerable groups without their free, prior and informed consent (ABN AMRO, 2021). Finally, insurers can exclude coverage for certain business activities from insurance products.

The question of whether investors should prioritize engagement or divestment in response to environmental, social and governance-related concerns has been the subject of ongoing debate. However, these approaches are not mutually exclusive. Many investors adopt a stewardship-led strategy, treating divestment as a measure of last resort within a broader escalation framework. For instance, the Norwegian Pension Fund Global combines active environmental, social and governance-related engagement and voting to encourage improved corporate practices, while also operating a Council on Ethics that advises on the exclusion or observation of businesses whose activities contravene the fund's ethical guidelines (Mestad, 2020). Stewardship is often a tool to promote 'best practice' while divestment sets the bottom line of what is acceptable. Given the fiduciary constraints on divestment, it is usually a recourse only when there are obvious, and material biodiversity-related financial risks associated with an investment. This is because once an investor divests, it loses the option of driving change from within the system (Principles for Responsible Investment (PRI), 2021).

Equally, there is evidence to show that the financial impact of divestment is often not enough to move a company to change its practices on environmental, social and governance issues; by its very definition divestment means that stock is bought by another investor which likely cares less about the environmental, social and governance-related issue over which the stock was sold. Nevertheless, divestment can be undertaken for purely ethical reasons irrespective of downstream consequences, with investors acknowledging that certain industries should be strictly off the table for investment. This can serve to de-legitimize certain businesses or industries, triggering divestment from other financial institutions as well. Investors, therefore, can benefit from carefully considering the advantages and disadvantages of the engagement and divestment options available to them (GEFI, n.d.; PRI, 2022). **Table 5.2** outlines relevant factors identified favouring divestments or engagement with businesses based on responsibility principles.

Table 5 2 **Factors favouring engagement with or disinvestment from a business.**

Factors favouring divestment	Factors favouring engagement
Investor is seeking value alignment	Investor is seeking real-world impact
Poor opportunities to transition to a more sustainable business model	Issue is systemic and non-diversifiable
Investors have low leverage, e.g., a controlled company, lack of legal recourse	Investors have or can improve leverage by working collaboratively
Other escalation measures have already been exhausted	Alternative escalation measures remain open to investors
	Fiduciary constraints on use of divestment

While the above-mentioned stewardship and escalation strategies are applicable both to active investors (those that themselves select stocks to invest in) and passive investors (those that do not select stock themselves but instead invest in managed funds that track stock indices), the latter may feel less incentivized to engage with investee businesses. This is because a passive investor usually has a diverse and diffuse portfolio – it's engagement with one company within its portfolio is not likely to result in significant risk management benefits. Likewise, divestment may not be easy for passive investors as it entails exiting from a managed fund in its entirety rather that divesting from a specific company or industry, something that active investors can easily do. These challenges are becoming increasingly significant as a growing share of global assets under management is being allocated to passive investment strategies, driven by leading asset managers such as BlackRock and Vanguard Group (UNPRI, 2019).

5.6.6 Financing green

According to United Nation's Environment Programme's 'State of Finance for Nature' (2023), approximately $200 billion is currently directed annually toward the protection, restoration and sustainable management of biodiversity. However, this figure must rise to $737 billion by 2050 to meet global needs. The private sector, including both financial institutions and businesses engaging through market-based mechanisms, currently contributes 10 per cent ($23 billion) of this total (UNEP, 2026). Through their 'financing green' type actions, financial institutions can help fill the global biodiversity finance gap. This includes financing for activities that aim to generate measurable biodiversity outcomes and nature's contributions to people, such as watershed protection, carbon sequestration, pollination and recreation, which can be monetized through mechanisms like biodiversity credits, ecotourism and sustainability certifications, and sold to buyers including project developers with offset obligations or consumers seeking certified sustainable products (Conservation Finance Alliance, 2014; Zu Ermgassen & Löfqvist, 2024). Outlined below are selected 'financing green' approaches that financial institutions decide on at the corporate level to support biodiversity enterprises.

5.6.6.1 Blended finance

Business activities that monetize biodiversity and nature's contributions to people are often perceived as high-risk and typically fall outside the scope of traditional, market-rate financing due to their limited bankability. Blended finance offers a mechanism to address this constraint by combining capital from public or philanthropic sources, such as governments, development agencies or foundations, with funding from private financial institutions, including banks and pension funds. This structure enables the reallocation of investment risks to public or philanthropic actors, who are more willing to absorb such risks to mobilize private capital, which continues to earn market-rate returns. The catalytic capital provided by public or philanthropic entities within blended finance structures can take several forms: early-stage risk capital (such as junior or first-loss equity or debt), concessional finance (including grants or below-market-rate loans), or credit enhancement tools (such as guarantees or insurance) (Lankes, 2021; OECD, 2020). Junior equity and subordinated debt instruments allow public or philanthropic investors to absorb greater risk by accepting lower priority in dividend payments or loan repayments, thereby improving the risk-return profile for private investors. In first-loss arrangements, these actors explicitly commit to absorbing initial losses if returns fall short of expectations (Earth Security, 2021; Kwon *et al.,* 2022). Several investment vehicles leveraging this blended finance model have emerged to provide seed and growth capital to biodiversity enterprises, including the EcoEnterprises Fund (EcoEnterprises Fund, 2025) and the Nature+ Accelerator Capital Investment Fund (IUCN, 2020).

5.6.6.2 Green or sustainability-linked bonds

Financial institutions may channel capital into bonds designed to support biodiversity protection or restoration efforts. These instruments typically take the form of either green bonds or sustainability-linked bonds. Green bonds, also referred to as 'use-of-proceeds' bonds, allocate funds to specific environmental projects and offer a fixed coupon rate – the interest paid to investors. In contrast, sustainability-linked bonds do not earmark proceeds for projects; instead, their coupon rates are contingent on the issuer's performance against predefined biodiversity-related targets (LSE, 2023).

An example of a biodiversity-focused green bond is the Forest Resilience Bond which has mobilized $4 million to finance wildfire risk mitigation activities, such as vegetation thinning and prescribed burns, across 15,000 hectares of the Tahoe National Forest, with private investors including Calvert Impact Capital and CSAA Insurance Group participating in the offering (Earth Security, 2021). In March 2025, Itaú Unibanco, with support from the International Finance Corporation and IDB Invest, issued a BRL 1.4 billion bond (around $250 million) divided into two series to fund biodiversity conservation and social initiatives in Brazil. One series will allocate up to $75 million to biodiversity projects, including Itaú and Syngenta's REVERTE® Program. This supports rural producers recover degraded land (with a target of 1 million hectares by 2030), while aiming

to preserve native vegetation, promote sustainable agriculture and contribute to Brazil's bioeconomy efforts (International Finance Corporation (IFC), 2025). A prominent example of a sustainability-linked instrument is the Wildlife Conservation Bond (also known as the 'Rhino Bond') issued by the World Bank in 2022 to support the recovery of the critically endangered Black Rhino population in South Africa. Unlike traditional bonds, the Rhino Bond links investor returns to conservation outcomes, with end-of-term payments based on the measured increase in rhino population. Purchasers included private asset managers such as Nuveen, Alliance Bernstein, ASN Impact Investors, Azimut Investments, BlueBay Asset Management, INGKA Investments and Mackenzie Investments (The World Bank, 2022). Both green and sustainability-linked bonds often operate within blended finance structures, incorporating participation from public or philanthropic entities to enhance creditworthiness or reduce perceived risk.

5.6.6.3 Impact investing

Impact investing refers to the deployment of capital with the explicit intention of generating positive environmental or social outcomes alongside financial returns, often with investors willing to accept returns below market rate. Such investments are made by a range of actors, including wealthy individuals and families – typically through family offices or private foundations – as well as private institutional investors and asset managers. A significant portion of impact investing takes place through pooled investment vehicles or impact investment funds, which aggregate capital from multiple investors. Some of these funds are conservation-focused and target early-stage investments in businesses seeking positive biodiversity outcomes (Conservation Finance Alliance, 2014). A recent example is the Biodiversity Impact Fund launched by Privium Fund Management in 2025, which aims to raise €500 million to invest in biodiversity conservation and restoration initiatives, with initial commitments secured from Dutch family offices (Higgins, 2024). These funds frequently incorporate blended finance structures, where public or philanthropic entities provide catalytic capital – such as concessional finance or risk-absorbing instruments – to attract commercial investors operating at market rates alongside those engaged in below-market-rate impact investing.

5.7 ACTIONS TO CHANGE THE SYSTEM AND INFLUENCE OTHERS

Transformative change requires businesses to go beyond addressing their own impacts and dependencies on biodiversity and nature's contributions to people (IPBES, 2024a). This section outlines the additional actions that businesses can take to help create an enabling environment for transformative change and to influence other businesses and non-business actors to also take positive action. These include: (1) halting and reversing biodiversity beyond private actions to mitigate impacts caused by their own operations and value chains; (2) engaging in system-level actions to address external barriers; (3) scaling the impact of individual actions through partnerships and collective action; and (4) credibly signalling actions and outcomes to inspire and influence others.

5.7.1 Delivering outcomes beyond impact mitigation goals

Businesses can contribute to global goals by taking additional conservation actions that deliver benefits beyond mitigation of their own impacts and dependencies on biodiversity and nature's contributions to people. These actions can support landscape-scale conservation objectives, such as restoring ecosystem connectivity (Lamont *et al.,* 2023), and may also contribute to broader conservation priorities or global targets (Langhammer *et al.,* 2024), even when outcomes are more difficult to measure or attribute to a single business action. Examples include funding biodiversity research, supporting education and capacity-building and contributing to the management of protected areas or threatened species and ecosystems, such as through invasive species control, sustainable ecosystem management, improved agricultural practices or climate adaptation initiatives (Finance for Nature, n.d.).

Many of these actions can form part of nature-based solutions, particularly when applied through ecosystem-based approaches. Businesses can invest in such solutions to address interconnected challenges like water security, climate adaptation and energy transition (Pörtner *et al.,* 2021). When well-designed, climate-focused initiatives can deliver co-benefits for biodiversity (World Bank, 2022b) – as shown by the IPBES Nexus Assessment through 71 response options identified (IPBES, 2024b) – although trade-offs are also a risk and require careful, strategic planning to optimize outcomes (IPBES, 2024b; Martin *et al.,* 2022). Global standards, such as those developed by the International Union for Conservation of Nature, support businesses in designing and implementing effective nature-based solutions (IUCN,

International Union for Conservation of Nature, 2020). As another example, The World Bank Climate Facility has released guidance for applying nature-based solutions in the mining sector, covering both operational activities and integrated approaches across climate, water and social objectives (World Bank, 2021).

The scale and location of additional conservation actions needed, and which businesses are most responsible for implementing these, remain key questions. Setting priorities and providing clarity and consensus on business responsibilities should be based on societal expectations and principles of just responsibility-sharing. This may include considerations of a business's dependencies on biodiversity, historic contributions to biodiversity loss, or other factors relevant to distributing responsibility fairly (Bai *et al.,* 2024). Emerging frameworks such as SBTN's landscape engagement targets (Science Based Targets Network (SBTN), n.d.-b) and industry-specific performance requirements are beginning to set clearer expectations for corporate participation in landscape-scale initiatives that aim to deliver proactive, measurable outcomes for biodiversity and nature's contributions to people.

5.7.2 Directly supporting the enabling environment

Businesses have a growing role to play in advocating for ambitious public policy on biodiversity (Business for Nature, 2024). While positive engagement is increasing, it remains relatively new and underdeveloped compared to climate advocacy (Business for Nature *et al.,* 2022). Larger, older, internationally active businesses with strong government relationships are more likely to engage in lobbying (Weymouth, 2012; Yamahaki & Marchewitz, 2024). Recent examples include Patagonia's advocacy for climate action and public lands' protection (Patagonia, 2021), Microsoft supporting low-carbon policy development (Microsoft, 2024), Unilever driving efforts on regenerative agriculture and sustainable palm oil sourcing (Unilever, 2024), Google promoting renewable energy adoption through initiatives like RE100 (Google, 2023), and Levi Strauss & Co. advancing sustainable water policies through the Alliance for Water Stewardship (Levi Strauss & Co, 2019). Best practice can draw from the more advanced field of climate lobbying (Global Standard on Corporate Climate Lobbying, 2022; We Mean Business Coalition, 2023) and includes embedding advocacy within core business strategy, allocating sufficient internal resources and making public commitments through leadership. Effective policy engagement entails extending actions to industry associations and pushing for alignment with biodiversity goals, especially given that corporate lobbying against strong environment policies remains common (Österblom *et al.,* 2022).

Businesses can influence outcomes through participation in financial associations that shape standards and practices. Organizations such as the International Capital Market Association (ICMA) and the Loan Market Association (LMA) bring together issuers, investors, banks, and intermediaries to establish common rules for directing capital toward environmental goals. Voluntary frameworks like the Green Bond Principles (GBP), Green Loan Principles (GLP), and Sustainability-Linked Bond Principles (SLBP) provide clear guidance on financing activities that deliver biodiversity benefits, from conservation and sustainable land use to ecosystem restoration. By aligning members around shared principles, these associations improve clarity and cohesion, strengthen accountability and create peer pressure for stronger environmental performance. In doing so, they help ensure that finance plays a catalytic role in driving collective action on biodiversity, complementing company-level strategies with systemic standards and incentives. These initiatives could support necessary reform of global and national financial systems (see **Chapter 6.3.2.2**) where appropriately aligned with global ambitions within the Kunming-Montreal Global Biodiversity Framework and the efforts of ministries of finance to transform fiscal and economic policies.

Businesses can drive system change by shaping consumer values and promoting sustainable consumption practices. Increasing consumption, driven by population growth and rising per-capita demand, are major drivers of biodiversity loss (IPBES, 2019a). For example, food systems alone account for 40 per cent of global biodiversity loss through land-use change and greenhouse gas emissions (Wilting *et al.,* 2017). Businesses can influence societal norms by disclosing product-level impacts, using labels and marketing to guide consumer choices, and investing in education and awareness campaigns. For example, the Satoyama Initiative brings together 328 partners, including businesses, academics, non-governmental organizations, governments and Indigenous communities, to promote eco-friendly agriculture, reduce waste and strengthen local food systems. By advocating for traditional diets and localized consumption patterns, the initiative fosters biodiversity, community resilience and sustainability, while reducing reliance on global value chains (Nishi *et al.,* 2021).

Businesses also have a role in shaping knowledge, skills and capacity. According to the World Economic Forum, up to 395 million jobs could be created through economic transitions (WEF, 2020). By investing in education, research and training, businesses can help build the capacity needed to implement biodiversity strategies. Engaging in social biodiversity leadership by publicly promoting biodiversity values and commitments can shift social norms among customers, suppliers and employees, while also attracting a growing cohort of sustainability-minded consumers and talent (Baggaley *et al.,* 2023). However, as outlined in

Chapter 6 (Section 6.3.6.1), if greenwash accusations are to be avoided, leadership ought to be underpinned by credible strategies and measurable action **(Box 5.1)**.

Businesses can play a catalytic role in making biodiversity data and tools publicly accessible as shared resources. Pre-competitive collaboration, where businesses collaborate on technology and data outside of direct competition, is key to enabling this. In Brazil, the Soy Moratorium, which is governed by Associação Brasileira das Indústrias de Óleos Vegetais (Brazilian Association of Vegetable Oil Industries (ABIOVE)), Associação Nacional dos Exportadores de Cereais (National Association of Grain Exporters (ANEC)) and civil society partners, ensures soy sold by signatories is not sourced from Amazon land deforested after July 2008 (Associação Nacional dos Exportadores de Cereais (ANEC), n.d.; Heilmayr *et al.,* 2020). The initiative relies on satellite monitoring provided by Brazilian Association of Vegetable Oil Industries in collaboration with Brazil's National Institute for Space Research and Agrosatélite (Agrosatélite Geotecnologia Aplicada Ltda., 2022; Grupo de Trabalho da Soja (GTS) *et al.,* 2023). Another example is Global Forest Watch, a free, open-access platform developed by the World Resources Institute with support from Google, the Jane Goodall Institute, and others, enabling stakeholders to monitor deforestation globally. Businesses have also partnered with non-governmental organizations in research, such as the collaboration between the World Wildlife Fund for Nature and Johnson & Johnson, to explore links between forests and human health (Beatty *et al.,* 2022; World Wildlife Fund (WWF), n.d.).

5.7.3 Collaboration, partnerships and collective action

The implementation of actions and the outcomes of those actions for biodiversity and nature's contributions to people can be scaled up through engagement, partnerships and collective action involving actors within and beyond the business sector (IPBES, 2024a). Meaningful engagement and partnerships are important for knowledge acquisition, democratic environmental governance and improved corporate legitimacy (Boiral & Heras-Saizarbitoria, 2017). Partnerships established through trade-associations and commodity roundtables and agreements can supplement formal rules of play across multiple actors, through developing guidance and standards that raise the bar on good practice (Cramb & McCarthy, 2016; Gibbs *et al.,* 2015; Lambin & Thorlakson, 2018; Levy *et al.,* 2023). For example, international leadership organizations have been shown to facilitate dissemination of innovation among mining businesses, in support of better outcomes across battery supply chains (Mendonca Severiano *et al.,* 2025). Public-private partnerships can unlock financing, generate new technologies, improve governance, expand partnerships with civil society organizations, including IPLCs, and lead to lasting and equitable outcomes for biodiversity (Andréasson, 2023; Fitzgerald, 2021; Schroeder *et al.,* 2020). For example, the Sahanala cooperative in Madagascar, created by the non-governmental organization Fanamby, enables local communities to pursue sustainable livelihoods near protected areas while participating in federations that operate in international markets under community-led governance (Sahanala, n.d.).

Partnerships vary in terms of their scale and purpose. Some focus on implementing and coordinating action at the landscape level to address issues within a specific geography **(Box 5.7)** or sector. For example, heavily traded agricultural commodities (e.g., coffee, cocoa, tea and palm oil) have more than 10 per cent of their production area under coordinated voluntary sustainability standards schemes (Tayleur *et al.,* 2017). Cross-border collaboration is crucial for addressing transboundary challenges, such as protecting wildlife migration corridors or managing river basins. Examples include the Great Green Wall in Africa (United Nations Convention to Combat Desertification (UNCCD), n.d.) and the Coral Triangle Initiative in Southeast Asia (Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), n.d.). Global partnerships can efficiently direct business resources and investment toward conservation priorities and where barriers to action are largest. Multi-stakeholder platforms, such as the Business for Nature coalition, for example, provide guidance to members on how to align business activities, including measurement and action, with global biodiversity targets. Public-private partnerships, such as the Great Barrier Reef Partnership – a AU$443 million initiative involving the Australian Government, BHP, Rio Tinto and over 500 other partners – aims to deliver large-scale conservation outcomes, which, as of 2025, has 370 projects aiming to restore and protect the reef (Great Barrier Reef Foundation, n.d.). Public-private partnerships can also support benefit-sharing agreements **(Box 5.8)** and enable businesses to contribute directly to National biodiversity strategies and action plans (NBSAPs) (UNDP BIOFIN, 2023; UNEP Finance Initiative (UNEP FI) & UNDP BIOFIN, 2023).

Partnerships also drive collective action at different decision-making levels. For example, the Fashion Pact is a sector-wide initiative led by chief executive officers (CEO), requiring member businesses to make corporate commitments to zero deforestation and land conversion, development of biodiversity strategies, and sourcing restrictions to reduce biodiversity impacts (The Fashion Pact, n.d.). The Pharmaceutical Supply Chain Initiative (PSCI) convenes businesses in the healthcare sector to improve environmental, safety, and social outcomes across their value chains (PSCI, n.d.). Institutional investor networks, such as the Principles for Responsible Investment (PRI), provide platforms for collaborative policy engagement on environmental issues, including biodiversity (Finance for Biodiversity Foundation, 2022).

Box 5 7 Place-based initiatives to enable coordinated landscape action on biodiversity.

Business can promote, endorse, finance and participate in the coordination of landscape-scale action on biodiversity. One example is the Rimba Collective in Indonesia. It is a collaboration of several consumer goods manufacturers connected to the agricultural commodities industry. The initiative was set up to help corporations deliver on their individual sustainability commitments and invest funds in attributable biodiversity outcomes (Rimba collective, n.d.). The initiative started with the palm oil sector. Each company delivers on its individual sustainability objectives, whilst protecting and restoring landscapes and supporting natural landscapes and supporting people's livelihoods.

Rimba projects are run by local civil society organizations, working together with communities and with different levels of government to deliver outcomes intended to benefit biodiversity and people. The engagement with a wide variety of actors is crucial for the long-term success and impact of the projects to ensure actions are aligned with the needs and priorities of the local communities while also promoting biodiversity conservation. Rimba projects like the one in the Pawan Pesaguan landscapes demonstrate the importance of adopting a holistic approach to forest management that considers the ecological, social, and economic aspects of sustainability (Rimba collective, n.d.).

Box 5 8 Partnerships and initiatives support benefit sharing and fair access to biodiversity: the case of South Africa's rooibos tea industry.

Aspalathus linearis (commonly known as rooibos) has long been used by the San and Khoikhoi peoples as a remedy for a wide range of ailments (Department of Environmental Affairs of Republic of South Africa, 2014). The plant's fine, needle-like leaves are naturally caffeine-free, rich in antioxidants, and used to relieve allergic symptoms, provide energy, and promote skin healing. Yet the rooibos tea value chain reflects a complex and often unequal history, transitioning from traditional harvesting by the Khoikhoi to large-scale commercial farming, and mirroring broader patterns of colonialism, economic exploitation, and cultural appropriation that have shaped many industries.

Global governance frameworks have gradually sought to address these inequities. The 1992 Convention on Biological Diversity, for example addresses the terms and conditions for access to genetic resources and benefit sharing, which was later supported by the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of Benefits Arising out of their Utilization, which provided steps and processes for fair access to biological resources and the equitable distribution of benefits from bioprospecting. This principle was reinforced in South Africa through the Biodiversity Act 10 of 2004, the Bioprospecting, Access and Benefit Sharing (BABS) Regulations of 2008, and the adoption of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention. Together, these frameworks have raised awareness of benefit-sharing obligations and opened new opportunities for communities to leverage their traditional knowledge (Natural Justice, 2019).

Despite this progress, only around 10 per cent of rooibos is produced by Indigenous farmers, underscoring the continued need for mechanisms that protect community rights and interests. A major milestone came in 2019, when the Khoikhoi and San peoples, as traditional knowledge holders, entered into an industry-wide access and benefit sharing agreement with the South African rooibos sector. This was underpinned by the Rooibos Biocultural Community Protocol, which sets out how communities are organized for benefit-sharing purposes and how they expect industry, government, and researchers to engage with them (National Khoisan Council, 2019). The Protocol has created a stronger sense of collective identity, particularly in the Cederberg Mountains, the natural home of rooibos. The South African Rooibos Council (Rooibos Council, n.d.) also plays a key role in promoting rooibos and supporting stakeholders through research and communication (Natural Justice, 2019).

International recognition has further reinforced the value of rooibos. In 2021, the European Commission granted rooibos protected designation of origin (PDO) status, making it the first African product to be entered into the EU's register of protected geographical indications (Law Society of South Africa, 2021). This recognition underscores the cultural and economic significance of rooibos, highlighting its association with superior quality, sustainability, and place-based identity. It also illustrates how geographical indications can serve as a valuable tool to safeguard traditional knowledge, while strengthening trade relationships that provide affordable food and livelihood opportunities across the value chain.

5.7.4 Social signalling actions to inspire action by others

Social signalling actions by business can be understood as deliberate, outward-facing commitments, disclosures or initiatives that aim both to advance biodiversity goals and to influence peers and stakeholders by setting visible norms and expectations (Booth *et al.,* 2024; Liu *et al.,* 2025). Such actions can demonstrate leadership, establish credibility and create peer pressure that encourages others within and beyond the industry to follow suit. In the biodiversity context, this includes public commitments such as adopting ambitious targets, joining high-profile pledges like the Finance for Biodiversity Pledge (Finance for Biodiversity Foundation, n.d.), Business for Nature's *Make it Mandatory* (Business for Nature *et al.,* 2022), *Call to Action* (Business for Nature, n.d.-a) and *Act Now for Nature* campaigns (Now for Nature, n.d.), and publishing disclosures aligned with frameworks such as the Taskforce on Nature-related Financial Disclosures.

Signalling also encompasses symbolic yet substantive leadership moves, such as establishing biodiversity funds, issuing biodiversity-focused bonds or securing eco-certifications that act as visible proof of commitment (Booth *et al.,* 2024). These actions help shape external conditions in which biodiversity-positive practices become industry norms (Baggaley *et al.,* 2023). By making their actions visible, businesses can advance their own agendas while amplifying influence, diffusing innovation, shaping investor and consumer expectations, and accelerating transformative change.

Divestment is a prominent example of signalling by financial institutions: withdrawing from companies with significant unaddressed biodiversity impacts and adopting exclusion policies for high-footprint industries sends a strong message on responsible practice **(Section 5.6.5.4)**. For example, ASN Impact Investors recently announced it would divest from clothing companies and exclude fast fashion businesses that fail to adopt circular business models, noting this decision followed extensive engagement efforts (ASN Bank, 2024).

However, as with advocacy **(Section 5.7.2)**, signalling must be backed by credible strategies, commitments, and tangible actions to manage a company's own biodiversity impacts and dependencies and meaningfully contribute towards system level change (Smith *et al.,* 2019). While disclosures can raise awareness and transparency, they rarely lead on their own to systemic shifts in business models or supply chains. They also often lack focus on specific biodiversity elements critical for achieving global goals (Adler *et al.,* 2018; Hassan *et al.,* 2022) and tend to be weakest where biodiversity and risks of loss are highest (Skouloudis *et al.,* 2019). To be effective in driving behaviour change, signalling needs to be combined with regulation, incentives and collaborative frameworks.

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Chapter 6

CREATING AN ENABLING ENVIRONMENT FOR BUSINESS: OPTIONS FOR ACTION BY GOVERNMENTS, THE FINANCIAL SYSTEM AND OTHER ACTORS[1]

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Chapter **6**

CREATING AN ENABLING ENVIRONMENT FOR BUSINESS: OPTIONS FOR ACTION BY GOVERNMENTS, THE FINANCIAL SYSTEM AND OTHER ACTORS

EXECUTIVE SUMMARY

1 **Governments, the financial system, civil society, Indigenous Peoples and local communities and businesses themselves can use measures of dependence and impact of businesses on biodiversity and nature's contributions to people to promote and evaluate businesses' actions and performance *(well established)* {6.1.2, 6.1.3}.** These actors can individually and collectively, with businesses themselves, via their influence on others (see **Chapter 5**), change the current conditions to create an enabling environment which supports transformative change by businesses and contributes to halting and reversing biodiversity loss. Actions by governments, the financial system, civil society and Indigenous Peoples and local communities, can range from those which deliver incremental change to those which deliver transformative change. They can drive changes to the current conditions to create an enabling environment through legal and regulatory frameworks, economic and financial systems, norms and values, technology and data, and capacity and knowledge.

2 **Changing the current conditions to create an enabling environment is not always possible by one actor alone — governments, the financial system, civil society, Indigenous Peoples and local communities and others have to work together, with businesses themselves, to promote and ultimately deliver the global systemic and transformative change needed to support businesses' efforts to contribute to the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity *(established but incomplete)* {6.1.4}.** An enabling environment requires mainstreaming biodiversity into strategies and practices on a local and global scale and across sectors. Such multi-actor collaboration is essential to ensuring transformative change and stable long-term results for biodiversity and nature's contributions to people, not threatened by changing private or public sector priorities. Actors can collaborate to advance deliberate transformative change following a range of strategies: conserving and regenerating places of value to nature and people; driving systemic change in sectors most responsible for biodiversity's decline; transforming economic systems for biodiversity and equity; transforming governance systems to be integrated, inclusive, accountable and adaptive; and shifting societal views and values to recognize interconnections between humans and biodiversity. Individually, governments, the financial system, civil society, and Indigenous Peoples and local communities can also take action to support businesses in their efforts.

3 **An enabling environment for action by businesses can be created through changes to a) policy, legislation and regulatory frameworks, b) economic and financial systems, c) social values, norms and culture, d) technology and data, and d) capacity and knowledge.** Changes to the legal and regulatory context for businesses include the use of evidence-based decision-making, inclusive governance, transparency and fair benefit-sharing. The economic and financial incentives for businesses can be changed to mobilize and reform financial systems, including ensuring inclusive and equitable access to finance. Actions related to changing norms and values encompass inclusive decision-making and partnerships, and raising awareness and standards. Advances in technology and data include greater accessibility, data collection, standardization and accounting frameworks, tools and models. Capacity and knowledge can be built and enhanced through training, stakeholder engagement, and empowerment and respect for rights as they relate to knowledge and knowledge systems. Changes can be made in each of these areas through individual or collective action by government, in the financial system and by other actors including civil society and Indigenous Peoples and local communities. The roles of these groups of actors vary across each of these areas. The changes required to create an enabling environment are different in different contexts, including according to different national circumstances.

4 **Governments can establish and implement policy options based on measures of impacts and dependencies to create an enabling environment for**

businesses *(well established)* {6.1.4, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5}. Different levels of government can create different enabling environments for businesses and financial institutions, working regionally and internationally but also at the national level with other governmental bodies. Governments can change the policy environment to reach global biodiversity goals and build a fair, competitive environment and political certainty for businesses to support transformative change. Different policy options, for example, financing research on measures of businesses dependence and impacts of biodiversity and nature's contributions to people and legislating on incentives and subsidies for biodiversity conservation, taxes to harmful actions to biodiversity, based on measures of businesses dependence and impacts of biodiversity and nature's contributions to people, can lead to transition pathways for businesses that contribute to the 2050 Vision for Biodiversity.

5 Financial policymakers and multilateral, national and global financial actors can change the financial system's architecture to support the 2050 Vision for Biodiversity *(well established)* {6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5 }. The financial system can create an enabling environment for businesses by greening finance (addressing nature-related risks) and financing green (incentivizing financing for nature through nature-related opportunities). Actors across the system can use measures of impact and dependence to support these efforts. Central banks and financial supervisors, public development banks, international finance institutions and standard-setting bodies can all drive more effective and coordinated efforts that lead financial institutions to allocate financial services (loans, investments, insurance policies) in ways that better account for environmental outcomes. Financial policymakers can support efforts through three main avenues: incentivizing financial actors to disclose nature-related risks, shaping financial actors' capital allocation decisions by providing better financing and refinancing conditions for green investments and loans, and working directly with governments to support national environmental objectives.

6 Civil society is vital in the education of businesses and consumers, advocacy, business accountability and in fostering collaboration with businesses to promote sustainability and address environmental challenges *(well established)* {6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5 }. Civil society refers to a diversity of actors including non-governmental organizations, international organizations, consumers and stakeholders. Civil society leverages expertise, networks, and advocacy efforts to bridge the gap between businesses and biodiversity. Civil society empowers stakeholders to make informed choices and hold businesses accountable for their social and environmental impacts by educating consumers, advocating for sustainable practices and promoting transparency in business operations. By facilitating collaboration and knowledge-sharing, civil society drives change towards a just and sustainable future, enabling businesses to integrate ecological considerations into decision-making processes.

7 Indigenous Peoples and local communities can apply measures of business impact and dependence to support collaborative monitoring and facilitate meaningful engagement in consultations and negotiations with businesses *(well established)* {6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5}. These measures can strengthen Indigenous Peoples' and local communities' ability to advocate for sustainable practices and ensure their perspectives are integrated into decision-making. Indigenous Peoples and local communities contribute valuable insights into sustainable resource management and play a critical role in tracking biodiversity change. However, addressing power imbalances requires mechanisms that enable Indigenous Peoples and local communities to engage in policy advocacy, participate equitably in businesses' activities, and uphold their collective governance structures. Ensuring that Indigenous Peoples' and local communities' voices are recognized and their interests protected necessitates systemic changes, including legal and institutional frameworks that mandate transparency and accountability. Additionally, capacity programmes tailored to Indigenous Peoples' and local communities' needs, knowledge systems, and lived realities are essential for enhancing their ability to navigate business relations and effectively utilize measures of impact and dependence.

8 There are still barriers to action by governments, the financial system, civil society and Indigenous Peoples and local communities that will need to be overcome if changes to create an enabling environment are to be successful *(well established)* {6.1.5, 6.4}. Actions will need to consider the different socioeconomic conditions and capacities as well as technical, technological, and financial challenges, including those faced by developing countries. Actions also need to consider that small and medium-sized businesses may have different barriers. All countries, particularly many developing countries, face unique situations like competing priorities, political constraints and instability, power imbalances, influence of vested interests and a lack of institutional frameworks. Significant barriers to be overcome to change the existing enabling environment for businesses include, but are not limited to, persistent relations of domination, especially those that emerged and were propagated in colonial eras, economic and political inequalities, inadequate policies and unfit institutions, unsustainable consumption and production patterns and individual habits and practices, and limited access to clean technologies and uncoordinated knowledge and innovation systems. Addressing these barriers will be key for enacting transformative change by businesses.

9 **There are also a range of knowledge gaps in understanding the enabling environment for businesses that are important to consider and many of these are similar for governments, the financial system, civil society and Indigenous Peoples and local communities *(well established)* {6.5}.** The gaps are categorized according to three categories: 1) knowledge and data which includes gaps in remote sensing technology for monitoring biodiversity, understanding Indigenous Peoples' knowledge, rights and genetic resources, and assessing the effectiveness of certification programmes and consumer behaviour; 2) methods and approaches including the need to integrate traditional knowledge into environmental impact assessments; and 3) policy-relevant studies which emphasize the necessity for research into financial systems' roles in preventing biodiversity loss, evidence-based biodiversity policies and economic instruments, long-term data on monetary policy's environmental effects and partnerships between civil society and businesses.

6.1 INTRODUCTION

6.1.1 The rationale and mandate of this chapter

Businesses operate within larger societal and legal contexts. Recognizing there is no one-size-fits-all approach, this chapter describes potential options for how governments, the financial system, civil society, Indigenous Peoples and local communities (IPLCs) and others may use measures of dependence and impact to promote and evaluate businesses actions and performance. The chapter also explores how the outcomes of such approaches for measurement can be integrated into other aspects of sustainability, considering the motivations described in **Chapter 5**.

The objectives of this assessment are to support efforts by businesses to contribute to the 2050 Vision for Biodiversity and the Convention on Biological Diversity objectives by strengthening the knowledge base on the impacts and dependencies of businesses on biodiversity. This includes strengthening the knowledge base among governments, the financial system, civil society and IPLCs to boost collective expertise, insights and information. While **Chapter 5** describes potential options for how businesses and private financial institutions may use measures of dependence and impact and contribute to transformative change, **Chapter 6** focuses on options for actions that can change the conditions to create an enabling environment for businesses and help achieve the 2050 Vision for Biodiversity.

This chapter considers the various actors that can create an enabling environment, why they are essential in supporting measures of impacts and dependencies by businesses, and what the options for action by these actors are that can support business efforts, including case studies where relevant. This chapter also illustrates how all the options for action by these actors can come together to change the existing enabling environment to one which supports transformative change by businesses.

In this chapter, the category of actors considered is adapted from the IPBES Values Assessment (IPBES, 2022), which identifies several stakeholder groups categorized into three different, but not exclusive, categories according to their level of influence and affectedness (Chevalier and Buckles, 2008):

- Influencers: people and organizations who influence decision-making processes related to biodiversity, impacting those who implement the decisions.
- Affected actors: people and organizations directly involved in (and dependent on) the implementation of biodiversity-related decisions and who have stakes and interests.
- Key players: people and organizations who both can influence and become affected by decisions – that is, in specific contexts, they serve as influencers while at the same time being involved in actual decision-making (Grimble & Wellard, 1997; Miles, 2017).

This chapter considers 'key players' only: governments, the financial system and other actors, considered to be civil society, including consumers, non-governmental organizations, international organizations and IPLCs. Building on the typology used in the IPBES Values Assessment, IPLCs are considered key players, rather than only an affected actor (Kelemen *et al.,* 2022). In the context of this assessment, IPLCs can have both an influence and can be affected by business decisions as per the definition for key players. In this assessment, the 'private sector' is considered to include private businesses and private financial institutions – private businesses and private financial institutions are considered in **Chapter 5**, and other non-state actors in the financial system, as well as governments, civil society and IPLCs are considered in **Chapter 6**.

6.1.2 Changes to create an enabling environment

This chapter builds on **Chapter 1** and considers the following categories of enabling conditions for each actor: 1) legal and regulatory 2) economics and financial 3) norms

and values, 4) technology and data and 5) capacity and knowledge.

Options for action by governments, the financial system, civil society and IPLCs, can range from those which deliver incremental change to those which deliver transformative change. Incremental change could mean, for example, small changes in the economic case for a management response by a business. In contrast, transformative change could mean, for example, regulating against a specific behaviour, subsidy reform, which influences the economics of a whole sector, or withholding insurance from particular activities which render them untenable. In many cases, options for action will operate across a spectrum of change from incremental to transformative, i.e., no binary classification exists.

Transformative change is system-wide; therefore, to achieve it, requires a whole-of-society and whole-of-government approach that engages all actors and sectors in visioning and contributing individually and collectively to transformative change. Transformative change will be needed to change the existing enabling environment for businesses and to halt and reverse biodiversity loss. The IPBES Transformative Change Assessment (IPBES, 2024a) notes five key strategies to advance deliberate transformative change (many of which are of relevance in this chapter and considered in **Section 6.1.4**):

1) Conserving and regenerating places of value to nature and people

2) Driving systemic change in sectors most responsible for nature's decline

3) Transforming economic systems for nature and equity

4) Transforming governance systems to be integrated, inclusive, accountable and adaptive

5) Shifting societal views and values to recognize interconnections between humans and nature.

The Sustainable Development Goals and the 2050 Vision for Biodiversity cannot be achieved without transformative change. In the short term (before 2030), all decision makers can contribute to the sustainability transformation through the rapid and improved deployment of existing policy instruments and new initiatives that more effectively incentivize individual and collective action for transformative change and the reform and removal of harmful existing policies and subsidies. Additional actions are necessary to enable transformative change in the long term (up to 2050) to address the root causes of biodiversity loss, including changes in social, economic and technological structures within and across nations (IPBES, 2019).

Although part of a broader transformation process, visioning is often a crucial first step to reshape understanding and build commitment for transformative change, by altering how people perceive the world, their expectations and sense of possibility (Moore *et al.,* 2014; Van Der Helm, 2009; Wiek & Iwaniec, 2014). This shift in understanding affects behaviours, experimentation, and crisis responses (Pereira *et al.,* 2018). Narratives have an important role in visioning. Narratives are abstract representations of how one sees causal relationships within systems, are often composed of multiple stories, frame problems and solutions with internal logic and may align with power structures (Leach *et al.,* 2010; Lynam & Brown, 2012). Thus, they can either embed within existing systems or enable renewal by legitimizing new ideas (Leach *et al.,* 2010; Lynam & Brown, 2012).

Challenging dominant narratives is frequently seen as key to sustainability transformations, as new narratives can shift mental models and mobilize actors toward transformative action (Galafassi *et al.,* 2018). A given narrative might be consistent with a range of potentially transformative options. This includes different economic concepts like post-growth, degrowth, circular economy, inclusive wealth and decoupling. It further encompasses other knowledge systems and ways of thinking about human-nature relations, for example, Mother Earth-centric actions, ecological civilisation, nature as a common pool resource or visions based on the incommensurability of nature. This could involve valuing and embedding biodiversity in decision-making and disclosure (Target 15 in the Kunming-Montreal Global Biodiversity Framework) so that governments, businesses, the financial system, civil society and IPLCs can make better long-term decisions; reforming subsidies and incentives (as it is called in some cultures) to reward positive action on biodiversity alongside innovative and circular business models and promote financial solutions that support nature (Target 18 in the Kunming-Montreal Global Biodiversity Framework); and joining forces for biodiversity so that the public and private sector can implement solutions and empower society to act (Business for Nature, 2020). These options can be coupled with scenarios of biodiversity change (Sala *et al.,* 2000) to test their effects on the drivers of biodiversity change and their interactions and can also be harnessed to inform the development of narratives that represent potentially transformative futures, for example how degrowth scenarios affect atmospheric carbon dioxide or land use and can in turn contribute to the transformation of economic systems for biodiversity and equity.

At the same time, narratives based on the Nature Futures Framework can also unpack existing concepts, such as continued but 'green' growth or post-growth/bio-cultural societies, by exploring what would be required to enable the development pathway and describing the future that

might emerge. The Nature Futures Framework is a flexible tool to support the development of scenarios and models of desirable futures for people, nature and Mother Earth. The framework was developed in direct response to the conclusions of the methodological assessment report on scenarios and models of biodiversity and ecosystem services (IPBES, 2016b), which identified limitations of existing scenario approaches in their usefulness for biodiversity and ecosystem services. It includes three value perspectives on the relationship between humans and nature: nature for nature (people view nature as having intrinsic value), nature as culture/one with nature (highlights relational values of nature, where societies, cultures, traditions and faiths are intertwined with nature in shaping diverse biocultural landscapes), and nature for society (highlights the utilitarian benefits and instrumental values that nature provides to people and societies).

Future-based narratives enable further exploration of possible actions and pathways to achieve transformative change, as presented in the IPBES Global Assessment of Biodiversity and Ecosystem Services and Transformative Change Assessment, and create an enabling environment (IPBES, 2019, 2024c). The Nature Futures Framework has been applied to different contexts – building scenarios framing the development pathways of a functioning national ecological integration (Mayer *et al.,* 2023), developing visions for a national park (Kuiper *et al.,* 2022), creating scenarios for urban development (Lembi *et al.,* 2020; Shaikh & Hamel, 2023), and exploring trade-offs between values and management options for adaptive decision-making (Palacios-Abrantes *et al.,* 2022; Stronge *et al.,* 2023) – but its use in developing business scenarios is still in its infancy. Although scenario analysis is widely used in business planning, it has historically focussed on business performance (Cork *et al.,* 2023). Nature futures scenarios can be used to explore the transition to new business models and understand how business ideal future states can shift traditional ways of forecasting impacts on nature to nature-centred visions and pathways considering biodiversity, ecosystem functions and services, and human well-being, and incorporating multiple systems of knowledge across sectors.

The options for action presented and discussed in **Section 6.3** can contribute to the formulation of such narratives to create an enabling environment.

6.1.3 How actions can create an enabling environment for business

Individually, governments, the financial system, civil society and IPLCs can take action to drive changes in business behaviour. However, when working collectively all actors can change the conditions to create an enabling environment for businesses and financial institutions that supports transformative change. Furthermore, coalitions of actors are often more effective for achieving common goals and transformative change than when actors pursue change individually (IPBES, 2024a). If actions are organized in an innovative and coordinated way, exponential change can happen, and transformation will be accelerated (IPBES, 2024a). Only together will these actors be able to unlock new opportunities to deliver the global systemic and transformative change needed to support businesses' efforts to contribute to the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity. Changing the existing conditions towards an enabling environment that supports transformative change requires mainstreaming biodiversity into strategies and practices, from the local to the global scale for all sectors. Adequate resources exist, but drivers for business action are required for meeting the 2050 Vision for Biodiversity of living in harmony with nature.

Establishing an enabling environment that safeguards Indigenous Peoples rights, and other applicable rights of local communities, and their territories and conserves biodiversity necessitates a multifaceted approach that involves various institutions, such as governments and intergovernmental, non-governmental and conservation organizations. A crucial aspect of this approach is acknowledging and protecting Indigenous rights, and other applicable rights of local communities and their territories. This can be accomplished by accurately documenting their lands and water, reinforcing their customary rights and law, and empowering them to assert their custodianship and recognition of rights through government endorsements and private sector recognition (WWF *et al.,* 2021). Collaborative governance among IPLCs and the public and private sectors on measures of impact and dependence on biodiversity can encourage inclusive decision-making processes which integrate traditional knowledge into environmental management.

6.1.4 Collective options for action to support transformative change

The IPBES Global Assessment of Biodiversity and Ecosystem Services identified eight priority points for intervention, or leverage points, with five associated 'levers' that may be applied by leaders in governments, businesses, civil society and academia to spark transformative changes towards a more just and sustainable world. The IPBES Transformative Change Assessment builds on these leverage points and levers to develop five key strategies to advance deliberate transformative change. Below, illustrative examples are provided where actors can come together to create an enabling environment for businesses according to these five strategies. While this section focuses on collective options for action, **Section 6.3** covers a wide range of

actions that can be taken by individual actors to support transformative change.

1) Conserving and regenerating places of value to nature and people

Transformative change can include enhancing legal protections for biodiversity, respecting the rights of nature and the rights of Mother Earth as recognized by some countries, basing conservation on diverse values and adopting regenerative views, structures and practices and integrated spatial planning.

Environmental laws and policies are important, for example, in the context of efforts to combat illegal, unreported and unregulated fishing and illegal wildlife trade, or to ensure that infrastructure development complies with environmental assessments and their findings. Sustainability standards are a relevant example in the context of this assessment. Despite some progress in developing and tightening voluntary sustainability standards (Lambin *et al.,* 2014), there is only limited evidence of the potential for standards to support in bending the curve on biodiversity loss (Khew *et al.,* 2016). Sustainability standards focus currently on a small number of commodities (Tayleur *et al.,* 2017) and there is research suggesting they need to be less lenient and ambiguous (Christian *et al.,* 2013). Governments and actors in the financial system can require, develop and support standards on biodiversity, civil society can strengthen standards and requirements for engaging with businesses, IPLCs can bring in diverse values and standard-setting bodies can strengthen compliance and assurance mechanisms of standards. The standards need to align with the mitigation and conservation hierarchy, include long-term management and monitoring for conservation areas (e.g., those with "high conservation value", as used in certification standards) and ensure recognition of the rights of Indigenous Peoples and local communities, in accordance with national legislation.

Taking pre-emptive and precautionary actions in regulatory and management institutions and businesses aligned to the mitigation and conservation hierarchy, and monitoring their outcomes is central to conservation action, especially taking account of the risk of approaching thresholds or tipping points which precipitate rapid loss of biodiversity and nature's contributions to people. As detailed in **Chapter 5**, the mitigation hierarchy (and the extended concept of the mitigation and conservation hierarchy) is fundamental for guiding business action to deliver outcomes for biodiversity and people at all scales and levels of decision-making. Proper implementation of the mitigation hierarchy needs to be strengthened and supported by businesses, the financial system, civil society, IPLCs and governments to robustly and meaningfully address impacts on biodiversity (Phalan *et al.,* 2018; von Hase & ten Kate, 2017).

2) Driving systemic change in sectors most responsible for nature's decline

Actions towards this strategy include regulating unsustainable exploitation of organisms, embedding technologies in transformative frameworks, financing for global sustainability and supporting civil society initiatives.

Many existing policies that comprise financial, economic and regulatory instruments (such as regulations and taxes) can have substantial negative effects on biodiversity but have the potential to become transformative. Government economic support, including subsidies, is pervasive in countries around the world. Incentives are often difficult to reform because of strong opposition from recipients and tight linkages with regional and international trade (Delabre *et al.,* 2021). Shifts in subsidies may have negative economic impacts on low income and poorly resourced producers if they are insufficiently thought out (Sumaila *et al.,* 2016). However, incentives are a necessary element of efforts to reform fisheries, agriculture and water management and to ensure that resources are in place to achieve restoration and support nature-based solutions for sustainable climate action. Some governments have revised their regulatory instruments based on environmental criteria, for example the New Zealand fisheries subsidy reform which includes strict sustainability criteria.

Public environmentally harmful subsidies are currently estimated at $2.6 trillion a year, equivalent to 2.5 per cent of global gross domestic product (GDP) (Koplow & Steenblik, 2024). Governments can 1) reform, phase out and eliminate harmful policy instruments to stop financial support to activities that have unintended negative impacts on biodiversity and the environment; and 2) increase incentives for actions by businesses and other stakeholders that deliver positive long-term outcomes for people, biodiversity and climate through innovative, circular, regenerative and profitable business models (Business for Nature, 2023). In the Kunming-Montreal Global Biodiversity Framework, Target 18 requires Parties to the Convention on Biological Diversity to "identify by 2025, and eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least $500 billion per year by 2030, starting with the most harmful incentives, and scale up positive incentives

for the conservation and sustainable use of biodiversity". The accompanying monitoring framework provides indicators to track progress towards the target, for example value of subsidies and other incentives harmful to biodiversity that have been eliminated, phased out or reformed. Collectively, perverse incentives can be eliminated by governments enforcing regulations and reviewing current incentive programmes (for example, following the step-by-step guide on how to repurpose subsidies harmful to biodiversity and improve their impacts on people and biodiversity (UNDP-BIOFIN, 2024)), but this will need to be undertaken in collaboration with the financial system, and with civil society holding governments and businesses accountable in addressing these perverse incentives.

Costa Rica provides a good example of policy mixes that include regulatory measurements (the Forest Law of 1996), payment for ecosystem services, and business actions, particularly in the agriculture and tourism sectors, in favour of biodiversity-friendly practices and community-based conservation projects. Non-governmental organizations and the government have provided training and investment in research on best practices, while the Global Environmental Facility and the Green Climate Fund have provided funding to support those initiatives (Wunder, 2005). This policy mix has led to significant positive impacts, for example, Costa Rica's Forest cover increased from 21 per cent in the 1980s to over 50 per cent, reversing decades of deforestation (Robalino & Pfaff, 2013). Eco-tourism has become a major industry, contributing to the national economy and creating jobs while promoting conservation.

3) Transforming economic systems for nature and equity

Transforming economic systems includes mainstreaming innovative economic tools, supporting just transitions towards good quality of life, reforming financial systems and institutions and adopting metrics of success that focus on social, economic, cultural and environmental goals.

Dominant value chains promote unsustainable sourcing and overproduction globally, but well-designed international agreements can help regulate these value chains to reduce unsustainable consumption and production. As an example, the reduction of waste is context-dependent and linked with development pathways. Rapid urbanization and globalization mean that supply chains require adequate infrastructure to reduce loss. Addressing waste is challenging because of shifts toward items with short shelf life (Parfitt *et al.,* 2010). Governments and the financial system can work together to regulate businesses to reduce and report on waste, the academic community and businesses themselves can support social and technological innovation, civil society can increase citizens' awareness of biodiversity impacts in supply chains, and standard-setting bodies can develop independent codes of conduct.

4) Transforming governance systems to be integrated, inclusive, accountable and adaptive

Involving diverse stakeholders in decision-making and addressing governance challenges is key to transformative change by businesses. The Sustainable Development Goals and the targets of the Kunming-Montreal Global Biodiversity Framework refer to integrating biodiversity values into national and local planning, development processes and poverty reduction strategies and accounts. Government policies and market transactions typically do not reflect the full value of nature's contributions to people (Guerry *et al.,* 2015) and, as an example, there can be a barrier to the implementation of methods, such as natural capital accounting, due to the current lack of interdisciplinary competencies to support addressing Indigenous and local knowledge systems alongside scientific analysis in business decision-making and policymaking (non-monetary values that do not relate to economic methods are rarely considered) (IPBES, 2016a).

Integrated decision-making is a defining feature of the biodiversity-inclusive one health transition by the World Health Organization and is also essential to enable integrated planning and management by businesses of infrastructure, landscapes, seascapes and water resources. Governments can develop and democratize natural capital accounting systems that incorporate economic, cultural, social, intrinsic and intergenerational values of biodiversity with clear guidance on how the private sector can input, including through sector transition plans, IPLCs can bring in diverse values and civil society can strengthen the transparency of measures. The number of countries and businesses that have developed natural capital accounting systems, which consider the explicit role of biodiversity in poverty reduction strategies and other key development plans could be tracked. Progress could also be tracked by measuring the frequency of use of valuation tools by businesses that assess the diverse conceptualization of multiple values of nature and its benefits.

5) Shifting societal views and values to recognize interconnections between humans and nature

Shifts can be facilitated through cultural narratives and by changing dominant social norms, facilitating transformative learning processes, co-creating new

knowledge and weaving different knowledge systems, world views and values into business decision-making.

As an example, promoting sustainable lifestyles is fundamental to addressing inequality in distribution and access and acknowledging that diets are embedded in cultural, social, and ecological contexts (Leach *et al.,* 2020; Schröter *et al.,* 2020) – for example, by businesses in the food and beverage sector. Shifting toward varied diets with fewer animal products could support people (particularly in the global North) in reducing their high environmental footprints (Willett *et al.,* 2019). The financial system and businesses themselves can incentivize sustainable farming and food systems and IPLCs can maintain local/traditional knowledge and bring diverse worldviews and lifestyles to business decision-making. Governments can support the development of ecological footprints, which consumers as well as businesses can use. Civil society can support shifts in perceptions and behaviours of citizens, and governments can put in place stronger controls for businesses on advertising which encourages unsustainable consumption behaviour.

Multi-actor collaboration is essential to ensuring that deliberations and participation between collaborators is meaningful, by linking actions to long-term empowerment processes (G. Williams, 2004). Bringing all actors together to change the conditions and create an enabling environment means ensuring more stable long-term results for biodiversity and its components that are not threatened by, for example, changing priorities in the private sector, changing governments or funding resources being depleted (Delabre *et al.,* 2021).

6.1.5 Constraints and limitations in enacting transformative change

Potential options for action by governments, the financial system, civil society and IPLCs to change the current conditions and create an enabling environment which supports transformative change by businesses will need to consider different socioeconomic conditions and capacities as well as technical, technological and financial challenges, including those faced by developing countries. The IPBES Transformative Change Assessment (IPBES, 2024a) identifies five overarching challenges to transformative change which can also be challenges for businesses: i) persistent relations of domination, especially those that emerged and were propagated in colonial eras, ii) economic and political inequalities, iii) inadequate policies and unfit institutions, iv) unsustainable consumption and production patterns and individual habits and practices, and v) limited access to clean technologies and uncoordinated knowledge and innovation systems.

All countries, particularly many developing countries, face unique situations like competing priorities, political constraints and instability, power imbalances, influence of vested interests and a lack of institutional frameworks. Significant barriers towards an enabling environment for businesses include, but are not limited to, inconsistency in policy and existing regulation and incentives, lack of capacity (e.g., financial resources, skills), constraints on the role that developing countries play in global trade, which may restrict their capacity to implement reforms, complexity of supply chains and the challenge of tracing biodiversity impacts. Addressing these barriers will be key for enacting transformative change.

Section 6.4 covers the constraints and limitations ("barriers to action") that may be faced by governments, the financial system, civil society and IPLCs.

6.2 ACTORS

6.2.1 Overview

6.2.1.1 Governments

Different structures of government systems exist depending on the political ideology or system (e.g., monarchy, democracy, federal republic) and governance approach (e.g., top-down or bottom up) that a country or state adopts, and its geographical region historical background. Regardless of what system a country adopts, all government systems operate at different levels (Alam, 2019), making governance a multi-tier endeavour.

These different types of governments function predominantly at different levels that interact with each other, forming a governance process. The interactions or relationships between different levels of governments determine how services are provided – meaning that different levels of governments may interact differently with businesses, although there is a clear distinction in types of government systems (governing at different levels) (Kourula *et al.,* 2019; Steurer, 2013). It is, thus important to understand the different tiers of governments to comprehend how these entities respond to and interact with businesses and financial institutions on issues like sustainability and biodiversity (Abbott, 2012; Lambin & Thorlakson, 2018). Central and state or provincial governments typically hold legislative and judicial powers, unlike local or municipal governments. This lack of power at the local level can hinder their ability to respond to emerging issues and create supportive environments for businesses. However, local governments are often responsible for implementing actions stemming from multilateral environmental agreements, even

though these are signed by the central government. The Conference of the Parties to the Convention on Biological Diversity has urged parties to engage local authorities in its implementation, as reinforced by the updated Plan of Action on Subnational Governments, Cities and other Local Authorities for Biodiversity (2023-2030) (CBD/COP/DEC/15/12) (Convention on Biological Diversity (CBD), 2022c). Although typically the relationship between all levels of governments and businesses is not explicitly revealed in any governance documents, it is understood that this relationship is mutual and somewhat interconnected and customarily related to licencing, taxes and conformance to applicable regulations, including those related to ensuring business compliance regarding the rights of Indigenous Peoples and local communities, in accordance with national legislation.

Regional cooperation, primarily through central governments, has effectively addressed shared interests like biodiversity conservation. While central governments are mandated to sign international agreements, other government levels may participate when relevant to their jurisdiction. Examples include the Association of Southeast Asian Nations, the European Union, and the African Union, which use working groups to tackle specific issues. The Association of Southeast Asian Nations, for example, has a dedicated working group called the Association of Southeast Asian Nations Business Advisory Council established to provide private sector feedback and guidance to boost efforts towards economic integration. In 2023, the Council, together with the Association of Southeast Asian Nations Centre for Biodiversity launched the Association of Southeast Asian Nations Business and Biodiversity Initiative, a platform to foster mainstreaming of biodiversity into business decision-making in the region (ASEAN Centre for Biodiversity, 2023).

6.2.1.2 Financial system

Climate change and biodiversity loss initially entered the agendas of financial actors as part of a broader shift in the financial regulatory paradigm that followed the financial crisis starting in 2007 (Deyris, 2023; Quorning, 2024), which undermined financial policymakers' optimistic assumptions about investors' abilities to accurately price risk (Stellinga, 2020). The financial system can play a pivotal role in ensuring that businesses contribute to achieving the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity through a regulatory environment that enables businesses to take transformative actions. A country's financial system includes banks, non-bank lenders, insurers, securities' markets, and investment funds. It also includes clearing counterparties, payment providers, central banks, financial regulators and supervisors (IMF, n.d.). The financial system beyond private financial institutions (which are covered in **Chapter 5**) includes financial regulators,

Table 6 1 **A typology of actors in the financial system beyond private financial institutions.**

Actors	Definition	Examples
Central banks and financial supervisors	Central banks are public institutions that manage through their monetary policy the currency of a country or group of countries to preserve price stability and depending on their specific mandate also secondary objectives like employment (ECB, 2015). Supervisors are public micro- and macro-prudential authorities that aim to promote financial stability and protect the customers of financial services (European Parliament, 2023).	National and regional central banks and supervisors, e.g., People's Bank of China, South African Reserve Bank, European Central Bank (ECB), the Federal Reserve in the United States.
Public development banks	Legally independent and financially autonomous public financial institutions initiated by governments to pursue public policy objectives (Finance in Common, n.d.).	Brazilian Development Bank (BNDES), French Development Agency (AFD).
International financial institutions	Multilateral, regional and national development banks with international operations that have been established (or chartered) by more than one country (UNDP, n.d.).	IMF, World Bank, Asian Development Bank, Bank for International Settlements (BIS), United States of America International Development Finance Corporation (DFC), Inter-American Development Bank (IADB).
Standard-setting bodies	International organizations that establish financial reporting standards are typically private sector, not-for-profit, self-regulated organizations with boards comprised mostly of experienced accountants, auditors, academics and users of financial statements (IAASB, 2020; IMF, 2021).	International Sustainability Standards Board (IFRS-ISSB), Global Reporting Initiative, European Financial Advisory Group (EFRAG).

central banks and supervisors, public development banks, international financial institutions, and standard-setting bodies (see **Table 6.1**) – noting that there will be some overlap between these actors and the actions they can take with the actions that can be taken by governments, e.g., ministries of finance.

Central banks and financial supervisors can contribute to addressing climate change and biodiversity loss both through monetary policy as well as through supervisory practices that take into account climate and nature-related financial risks. Public development banks have a mandate to finance public policy on behalf of the state. They operate under the authority and supervision of one or several governments but have independent financial and legal status. Their purpose is to facilitate sustainable development through their own lending. International financial institutions can drive actions in alignment with the Kunming-Montreal Global Biodiversity Framework through mobilizing global private and public finance for nature, including grant capital and developing innovative financing mechanisms (UNDP, 2020). Standard-setting bodies can establish nature-related financial reporting standards to promote comparability and accountability.

It is important to note that, although this chapter discusses the role of governments and the financial system separately, public-private collaborations are at the core of financial systems (Braun, 2020).

6.2.1.3 Civil society

IPBES assessments have consistently emphasized the crucial role of civil society in the conservation and sustainable use of biodiversity and nature's contributions to people and have used a broad definition beyond traditional non-governmental organizations and international organizations that acknowledges the diversity of actors, including relevant consumers and stakeholders, who contribute their knowledge, expertise and resources towards conserving and sustainably using biodiversity and nature's contributions to people. In the context of this chapter civil society is broader than the institutionally recognized organizations, unions, associations, and other pressure groups. It considers citizens as historical subjects capable of understanding and changing the world around them instead of being passive recipients of a ready-made ideology. The Internet and other new information and communication technologies facilitate the rise of self-organized, leaderless movements, allowing a rapid and efficient mobilization of citizens (Adapted from IPBES *et al.*, 2018).

The demand for services provided by civil society has experienced remarkable growth over the decades, reflecting the increasing complexity of global challenges and the expanding role of non-governmental organizations in addressing them. There has been substantial growth in the number of international non-governmental organizations from 1900 to 2016 (Anheier, 2017). This surge can be attributed to several factors, including the globalization of human rights, environmental conservation and poverty alleviation, which require coordinated efforts across borders. In addition, advancements in communication and technology have facilitated the formation and operation of non-governmental organizations, enabling them to mobilize resources, advocate for change and deliver services more effectively globally.

The growth of international non-governmental organizations underscores the increasing recognition of civil society's vital role in holding businesses accountable, complementing government efforts, filling gaps in service delivery and amplifying the voices of marginalized communities. These organizations often operate where governments are unable or unwilling to act, providing critical support in areas such as humanitarian aid, development assistance and advocacy for social justice. Moreover, the rise of international non-governmental organizations reflects a shift towards more participatory forms of governance, where citizens and communities play an active role in shaping policies and decisions that affect their lives. As global challenges continue to evolve and become more interconnected, the demand for the contribution and expertise of civil society will likely continue growing, highlighting the need for continued support and investment.

6.2.1.4 Indigenous Peoples and local communities

IPLCs, as well as other vulnerable groups, can interact with businesses in many ways when businesses' activities intersect with the territories, perspectives and cultural and environmental landscapes. Lack of recognition, protection, respect, responsible behaviour, adequate policies and strategies, and mutually beneficial outcomes often leads to conflicts or failure to achieve common objectives. On the other hand, mechanisms to foster better understanding, engagement and interests' alignment to transform the status quo from businesses' preponderance and community resistance to constructive integration of different perspectives of these actors will pave the road to produce positive outcomes (Klemm Verbos *et al.,* 2017). IPLCs are essential actors[2] to support efforts by businesses to achieve the 2050 Vision for Biodiversity and the objectives of the Convention on Biological Diversity, and options for action by IPLCs regarding measures of dependence and impact.

2. Data management report referring to the role of IPLCs in transforming the enabling environment https://doi.org/10.5281/zenodo.12787554.

6.2.2 Why these actors are important

Each of the groups of actors described above have influence over and insight to facilitate a shift towards an enabling environment for business action. This is because they play a role in a) translating international conventions and agreements to the national level, b) setting financial incentives, c) shaping norms, expectations and values and d) generating data, knowledge and capacity to act.

6.2.2.1 Translating international conventions and agreements to the national level

The Kunming-Montreal Global Biodiversity Framework stresses that a whole-of-government and whole-of-society approach are needed to implement the necessary transformative changes by 2030 (CBD/COP/DEC/15/4) (Convention on Biological Diversity (CBD), 2022a). In doing so, the Parties to the Convention on Biological Diversity recognize that both action and cooperation are needed, not only across all levels of government, but also by all actors in society. The groups of actors identified in this chapter — governments, those in the financial system and other actors (including civil society and IPLCs) — can play a role in translating the goals and ambitions of international conventions and agreements into action. This is in addition to the role played by businesses themselves (discussed in **Chapter 5**).

Governments are important actors because they are collectively responsible for setting international ambitions and can facilitate mainstreaming of these ambitions in businesses decision-making through national strategies and plans with forward looking visions. This leverages the role of visioning as an important driver for innovation and transformative change (Loorbach *et al.,* 2017). National biodiversity strategies and action plans as well as local biodiversity strategies and action plans contribute to biodiversity mainstreaming at the national level. Developing countries show more awareness of the importance of mainstreaming biodiversity across economic sectors in their national biodiversity strategies and action plans than developed countries (Whitehorn *et al.,* 2019). The need for businesses to be involved in the implementation of actions aligned with agreements under the Convention on Biological Diversity at the local level was recognized in 2006 (UNEP/CBD/COP/DEC/VIII/17) (Convention on Biological Diversity (CBD), 2006) and reinforced in subsequent decisions. Parties have made significant progress to explicitly include businesses' role in the implementation of their national plans, particularly to align with the vision and mission of the Kunming-Montreal Global Biodiversity Framework. For example, 100 parties have set at least one national target on Target 15 and there are 216 national targets aligned with Target 15.[3] Additionally, 16 parties[4] have non-state actors' commitments on Target 15 as part of their national targets. By setting policy for economic sectors and financial institutions, governments can create a "level playing field" and give businesses and financial institutions the political certainty they need to invest and change their business models required to reach the 2050 Vision for Biodiversity (Business for Nature, 2020).

IPLCs are recognized as key actors in multiple international conventions and agreements. The Kunming-Montreal Global Biodiversity Framework acknowledges that Indigenous rights, and other applicable rights of local communities, knowledge, including traditional knowledge associated with biodiversity, innovations, worldviews, values and practices must be ensured, including their full and effective participation in decision-making. Article 8(j) of the Convention on Biological Diversity recognizes IPLCs as groups that possess traditional lifestyles relevant for the conservation and sustainable use of biodiversity (CBD, 2022).

Decisions under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1973) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS, 1979) reinforce the need for IPLCs' engagement and stewardship. The International Treaty on Plant Genetic Resources for Food and Agriculture recognizes farmers' rights, including the protection of traditional knowledge relevant to plant genetic resources and the equitable sharing of benefits arising from their use (FAO, 2001). The Ramsar Convention on Wetlands supports the conservation and sustainable use of wetlands, which are critical for IPLCs' livelihoods (Ramsar, 1971). Additionally, the World Heritage Convention protects natural and cultural sites of outstanding universal value, often involving IPLCs in the stewardship of these sites (UNESCO, 2008). The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity provides a legal framework that includes traditional knowledge associated with genetic resources. The United Nations Declaration on the Rights of Indigenous Peoples outlines that Indigenous Peoples have the right to self-determination, land, territories and resources. It emphasizes that activities affecting Indigenous lands or resources need their free, prior and informed consent and requires collaboration among stakeholders. For example, the Indigenous Peoples of Africa Coordinating Committee is currently working with partners in Namibia and Botswana

3. Data management report referring to a systematic review of governments' actions https://doi.org/10.5281/zenodo.12787400.
4. Burkina Faso, Benin, Dominican Republic, United Kingdom of Great Britain and Northern Ireland, Equatorial Guinea, India, Kenya, Lao People's Democratic Republic, Lesotho, Mexico, Niger, Papua New Guinea, the Philippines, Sierra Leone, Thailand, Venezuela (Bolivarian Republic of).

on developing free, prior and informed consent protocols that are fit-for-purpose for local communities.

The role of actors in the financial system in implementing the three objectives of the Convention on Biological Diversity is recognized in decisions, specifically relating to governments, multilateral development banks, international financial institutions, bilateral and multilateral funding organizations and other relevant organizations. This includes recognizing the need to increase international biodiversity-related financial flows and financial resources from all sources to fund nature-based solutions and achieve the objectives of the convention and the goals and targets of the Kunming-Montreal Global Biodiversity Framework (CBD/COP/DEC/15/4; 15/7; 15/15; 16/33) (Convention on Biological Diversity (CBD), 2022a, 2022b, 2022d, 2024) (see **Annex 6.1**).

6.2.2.2 Setting financial incentives

Governments and those in the financial system have significant influence over the financial incentives for business behaviour and action. Public interventions (e.g., public investments, removal of subsidies, *ad hoc* regulations) can enable businesses and private financial institutions to change their practices. Central banks and financial supervisors, public development banks, international financial institutions and standard-setting bodies can also incentivize financial institutions to allocate financial services (loans, investments, insurance policies) in ways that better account for environmental outcomes. Such actions can aim to (a) protect financial stability by addressing systemic nature-related financial risks, including by addressing the financial system's role in driving environmental degradation and related financial risks (the endogeneity of nature-related financial risks), as well as (b) ensure better environmental outcomes.

The financial system can change the existing conditions for business to an enabling environment which supports transformative change by greening finance (addressing nature-related risks and impacts in finance) and financing green (incentivizing financing for nature), and through aligning with international agreements. Decisions relating to financial incentives or resource mobilization are increasingly common in the context of the Convention on Biological Diversity. For example, see **Annex 6.1** showing that to date, decisions have tended to focus on financing green and providing more funds for the conservation and restoration of biodiversity, as opposed to reforms of the financial system and greening finance.

Actors in the financial system play an important role in incentivizing businesses' behaviour in part because the financial system is at risk from the loss of biodiversity (NGFS-INSPIRE, 2022). To address the global biodiversity crisis, public and private financial actors have a responsibility for providing financial stability and enhancing public interest, which includes a responsibility to address the systemic risk arising from their direct and indirect role in biodiversity loss. The financial system can work on 'greening finance', that is directing financial flows away from projects with a negative impact on biodiversity and nature's contributions to people to projects that mitigate negative impact or pursue positive environmental impact as a co-benefit (World Bank Group, 2020). In addition to redirecting financial flows in this way, financial actors can also wield their influence to ensure that companies engaged in harmful projects work on mitigating negative impacts.

Greening finance, while progressing under the guidance of various frameworks and financial institution networks, is still largely limited to addressing climate change (Deutz, A. *et al.,* 2020). For example, central banks and financial supervisors are not yet taking the same actions for biodiversity as they are taking on climate change. However, they increasingly acknowledge the impact of biodiversity loss on price, associate financial stability with climate stability and increasingly recognize the relationship between climate change and biodiversity (NGFS, 2023a). This is despite research showing that central banks and financial supervisors are giving insufficient attention to biodiversity. Additionally, they mainly focus on what is financially material, and do not acknowledge what is material for biodiversity and society, commonly referred to as the double materiality concept (Boissinot *et al.,* 2022).

The financial system is also important because of the scale of funding needed to address the loss of biodiversity. To halt and reverse the loss of biodiversity, increased finance for biodiversity by an average of $711 billion a year over the next decade will be required (WWF, 2023b). The current financial flows to nature-based solutions of $200 billion are vastly outweighed by finance flows with direct negative impacts on biodiversity of almost $7 trillion per year (UNEP, 2026). Of this total, public finance flows through environmentally harmful subsidies accounted for approximately $2.4 trillion, directed primarily towards fossil fuels ($1.13 trillion), agriculture ($0.41 trillion), water ($0.40 trillion), transport ($0.18 trillion), construction ($0.15 trillion) and fisheries ($0.06 trillion) (UNEP, 2026). The private sector was responsible for the majority of the nature-negative finance flows in 2023, estimated at $4.9 trillion and concentrated on utilities ($1.6 trillion), industrials ($1.4 trillion), energy ($0.7 trillion) and basic materials, including fertilizers and agricultural inputs ($0.7 trillion). In contrast, biodiversity funds reached $1.4 billion in 2023, with most of these funds domiciled in Europe and most funds sitting well below $100 million in assets (Environmental Finance, 2024). Nevertheless, most of these biodiversity funds are focused on mitigating negative biodiversity impacts, rather than investing in activities that restore nature or provide new nature solutions.

Other sources estimate that more than $102 billion of private finance, including 'debt-for-nature conversions, nature-supportive exchange traded funds (ETFs), biodiversity credits and private venture capital for biodiversity' have been allocated to nature finance, compared to $9.4 billion four years ago (UNEP FI, 2024). The UNEP Finance Initiative estimates that there is a potential to unlock $1.45 trillion towards 'nature-related investment themes' by 2030 if current trends continue. Though public investments in nature do not have to be financed by debt (Kedward, Zu Ermgassen, *et al.,* 2023), they can also be financed by reorienting public subsidies that are harmful to nature, as well as through redistributive mechanisms such as debt relief and tax justice (Dempsey *et al.,* 2021).

The increasing financialization of nature poses significant risks to the integrity of traditional and local knowledge systems. The integration of IPLCs' contributions within market frameworks as 'assets' may undermine the intrinsic value of their knowledge systems and governance structures. There has been a historical absence of IPLCs' voices when defining projections of economic or environmental change, in the production of management knowledge and research, and in international business textbooks and business school education (Boussebaa, 2020; Dar *et al.,* 2021; Fougère & Moulettes, 2012; Özkazanç-Pan, 2008; Srinivas, 2021). Diversifying the scope of values by including IPLCs' perspectives will promote a pluralistic debate (Banerjee, 2022; Mignolo & Walsh, 2018; Sarkki *et al.,* 2023). The Mai Ka Pō Mai Native Hawaiian Guidance Document for the Management of the Papahānaumokuākea Marine National Monument is an example of incorporating the cosmovision and the environmental and cultural dependencies of IPLCs on biodiversity for the demarcation of a conservation area and the management of physical and biological resources of a region that is intrinsically linked with the worldviews of its people (Quiocho *et al.,* 2023).

6.2.2.3 Determining norms, expectations and accountability

Governments have a critical role in changing the norms and expectations for economic sectors, for example supporting more sustainable patterns of consumption, to create an enabling environment for businesses and civil society to redefine value and transform decision-making of businesses and financial institutions (OECD, 2019). With growing global awareness of environmental issues, civil society acts as a bridge between the public and businesses, pressing for transparency and responsible behaviour. Environmental non-governmental organizations are vital in raising awareness and mobilizing public opinion to pressure companies into prioritizing environmental, social and governance issues. Environmental non-governmental organizations advocate for companies to adopt more responsible and sustainable practices, aligning their operations with broader societal values and expectations.

Beyond raising awareness, civil society contributes significantly to developing and enforcing the accountability of businesses. They participate in policy discussions and collaborate with governmental bodies to shape legislative frameworks encouraging businesses to assess and disclose their environmental impacts. Through initiatives such as certification programmes, partnerships and stakeholder engagement, civil society fosters a culture of accountability, encouraging businesses to integrate ecological considerations into their decision-making processes (Dimson *et al.,* 2018).

Moreover, environmental non-governmental organizations often leverage their networks and expertise to hold companies accountable for their environmental and social impacts. By conducting research, monitoring corporate behaviour, and advocating for policy changes, these organizations spotlight companies that fail to prioritize environmental and social issues and push for greater transparency and accountability. Environmental non-governmental organizations can amplify their impact and drive positive change towards a more sustainable and equitable future through strategic engagement with stakeholders, including consumers, investors and policymakers (AUN, 2023).[5]

IPLCs are vital actors because they traditionally occupy and manage land- and seascapes where much of the current biodiversity of the world can be found (Brondizio & Tourneau, 2016; Garnett *et al.,* 2018). Worldviews encompass a holistic view of nature, whereby biodiversity is not merely a collection of species with which people interact but rather an interconnected web of life within which people are found, emphasizing other dimensions of dependency measures. Dependency measures from anthropogenic worldviews of living *from* and living *in* nature will differ from bio/ecocentric and pluricentric worldviews of living *with* and *as* nature (IPBES, 2022b). Living from nature emphasizes resource provisioning for sustaining livelihoods, needs and want. Living in nature refers to the importance of places as settings for people's lives, practices and cultures. Living with nature values its life-supporting processes in connection with the rights of 'other-than-human' elements. Living as nature is to perceive it as a physical, mental and spiritual part of oneself (IPBES, 2022b). In addition, IPLCs can be more strongly affected by biodiversity loss and the consequent environmental impacts, as their identities are more directly linked to and dependent on its components (Cámara-Leret *et al.,* 2019; S. Lam *et al.,* 2019; Richmond *et al.,* 2005). This is especially important for Indigenous Peoples

5. Data management report referring to a literature review for the civil society https://doi.org/10.5281/zenodo.12787976.

worldviews which consider that the health of the land and the community are synonymous, such as the Maasai Indigenous Peoples of Kenya, who believe the land is alive and it is seen as dead or dying when bare, symbolizing the end of life and sadness (Karmushu, 2024).

6.2.2.4 Generating data, knowledge and capacity

There is a lack of consistent and comparable data across countries on a range of indicators that would enable monitoring and evaluation of the outcomes and impacts of biodiversity mainstreaming interventions. Progress in this regard will require concerted efforts from finance, economic, environment and other sectoral ministries both within and across countries. This will entail, for example, adapting measures of economic performance to better incorporate biodiversity, reforming fiscal and economic policy to mainstream biodiversity in decision-making, and transforming the financial system so that it systematically accounts for biodiversity-related impacts and risks (OECD, 2021). Governments play an important role supporting the range and quality of data available by harnessing new and innovative technologies and approaches (e.g., through citizen-based approaches, in some countries recognized as citizen science, artificial intelligence and Earth observation) for monitoring and analyzing data, as described in **Section 6.3.4** (OECD, 2019).

Civil society is also essential in generating data, knowledge and capacity as it gathers important biodiversity information and holds scientific expertise to help bridge the gap between businesses and biodiversity or nature's contributions to people (Dickinson *et al.,* 2010; Stephenson & Stengel, 2020). Civil society is fundamental to creating an environment where businesses can thrive while promoting sustainable practices. Civil society's core competencies, including mobilizing resources, disseminating information, offering intellectual insights, and fostering credibility, are pivotal in shaping a conducive business atmosphere (Boiral & Heras-Saizarbitoria, 2017).

Traditional knowledge systems, with deep-rooted cultural connections to their ecosystems developed over centuries, offer critical insights into sustainable resource management and intergenerational equity (Berkes *et al.,* 2000; D. P. M. Lam *et al.,* 2020; Parrotta *et al.,* 2016; Tengö *et al.,* 2014; Uprety *et al.,* 2012). They often include adaptive strategies to cope with environmental changes that, when integrated into business strategies and regulatory frameworks, under free, prior and informed consent, can enhance long-term resilience over short-term gains in the face of climate change and other global challenges, increasing the number of solutions to halt and reverse biodiversity loss and prioritize sustainability and social equity (Granderson, 2017; Leonard *et al.,* 2013; Nyong *et al.,* 2007; Riedlinger & Berkes, 2001).

6.3 OPTIONS FOR ACTION

6.3.1 Legal and regulatory

6.3.1.1 Evidence-based decision-making and use of impact and dependency measures

Governments can follow the process of evidence-based decision-making (Baba & HakemZadeh, 2012) in establishing and implementing policies for the conservation and sustainable use of biodiversity. Evidence can be defined as 'the interpretation of empirical data which results from formal research or systematic investigations using any type of science or social science methods' (Rychetnik *et al.,* 2002). Evidence can also include local knowledge and Indigenous knowledge through observation and experience (Nyboer *et al.,* 2025; Termansen *et al.,* 2022). Measures of dependence and impact on biodiversity and nature's contributions to people by businesses can be used to provide evidence for decision-making for biodiversity conservation and management and support the design of policy instruments.

Evaluating the impact and cost-effectiveness of biodiversity policy instruments also provides crucial evidence for developing strategies to mobilize and scale-up finance in biodiversity policy-making (Karousakis, 2018). Twenty cases of evidence-based policies to regulate and facilitate business actions for biodiversity were selected based on a search of articles.[6] The cases offer information on potential policy instruments, the data used (evidence), target resource (industry) and name of countries **(Table 6.3)**. Several studies included in the literature review illustrate potential policy options, including incentives and subsidies for businesses, based on measures of dependence and impact of biodiversity. The cases have a specific focus on industries, such as agriculture, forestry and fisheries which are highlighted in Target 10 of the Kunming-Montreal Global Biodiversity Framework. For example, a comprehensive sustainability impact assessment of agricultural intensification scenarios including measurement of biodiversity indicators provided relevant evidence for agricultural management policy and decision-making which influenced agricultural practices by farm businesses in Brandenburg, Germany (Gutzler *et al.,* 2015). The case from China shows recommendations for introducing incentives to encourage farmers to adopt sustainable agricultural practices, based on evidence on landscape diversity and natural resource management (Zhao *et al.,* 2023). In Canada, the Government of British Columbia phased out subsidy programs and royalty credits for oil and gas companies because of the impacts of oil and gas operations

6. Data management report referring to a systematic review of governments' actions https://doi.org/10.5281/zenodo.12787400.

on British Columbia's endangered Woodland Caribou (DiSilvestro & Irvine-Broque, 2023).

Central banks and financial supervisors can use measures of dependence and impact on biodiversity and nature's contributions to people by businesses to incentivize financial institutions to allocate financial services (loans, investments, insurance policies) in ways that better account for environmental outcomes through pursuing three main avenues, listed in increasing order of potential for transformative change (Oman *et al.,* 2024):

- First, they can require financial institutions to systematically disclose not only the climate change and nature-related risks faced but also their impacts on climate and biodiversity, in line with decision CBD/COP/DEC/15/4. For instance, Article 29 of France's Energy and Climate Act No. 2019 1147 of 8 November 2019 and its implementing legislation extended climate risk reporting requirements to include biodiversity-related issues. Investors are now required not only to disclose how they identify and manage biodiversity-related risks, but also how they impact biodiversity and align their investment strategies with long term biodiversity targets. Immediate actions which central banks and financial supervisors can take in the next two years aligned with decisions CBD/COP/DEC/15/4 and CBD/COP/DEC/15/7 (Convention on Biological Diversity (CBD), 2022a, 2022b) include: facilitating disclosure on nature-related dependencies, impacts, risks and opportunities, embracing available sector overviews providing insights into harmful activities and agreeing on an overview of sectors harmful to nature; updating the fit and proper assessment (assessing the capabilities of the management bodies) of an institution and assessing knowledge levels specifically for nature-related risks; requiring mandatory disclosures of impacts, dependencies and nature-related risks and for financial institutions to demonstrate that there are no nature crimes in their financing value chains, either through anti-money laundering rules being broadened, or stand-alone mechanisms being introduced. However, increasing evidence on the impacts of disclosure (Kedward *et al.,* 2022; Kiel & Deveau, 2021) suggests that the increasing "riskification of nature" (Van 'T Klooster & Prodani, 2025) — that is, conceptualizing environmental degradation as well as policies to protect nature as drivers of measurable financial risk – has had limited effectiveness in shifting capital allocation.

- A second approach includes arguing that central banks and financial supervisors have the ability not only to 'fix' market failures but also to 'shape' markets' behaviours toward environmental outcomes (Smoleńska & Van 'T Klooster, 2022) through more proactive policies and measures. For instance, central banks could provide better refinancing conditions or targeted long-term refinancing operations, e.g., by providing banks with preferential loans 'earmarked' for certain environmental projects (Couppey-Soubeyran, 2020; van't Klooster & van Tilburg, 2020). Proactive monetary and financial policies are already being introduced in some countries (Dikau & Volz, 2021; D'Orazio & Popoyan, 2019). For example, the People's Bank of China differentiates interest rates on banks' deposits at the central bank based on the environmental performance of banks (Baer *et al.,* 2021). These actions would contribute to shaping markets' behaviours toward environmental outcomes without waiting for businesses to do so on their own. Central banks and financial supervisors can do this through requiring financial institutions to include biodiversity in their climate transition plans, considering the interconnectedness of biodiversity loss and climate change, and the potential trade-offs. In the long term, they can require mandatory transition plans for biodiversity, integrated or at least consistent with climate transition plans. They can also work towards integrating biodiversity-related transition plans in existing micro prudential supervisory policies and integrating biodiversity in existing macroprudential policies such as concentration limits and the systemic risk buffer.

- A third approach goes one step further: if insufficient actions on issues such as biodiversity loss and climate change are caused by a lack of revenues, central banks and financial supervisors can seek to support governments (Braun & Downey, 2020). For instance, central banks could facilitate investments in environmental projects by buying green bonds issued by governments or public banks, either in primary or secondary markets (Bhattacharya *et al.,* 2021; Couppey-Soubeyran, 2020; Gabor, 2020; Grauwe, 2019), in line with decision CBD/COP/DEC/15/7. They can work with governments on research into sectoral transition pathways and promote direct investments that halt and reverse the loss of biodiversity. Until that is available, they can work with the most pressing issues for which guiding goals are already defined, providing insights into the required transition. Together, they can also apply lessons learned from decarbonizing monetary policy instruments to incorporating nature-related risks in monetary policy.

IPLCs can use measures of businesses impact and dependence on biodiversity to help demonstrate their relationships with the natural environment, making the links between business activities and their communities explicit and facilitating their incorporation in the value chain (Claridge & Kobei, 2023; Girard *et al.,* 2022; Heinämäki, 2010; Posey, 1996). IPLCs, governments and businesses can collaborate in using measures of impact and dependence at a landscape level to identify critical landscapes that

hold historical, cultural, and spiritual significance for IPLCs. This collaboration can help demarcate Indigenous territories, thereby ensuring ethnocultural integrity and environmental viability (Brown & Kothari, 2011). The formal recognition of IPLCs' land tenure rights has played an important role in promoting ecological conservation or attenuating interlinkages between agriculture expansion and intensification in Latin America (Ceddia *et al.,* 2015). In a study with 587 demarcated Indigenous lands in Brazil, Begotti & Peres (2020) show that physically demarcating sufficiently large Indigenous reserves is essential to ensure both the long-term ethnocultural integrity and the territorial environmental viability of native Amerindians. Measures of impact and dependence can be essential to extend territorial coverage or establish and protect buffer zones around it, as impacts on biodiversity in areas adjacent to IPLC-designated territories often disrupt their livelihoods by, for example, reducing the abundance and diversity of animals used as a food source or by chemical contamination through food (Alcala-Orozco *et al.,* 2019; Damiani *et al.,* 2023; Harada *et al.,* 2005; Ramirez-Gomez *et al.,* 2016; Rorato *et al.,* 2021). By supporting the establishment of buffer zones around IPLCs' territories, businesses can mitigate adverse impacts on biodiversity that disrupt livelihoods (Ford & Rowse, 2012).

Table 6 2 **Examples of evidence-based policy instruments to facilitate action by businesses on biodiversity.**[7]

Policy instrument	Data (evidence)	Target resource (industry)	Country	Reference
Subsidy	Provincial royalty credit program data, caribou populations and habitat data	Oil and gas	Canada	DiSilvestro & Irvine-Broque (2023)
Levy	Monitoring data	Fisheries	Global	Donlan & Wilcox (2008)
Tax	Monitoring data and survey to landowners	Agriculture	United States	Forshay *et al.* (2005)
Incentive	Data on impact of geodiversity and natural resource management	Agriculture	China	Zhao *et al.* (2023)
Certification	Biodiversity impact data	Agriculture	Colombia	Vargas *et al.* (2015)
Protected areas	Evaluation data on community nursery viability	Forestry and agriculture	Mexico	Luna-Nieves *et al.* (2019)
	Monitoring data	Forestry	Chile	Stephenson *et al.* (2022)
	Socio-economic impact data	Housing construction	Australia	Heagney *et al.* (2015)
Biodiversity offsets	Biodiversity accounting data	Development and forestry	India	Narain & Maron (2018)
	Standard on biodiversity offsets	Oil and gas	Global	Kate & Jeter (2012)
	Biodiversity accounting data	Development	Global	Gardner *et al.* (2013)
Decision-support system	Land and water use scenarios	Water	Australia	Elmahdi & McFarlane (2009)
	Data of costs and impacts, participatory rapid economic valuation, scenarios	Forestry, Fisheries, Tourism, Agriculture	Indonesia	Cannon & Surjadi (2004)
	Vegetation data, agricultural product yield data, GIS data, multi-criteria analysis	Agriculture	Australia	Zerger *et al.* (2009)
	Biodiversity data	Land use	Australia	Summerell *et al.* (2011)
Multiple instruments	Biodiversity impact data	Energy, transportation	Botswana	Kgathi *et al.* (2017)
	Biodiversity impact data	Agriculture, forestry	Global	Driscoll *et al.* (2012)
	Biodiversity impact data	Multi sectors	Global	McElwee *et al.* (2020)
	Multiple types of data	Multi sectors	Global	Turnhout *et al.* (2021)
Not specific	Impact assessments for agricultural intensification scenarios	Agriculture	Germany	Gutzler *et al.* (2015)

7. Data management report referring to a systematic review of governments' actions https://doi.org/10.5281/zenodo.12787400.

6.3.1.2 Laws and regulations

Legislation is a powerful policy instrument with binding force by governments. Governments require legal accountability of officials and other actors based on laws (Brandsma & Schillemans, 2013). Legislation is an overarching framework to regulate and facilitate business actions and performance and can use measures of dependence and impact on biodiversity. Governments and regulatory agencies responsible for overseeing and enforcing rules within markets (e.g., stocks, bonds or derivatives) can mandate disclosure requirements for biodiversity-related impacts, dependencies, risks and opportunities; help ensure consistent risk assessment and reporting frameworks; take legal action when companies fail to disclose nature-related risks adequately; and require investors to disclose their proxy voting decisions (e.g., on board elections, executive compensation or corporate strategy) and how biodiversity considerations are considered in these.

Governments can also amend biodiversity conservation and corporate laws to align with global sustainability standards such as those currently being explored by the International Sustainability Standards Board for biodiversity and ecosystem services (Grunewald *et al.,* 2024). Data on business impacts on biodiversity can be crucial as evidence in legal proceedings to demonstrate the ecological, cultural and economic significance of its components for IPLCs, supporting compensation claims (Kirsch, 2001; Turner *et al.,* 2008). Impact assessments can establish legal guarantees for full compensation and hold businesses accountable for environmental and cultural damage (Gregory & Trousdale, 2009) see **Box 6.1**.

As a specific case study, environmental impact assessments were introduced to support decision-making in environmental management in many countries. An environmental impact assessment is a process used to evaluate the potential environmental impacts of a proposed plan, policy or project prior to the decision to start the project. It is a standard tool for evidence-based decision-making in land use planning and as of 2011, 191 of the 193 Member States of the United Nations either had national legislation or had signed some form of international legal instrument that refers to the use of environmental impact assessments. Governments require companies to conduct environmental impact assessments prior to moving forward with the proposed actions such as infrastructure, recreation facilities and other projects. Many governments use the outputs of environmental impact assessments including the measures of business impacts on biodiversity within these assessments (Cares *et al.,* 2023) as a basis for decision-making. Article 14 of the Convention on Biological Diversity stipulates that 'each contracting Party as far as possible and as appropriate, shall (a) introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures' (Morgan, 2012).

Governments can design legislation that mandates action by businesses to avoid negative impacts on biodiversity. The Government of the United Kingdom of Great Britain and Northern Ireland has adopted Biodiversity Net Gain legislation, which requires developers to demonstrate that their proposals will achieve at least a 10 per cent net

Box 6 1 **Litigation for ecological, cultural and economic impacts of biodiversity loss on Indigenous Peoples and local communities.**

In one of the biggest socio-environmental disasters in Brazilian history, Fundão dam, owned by Samarco Company, Vale and BHP Billiton, collapsed in 2015 in Mariana, releasing around 50 million m^3 of mining waste slurry and sediments, destroying riparian, freshwater and marine ecosystems along more than 600km of watercourse and killing 19 people, while displacing another 600 (Fernandes *et al.,* 2016). This disaster impacted local fishing communities and the Krenak Indigenous Peoples directly and indirectly, for whom the Doce (*Watu*) river is not only a subsistence resource but also a kin entity that provides counsel, protects, and contributes to the formation of the Krenak identity (Zhouri & Pascoal, 2022). In 2023, eight years after the disaster, victims are still trying to negotiate payment of compensation and environmental reparation, as the companies did not fulfil the agreement reached in 2015 (G1, 2023). In such contexts, it is essential to consider that biodiversity offsetting, a last step in the mitigation hierarchy, can aim to compensate for lost biodiversity 'values' in other distant areas, but may not be able to compensate for peoples' values associated with the specific local biodiversity (Tupala *et al.,* 2022). As such, efforts should prevent and avoid impacts and provide IPLCs with resources to navigate complex legal processes.

Measures of environmental and public health impact were also key to plan and establish a clean-up strategy for pollution restoration related to the historical oil-spills from the oil extracting activities of The Royal Dutch Shell company on the territory of the Ogoni People in Nigeria. The United Nations Environment Programme's Assessment Report on Ogoniland, which assessed more than 200 locations, estimated that Ogoniland's sustainable recovery could take 25 to 30 years, requiring a joint effort of the Government, the oil industry and the traditional rulers and people of Ogoniland.

gain in biodiversity in order for them to obtain planning permission from local planning authorities (zu Ermgassen *et al.,* 2021). If developers are unable to achieve biodiversity net gain on-site, they can look at off-site delivery (ideally in the same local planning authority) or purchase statutory biodiversity credits from the Government (UK Department for Environment, Food & Rural Affairs, 2024). Governments can also secure land access through a legal framework. The Kenyan Community Land Act (2016) provides a framework for IPLCs to utilize and demand benefits that may arise from biological resources in the communal lands in Kenya (Otieno, 2023). In addition, they can take legal measures to provide consumers with the information needed to promote sustainable consumption patterns. Environmental labels and certifications also give information to consumers and so do companies with marketing incentives that are recognizable among the public, such as awards (Thompson, 2018).

6.3.1.3 Participation, governance, and partnerships

Laws and regulations need to encourage the development and enforcement of business policies that guarantee IPLCs' inclusion in the decision-making processes of businesses that depend on or impact biodiversity within their lands (Arquette *et al.,* 2002; Black & McBean, 2016; Fridkin *et al.,* 2019; Sangha *et al.,* 2019; Kløcker Larsen & Raitio, 2023; Nadasdy, 2003). Changes to the policy environment for IPLCs and business relationships can secure the role of IPLCs in managing resources related to their historical territories, promoting practices aligned with their traditional knowledge and based on free, prior and informed consent (Bulengela *et al.,* 2020; Golden *et al.,* 2015; Reyes-García *et al.,* 2022; Thériault *et al.,* 2022). When investors seek territorial control through legal ownership of the land by dispossessing IPLCs without their free, prior and informed consent, it leads to the criminalization of IPLCs' actions on their historical land (Karmushu, 2024). In this context, creating mechanisms for IPLCs to overcome unequal power structures, engage in policy advocacy and fairly participate in business activities such as consultations, negotiations and policy development can ensure that their voices are heard and respected and their interests are considered (Kløcker Larsen & Raitio, 2023; Nadasdy, 2003).

It is also essential to guarantee that participation takes place not only prior to management but is set up as a long-term partnership. Mechanisms for community-based participation like design charrettes can act as trust-building exercises between stakeholders and support collaborative processes (Roggema *et al.,* 2014). The Khwa Ttu San culture and education center in South Africa is an example of a partnership jointly directed by the San People and a Swiss organization which provides on-the-job training for young San through tourism and cultural activities. However, when domination and colonial legacies structure the relations between IPLCs and businesses, or when it does not follow the communities' procedures of collective governance, it can lead to internal conflicts and entangle communities in more profound oppression (Banerjee, 2022; Gustafsson & Schilling-Vacaflor, 2022).

Whole-of-government approaches are crucial for addressing complex and interconnected challenges by ensuring integrated policymaking, efficient resource use, and comprehensive solutions (OECD, 2023). Several sectors such as agriculture, trade, tourism and many more, need to interact when it comes to biodiversity management. Therefore, coherence of policy instruments between and within sectors is needed for businesses to support the management of biodiversity. Coherent approaches would promote collaboration and information sharing among government entities, enhance stakeholder engagement including with businesses, align national policies with global commitments and improve transparency. By coordinating efforts across various sectors and levels of government, whole-of-government approaches create sustainable and holistic solutions to halting and reversing the loss of biodiversity and ensure that conflicting policies at different levels of government do not undermine biodiversity commitments (WEF, 2024).

Further, civil society can actively participate in policy discussions. They can advocate for stronger environmental regulations and work with policymakers to develop and enforce laws that promote sustainable practices and biodiversity conservation. They also contribute to improving institutional competencies by conducting research, providing recommendations, and engaging in policy dialogue at both national and international levels, thus enhancing the regulatory framework necessary for biodiversity conservation and sustainable business practices (Buijs *et al.,* 2024; Ghaus-Pasha, 2005). Civil society engages with policymakers, stakeholders and government agencies to foster the integration of sustainability principles into policies, programs and regulations which provide clarity on sustainable business practices. This advocacy may involve lobbying for financial incentives for businesses that adopt sustainable practices, promoting research or advocating for the inclusion of sustainability criteria in trade agreements (Arenas *et al.,* 2013; Zompetti, 2006).

6.3.1.4 Accountability and transparency

Standard-setting bodies can cooperate on the harmonization of sustainability disclosures and drive the transition of businesses and the financial sector away from activities that harm biodiversity, towards activities that protect and restore biodiversity. The International Sustainability Standards Board, in 2024, has commenced a research project on the disclosure of risks and opportunities associated with biodiversity, ecosystems and ecosystem

services, and also rolled out a work plan to develop strategic relationships with other standard-setting bodies and nature-related taskforces to align efforts, including the Transition Plan Taskforce, GHG Protocol, Carbon Disclosure Project (CDP), Taskforce on Nature-related Financial Disclosures (TNFD) and Global Reporting Initiative (GRI).

A comparison report on nature-related assessment and disclosure frameworks and standards by UNEP-WCMC and the UNEP Finance Initiative also analyzed seven key bodies including CDP, European Sustainability Reporting Standards (ESRS), GRI, Natural Capital Protocol, Science Based Targets Network (SBTN) and TNFD to offer financial institutions insights into the evolving regulatory landscape related to nature and biodiversity (UNEP-WCMC & UNEP FI, 2025).

It is important to note that international standard-setting bodies often have tenuous claims to legitimacy and have been criticized for being captured by private interests and lacking in ambition (Chand & White, 2007; Richardson & Eberlein, 2011; Warren, 2024).

Civil society can play a crucial role in providing transparency to processes related to businesses and biodiversity by employing measures of impact and dependence (see examples in **Box 6.2**). These measures help illuminate the connections between business activities, their effects on biodiversity, and the degree to which businesses rely on biodiversity and nature's contributions to people. By quantifying and communicating these relationships, civil society can promote greater stakeholder accountability and understanding, facilitate informed decision-making, and foster a more equitable dialogue.

6.3.1.5 Benefit-sharing, intellectual property and traditional knowledge

Businesses can adopt robust measures that secure fair and equitable sharing of the benefits arising from using traditional knowledge systems associated with genetic resources, with IPLCs holding such knowledge under mutually agreed terms (Andoke Andoke *et al.,* 2023; CBD, 2011; McDermott *et al.,* 2013; Salafsky *et al.,* 2001). This is crucial to prevent harm to traditional lifestyles from patent systems based on commercial interests and biopiracy, which can misappropriate traditional knowledge and reduce biological diversity. Patents over biochemical substances from traditional medicinal plants, for example, have historically generated billions of dollars in the pharmaceutical and natural product industries that, most of the time, did not result in revenues for IPLCs as stewards of the knowledge associated with these genetic resources. Important examples of disputes include patents in the United States of America over a strain of ayahuasca, a sacred plant for many Amazonian Indigenous Peoples (Press, 2022), varieties

Box 6 2 **Examples of accountability.**

One example of such an initiative is the Science based Targets Initiative (SBTi, n.d.), which is an effort in assisting companies to set science-based targets to reduce greenhouse gas emissions in alignment with the objectives of the Paris Agreement. SBTi offers a standardized framework for businesses to establish emission reduction goals that are scientifically rigorous and aligned with climate science. Through SBTi, companies receive guidance and support to develop ambitious, achievable targets that reflect their contribution to fighting the climate crisis. SBTi enables businesses to measure and track their progress towards sustainability goals by providing a comprehensive methodology and toolkit for setting emission reduction targets. This standardized approach ensures consistency and comparability across different industries and sectors, facilitating benchmarking and best practice sharing among companies. By adopting science-based targets, businesses enhance transparency and accountability in their environmental performance, demonstrating their commitment to addressing climate change and contributing to the global effort to achieve climate resilience and sustainability. SBTi's engagement with companies also encompasses ongoing support and guidance throughout the implementation process. SBTi provides resources, training and technical assistance to help companies integrate emission reduction targets into their business strategies, operations, and supply chains. This comprehensive support enables businesses to overcome barriers and challenges in transitioning to low-carbon operations, fostering innovation and driving continuous improvement in environmental performance.

Another example is the forest footprint disclosure project (Sustainable Forest Products, n.d.) an initiative to encourage companies to disclose their impacts on forests and proactively mitigate deforestation and forest degradation within their supply chains. It is a platform for companies to voluntarily disclose information regarding their forest-related activities, including deforestation risks, forest management practices and efforts to promote forest conservation. By participating, companies demonstrate their commitment to transparency and accountability in addressing their forest footprint. One of the key objectives of the project is to provide investors, consumers and policymakers with access to critical information about corporate forest risk exposure. Through comprehensive reporting and data disclosure, it enables stakeholders to assess how companies' operations and supply chains are linked to deforestation and forest degradation.

of quinoa, a staple grain for Andean IPLCs (Powledge, 2001), or antifungal agents from the neem tree, which have been used for centuries by Indian IPLCs (Hellerer & Jarayaman, 2000).

The Conference of the Parties to the Convention on Biological Diversity, at its 16th meeting, in decision 16/2, adopted modalities for operationalizing multilateral mechanisms, including a global fund – the Cali Fund for the Fair and Equitable Sharing of Benefits from the use of Digital Sequence Information on Genetic Resources (CBD/COP, 2024). One of its modalities states that at least half of the funding of the global fund should support the self-identified needs of IPLCs, including women and youth within those communities, through government authorities or by direct payments through institutions identified by IPLCs. Voluntary contributions by businesses are also encouraged if they are using such genetic resources.

Individual property rights and commodification of nature may also contrapose communal usage and stewardship principles from many IPLCs' worldviews, and options, such as communal patents, may provide a more substantial base for fair and equal benefit sharing (Aubertin, 1998; Mgbeoji, 2001; Raymond *et al.,* 2013). IPLCs can use measures of impact and dependence of businesses on biodiversity in legal cases involving business activities and settle agreements to ensure their rights to intellectual property and benefit-sharing mechanisms. Benefit-sharing mechanisms can be monetary, e.g., sharing royalties when resources are used to create a commercial product, but also non-monetary, e.g., developing research skills (Chuah *et al.,* 2014; Sanghera *et al.,* 2015).

6.3.2 Economic and financial

6.3.2.1 Mobilizing finance for biodiversity

Governments can adopt economic instruments and mobilize finance for biodiversity. The Kunming-Montreal Global Biodiversity Framework calls for governments to scale up positive incentives for the conservation and sustainable use of biodiversity. The instruments may include taxes, fees, subsidies, payments for ecosystem services and biodiversity offsets. The design of the economic instruments can be based on measures of dependence and impact on biodiversity. According to the OECD's Policy Instruments for the Environment (PINE) database (OECD, 2021), a total of 227 biodiversity-positive taxes have been reported, spanning 70 countries. Across all countries' reporting, the total revenue generated by biodiversity-relevant taxes is $9.96 billion a year (average 2020 - 2022). 301 fees are in force across 75 countries, and 240 biodiversity subsidies are in force in 34 countries. As of 2024, 51 payments for ecosystem services schemes and 17 biodiversity offset programs are in force, in 28 and 9 countries, respectively. Biodiversity incentives are mainly applied in the agriculture, forestry and fishing sectors (OECD, 2023).

For example, Costa Rica has established a longstanding framework for payment for ecosystem services as a mechanism to promote biodiversity conservation. The Private Wildlife Refuge Program require landowners to develop and implement a government-approved management plan that delineates specific restrictions on land and resource use. In exchange, refuge proprietors are entitled to three primary benefits: (1) exemption from property taxes on land designated as a refuge, (2) access to technical support for the effective management of the protected area, and (3) governmental assistance in cases of squatter encroachment (Langholz *et al.,* 2008).

Governments can also support blending public and private funds to de-risk biodiversity investments (Flammer *et al.,* 2025). Blended finance is one example of an innovative financial instrument that can contribute to biodiversity efforts. This combines concessional public financing, primarily from development finance institutions and other resources, to leverage additional funds from the private sector to bridge the Sustainable Development Goals financing gap (EIG & World Bank Group, 2020). This form of financing between public and private actors is often used to "mitigate risk and facilitate financing for private sector-led projects that have the potential to generate social [and environmental] benefits" (EIG & World Bank Group, 2020). Many innovative financial transactions in support of biodiversity have been developed using blended finance, including debt-for-nature swaps (see **Box 6.3**), conservation bonds and potentially some projects that include nature-based solutions. Other traditional sustainable finance instruments, including the use of proceeds (project finance, etc.), sustainability-linked loans and sustainability-linked bonds, as well as biodiversity-related funds, can also be used to allocate capital towards biodiversity to meet the Kunming-Montreal Global Biodiversity Framework's goals and targets (Sustainalytics, 2021). However, it is important to note that blended finance can bring about harmful outcomes (Attridge & Engen, 2019) if it is informed by a 'de-risking' logic (Gabor, 2021) that redistributes financial risks from the private to the public sector.

International financial institutions can support governments in developing nature-related bonds, such as sustainability-linked bonds and sustainability-linked sovereign debt-related bonds, to advance biodiversity goals while refinancing foreign debt pressures related to biodiversity. They can be more strategic in allocating and targeting their biodiversity spending in countries and regions where there is most need and success for actions to halt and reverse the loss of biodiversity. They can do so by making investment decisions

Box 6 3 Case study: Debt-for-nature swaps – Galápagos marine bond.

In 2023, the Government of Ecuador closed one of the world's largest debt-for-nature swaps by selling a new $656 million blue bond, reaching maturity in 2041, which will funnel $12 million for the conservation of the Galapagos Islands, an endangered ecosystem with giant tortoises, marine iguanas and Darwin's finches (Jones & Campos, 2023). This innovative transaction took place in the form of blended finance, with Crédit Suisse arranging and structuring the bonds and development finance institutions, such as the Inter-American Development Bank and the International Development Finance Corporation of the United States of America, providing credit guarantees and political risk insurance (DFC, 2023). Other technical actors were also involved in the closing of this transaction.

based on biodiversity-related data and evidence, in addition to poverty alleviation and other social and economic considerations (Hickey & Pimm, 2011). They can also play an active role in risk mitigation such as offering guarantees, insurance, or co-investment schemes to lower the risks for businesses investing in biodiversity-focused projects.

For example, the World Bank Group supports green, resilient and inclusive development in client countries by integrating protection and restoration of biodiversity into economic policy, development programs, and strategic investments. It is a leading multilateral financier of biodiversity and ecosystem conservation, whose active portfolio included $2.8 billion of direct investments in biodiversity in 2022 (World Bank Group, 2023). The International Monetary Fund, on the other hand, currently concentrates investments and efforts on climate change, and does not yet have a clear strategy for addressing biodiversity-related challenges. Decision CBD/COP/DEC/15/7 (Convention on Biological Diversity (CBD), 2022b) of the Conference of the Parties to the Convention on Biological Diversity on resource mobilization, specifically calls on 'the World Bank Group and the International Monetary Fund, to immediately consider supporting implementation of the Kunming-Montreal Global Biodiversity Framework, including by partnering with the Kunming-Montreal Global Biodiversity Framework Fund, established as per paragraph 30 of the present decision'.

Public development banks have long-standing relations with private financial institutions and have a strong understanding of policy objectives and business concerns. Therefore, they can play a key catalytic role in bridging public and private commitments for green financing (Smallridge *et al.,* 2012). They are not necessarily subject to the same return requirements as private capital and therefore may be more suited to biodiversity investments that are not attractive at market rates. Providing ten percent of all annual private and public financing, public development banks are well placed to support public policies, set norms at national and regional levels, leverage private finance and contribute to global goals, its funding and their implementation (WWF & The Biodiversity Consultancy, 2021). However, public development banks' lending can also do harm to biodiversity. The potential damage to biodiversity resulting from public development banks leading activities driving deforestation and water scarcity and carried out without effective safeguards to mitigate them is $800 billion annually (Finance for Biodiversity Initiative, 2021). Therefore, public development banks need to first manage their impacts and dependencies on and mitigate any risks to biodiversity and then increase their biodiversity investments. Public development banks can complement their climate investments by making explicit nature-based goals and targets a fundamental part of their efforts to support sustainable development and achieve the necessary convergence of climate and biodiversity finance.

Civil society plays a key role working with businesses to restore and sustain biodiversity to manage the biodiversity finance gap (Crisostomo, 2025; WEF, 2020). They play an important role in designing biodiversity finance instruments like biodiversity offsets, conservation trusts and payment for ecosystem services schemes, which provide opportunities for businesses to invest in or co-finance initiatives to ensure that instruments are deployed at the right scale to address biodiversity loss (Kujala *et al.,* 2022). Civil society often acts as independent evaluator of the impact of financial instruments to reduce biodiversity loss, enhancing transparency and credibility of business contributions, as illustrated through the collaboration of the World Wildlife Fund with companies like H&M and IKEA to evaluate and improve biodiversity outcomes across supply chains (WWF, 2025; WWF & H&M Group, n.d.). In addition to increasing the total available for investment, the engagement of civil society in this effort can help improve the chances of success of the investment. For example, the Livelihoods Carbon Fund brings together companies like Danone with non-governmental organizations to finance agroforestry and ecosystem restoration projects in Africa and Asia (Flammer *et al.,* 2023). Furthermore, civil society connects communities and smallholders with opportunities to access, as well as train them to use financing tools (e.g., eco-certification, biodiversity credits), which enhances business abilities to contribute to biodiversity investments (Milder *et al.,* 2015).

6.3.2.2 Reforming global and national financial systems

The decision of the Conference of the Parties to the Convention on Biological Diversity, at its 15th meeting, on resource mobilization (CBD/COP/DEC/15/7) (Convention on Biological Diversity (CBD), 2022b) specifically calls for 'transformation of the global financial architecture and the reform of multilateral development banks and international finance institutions, including investment banks, to make them fit for purpose in supporting implementation of the Kunming-Montreal Global Biodiversity Framework, sustainable development and just transition efforts in developing countries'.

In addition, in decision CBD/COP/DEC/15/15, a decision related to financial mechanisms and the Global Biodiversity Framework Fund, the Conference of the Parties encourages engagement of multilateral development banks and other international financial institutions in the design and operationalization of the Global Biodiversity Framework Fund, with a view to leveraging additional resources from and for the fund and channeling them through new and existing biodiversity portfolios, which need to be aligned with the goals and targets of the Kunming-Montreal Global Biodiversity Framework.

Ministries of finance can transform fiscal and economic policies to address biodiversity loss, including budget allocation for biodiversity conservation and ensuring that projects with significant potential negative impacts on biodiversity are subject to strict scrutiny and rigorous environmental impact assessments. Ministries of finance can also phase-out harmful subsidies and introduce tax incentives that align financial flows with the goals and targets of the Kunming-Montreal Global Biodiversity Framework (DiSilvestro & Irvine-Broque, 2023; Thompson, 2018), although reform of subsidies is not new to this framework and was included in previous targets. Governments can formulate policies encouraging responsible management and transition of stranded assets and can include environmental safeguards in financial regulation alongside money laundering and other financial crimes.

Ministries of finance can build a regulatory framework that accelerates investments in nature markets, companies and projects. In the report for the Coalition of Finance Ministers for Climate Action, actions for finance ministries, such as the development of nature investment plans and investments in global public goods, are recommended. They can support decentralized finance structures that allow capital to be made available on the biome level, region or location. Governments can also establish funds for biodiversity conservation.

As an example, the State of New South Wales (Australia) established the Biodiversity Conservation Trust for investments in private land conservation, which supports sustainable farming businesses and avoids land use conflicts with mineral and energy source industries. This was done in accordance with the biodiversity conservation investment strategy 2018 (NSW, 2018). The New Zealand Government developed the New Zealand Sovereign Green Bond Framework, which includes among its eight 'green categories' terrestrial and aquatic biodiversity. In 2022 the Green Bond Programme financed, under these categories, collaborative decision-making on freshwater improvements through providing information, training and capacity-building for stakeholders such as IPLCs (Māori), local councils and businesses (New Zealand Treasury, 2024).

In addition, international financial institutions can promote the inclusion of biodiversity criteria in debt sustainability assessments, thereby embedding biodiversity into sovereign debt markets, alleviating economies from debt crises and ensuring financial transitions halt and reverse the loss of biodiversity (Kraemer & Volz, 2022).

6.3.2.3 Supporting inclusive and equitable access to finance

IPLCs can use measures of impact and dependencies of businesses on biodiversity to support economic development by leveraging traditional knowledge (Sinthumule, 2023). IPLCs often engage in activities, such as eco-tourism, sustainable agriculture and traditional crafts, which contribute to economic progress and biodiversity conservation. For example, The Khoi and San tribes of the Western Cape Province, in South Africa, used the leaves of the Rooibos plant (Aspalathus linearis) to make tea. The Rooibos plant (red bush in Afrikaans) has been declared an Indigenous product, thus allowing the tribe to use their knowledge for sustainable agriculture and preservation, promoting economic growth (Haq *et al.,* 2023) (see also **Box 5.8**).

Studies highlight the potential for Indigenous Peoples-led businesses to benefit communities economically while maintaining biodiversity (Haq *et al.,* 2023; Robinson *et al.,* 2021; Sinthumule, 2023). Businesses can play a vital role in supporting IPLCs' economic initiatives by recognizing and protecting Indigenous rights, and other applicable rights of local communities, and perspectives on nature and providing funding and support. This includes advocating for the inclusion of Indigenous Peoples' perspectives on valuing impacts and dependencies on nature in economic decisions and promoting ethical codes within financial institutions that prioritize inclusion of IPLCs in business models. Existing financial structures often disadvantage IPLCs, creating economic disparities. Businesses can advocate for inclusive policies and breaking down financial barriers, both of which are essential for promoting economic equity and sustainable

development. Businesses can embrace new economic models that align with IPLCs' values. This shift requires promoting sustainable practices and acknowledging the intrinsic value of nature. Governments can also provide funding to invest in local co-management strategies and technical support.

6.3.3 Norms and values

6.3.3.1 Inclusive decision-making and partnerships

Governments can play a role in fostering a positive and fair competitive environment for businesses that ensures their operations do not harm biodiversity, and disclose them transparently, especially for companies that disclose voluntarily. This fostering role can ensure and emphasize the need for integration of biodiversity values into policy and regulation, highlighting the role of businesses in conservation through sustainable practices, investment in research and collaboration with policymakers.

Governments can improve public-private partnerships and dialogue with businesses (DCED, 2008). They can ensure that relevant stakeholders, particularly IPLCs, are involved in the decision-making process related to businesses while adhering to free, prior and informed consent. For example, they can promote ethical consumption and business practices through mandated reporting or regulations on business sustainability and social responsibility. Governments and financial actors together can conceptualize new ways of valuing biodiversity, ensuring it is accounted for in regulations, corporate decisions and national financial frameworks.

Another way of ensuring an inclusive decision-making process is to involve all relevant stakeholders into national level environment-related councils or working groups, thereby increasing awareness and ensuring involvement of all relevant stakeholders. In 1993, the President of the United States of America formed the President's Council on Sustainable Development that consisted of presidentially appointed leaders from businesses, the environmental sector, citizen organizations, Native American groups and government (Bell, 2002). The purpose of the group, dissolved in 1999, was to report on and make recommendations for sustainability issues in the United States of America that ensured inclusivity among stakeholders.

Forming partnerships with businesses is a prime example of how the role of civil society can be leveraged to promote sustainability (see example in **Box 6.4**). Civil society and businesses can co-create and implement sustainable practices that benefit biodiversity and businesses' profit by joining forces. This collaborative approach allows the sharing of expertise, resources and innovative solutions, leading to more effective and impactful outcomes. For example, some civil society organizations actively plan and implement restoration initiatives, working with businesses, governments and local communities to restore degraded ecosystems, enhance biodiversity and improve nature's contributions to people. Civil society can facilitate business partnerships by acting as intermediaries between businesses and communities, advocating for sustainable practices (see also Hidalgo-Ruz & Thiel, 2015), and ensuring that business interests align with environmental and societal needs. Through their grassroots networks, technical expertise and advocacy efforts, civil society contributes significantly to the success of restoration projects, fostering collaboration and mobilizing resources for long-term conservation outcomes.

Working alongside IPLCs enables businesses to develop sustainable resource management plans that balance resource utilization with biodiversity conservation by incorporating Indigenous practices and ecological knowledge (Alessa *et al.,* 2016). IPLCs contribute by emphasizing cultural sensitivity, social cohesion, and community engagement, which are crucial when working with Indigenous communities (Bone *et al.,* 2011; Houdet *et al.,* 2009; Lebel, 2013; Weber, 2010). By including Indigenous perspectives in business models, companies

Box 6 4 **Example of the Business for Nature Coalition.**

One example of collaborative efforts between businesses and civil society is Business for Nature (https://www.businessfornature.org), a global coalition comprising nearly a hundred organizations and companies that foster business actions towards a greener economy. Through Business for Nature, civil society and businesses advocate for policies and practices prioritizing biodiversity conservation and promoting sustainable development. By pooling their collective resources and influence, members of this coalition can amplify their impact and drive positive change on a global scale. This partnership model demonstrates the power of collaboration between civil society and business sectors in advancing sustainability goals. By working together, these stakeholders can harness their strengths and capabilities to address complex environmental challenges and create a more sustainable future.

Box 6 5 Integrating Indigenous and local knowledge in the sustainable devil's claw harvesting business: a case study from Namibia.

Globally, various strategic options exist to strengthen the relationship between IPLCs, biodiversity management and business. One notable example is Namibia's community-based natural resource management programme, which emphasizes integrating Indigenous knowledge into conservation and business plans for a balanced resource management and utilisation approach. In the case of this programme, various initiatives such as the sustainable harvesting of devil's claw programme, which is an Indigenous knowledge product that provides medicinal properties as well as benefits from ecological and Indigenous knowledge to facilitate a sustainable business model considering social and environmental aspects. This type of arrangement creates and facilitates benefit-sharing in a long-term working relationship between local communities and local business enterprises, even though the devil's claw is still to be recognized globally as an Indigenous product (Cole, n.d.).

Box 6 6 Examples of certification programmes.

One example of a certification programme developed by civil society is the **Fairtrade certification** (Fair Trade Certified, n.d.), which promotes equitable trading relationships, supports sustainable development and is a powerful tool for promoting equitable trading relationships and fostering sustainable development, particularly in developing countries. Established in the 1980s, Fairtrade certification addresses the inherent inequalities in global trade by ensuring that producers, particularly small-scale farmers, and workers in marginalized communities, receive fair compensation for their products. Through Fairtrade certification, producers are guaranteed a minimum price for their goods, which is set to cover the cost of sustainable production and provide a living wage for workers. In addition to advocating for fair prices, Fairtrade certification requires producers to comply with environmental standards, encouraging sustainable farming practices that minimize environmental impact and promote ecosystem health. Producers certified under Fairtrade must adhere to criteria such as restricting harmful chemicals, conserving natural resources, and protecting biodiversity. Fairtrade certification promotes sustainable agriculture by mitigating environmental degradation caused by certain conventional farming practices. It contributes to the conservation of ecosystems and natural habitats. Fairtrade certification goes beyond economic and environmental considerations to prioritize social development and community empowerment. Producers certified under Fairtrade must invest some of their earnings into community development projects, such as education, healthcare and infrastructure improvements. This investment helps to strengthen local economies, improve livelihoods, and empower communities to become self-sufficient and resilient. Fairtrade certification fosters a sense of global solidarity by empowering consumers to support ethical and sustainable businesses. It promotes social justice, ultimately contributing to a more equitable and sustainable world.

The **Marine Stewardship Council** (Marine Stewardship Council, n.d.) works closely with fisheries, scientists, conservation organizations and other stakeholders to establish and implement rigorous standards for sustainable fishing practices. These standards encompass a range of criteria, including the health of fish stocks, the impact of fishing activities on marine habitats and ecosystems, and the effectiveness of fisheries management measures. Through extensive consultation and stakeholder engagement, the certification process involves scientific assessment, on-site inspections and stakeholder feedback to evaluate fisheries against these standards. Fisheries that meet the stringent criteria are awarded certification, signalling to consumers that the seafood products originating from these fisheries have been sourced sustainably. This certification helps consumers make informed choices about their seafood purchases, enabling them to support fisheries that prioritize environmental stewardship and responsible fishing practices. The certification also benefits consumers and incentivizes fisheries to adopt more sustainable practices and improve their management strategies. By providing market incentives for sustainable fishing, the certification encourages fisheries to invest in measures to reduce bycatch, minimize ecosystem impacts and enhance long-term sustainability. Ultimately, the certification contributes to the conservation of marine biodiversity and the health of marine ecosystems by promoting sustainable seafood consumption and supporting fisheries that prioritize environmental responsibility.

Another certification scheme based on the positive effect of businesses on biodiversity is the **LIFE certification** (LIFE Institute Global, n.d.). Developed and managed by the LIFE Institute, a non-profit standard-setting organization founded in 2009, the LIFE certification aims to incentivize businesses to adopt practices contributing to biodiversity conservation, ecosystem restoration and sustainable natural resource management. Unlike traditional certification schemes that focus solely on minimizing negative environmental impacts, the LIFE certification emphasizes the proactive role that businesses can play in enhancing biodiversity and nature's contributions to people. The LIFE Institute has developed a set of methods and criteria that businesses must meet to qualify for LIFE certification. These criteria are tailored to different sectors and industries, considering the specific environmental

Box 6 6

challenges and opportunities faced by each sector. To achieve certification, businesses undergo a thorough assessment process by independent third-party auditors, who evaluate their performance against the LIFE standards. This assessment includes habitat conservation, species protection, water and soil management, and promoting sustainable land use practices. By promoting positive contributions of businesses to biodiversity, the LIFE certification scheme encourages a more holistic approach to sustainability that integrates biodiversity conservation into business strategies and operations.

can adopt more holistic approaches to development that align cultural values with contemporary economic practices (Berkes *et al.,* 2000). This collaboration facilitates the integration of traditional ecological wisdom, which often emphasizes long-term sustainability and environmental stewardship. Such engagement fosters mutual respect and understanding, ultimately enhancing the resilience of both businesses and ecosystems and benefiting all parties involved (Berkes *et al.,* 2000; Graça & Camarinha-Matos, 2023).

Moreover, the recognition of equal rights in relationships and the simultaneous need for businesses to protect the environment for mutual benefits highlights the integral role that businesses can play in environmental conservation efforts (see example in **Box 6.6**).

6.3.3.2 Awareness raising and certification

Civil society offers valuable guidance and support to businesses seeking to operate ethically and sustainably (AUN, 2023), whether by advocating for eco-tourism ventures that promote conservation efforts, forging green supply chains that minimize environmental impact or promoting responsible sourcing practices. These initiatives benefit the environment and create opportunities for businesses to differentiate themselves in the market, attract environmentally conscious consumers and build long-term resilience. Civil society organizations can launch campaigns, including for example beach and river plastic waste clean ups, to raise public awareness about businesses' environmental impacts. By informing the public, they pressure companies to improve their practices and encourage consumers to make informed, environmentally conscious choices.

By encouraging or establishing credible, third-party audited or officially recognized certification programs and industry standards, civil society can influence consumer choices and create a competitive environment where businesses are recognized and rewarded for their commitment to environmentally sustainable practices. These certifications and standards (see examples in **Box 6.5**) inform consumers that products and services meet certain environmental criteria and may influence purchasing decisions or drive demand for sustainable goods and services.

The complex technical requirements and implementation cost of certifications may inadvertently exclude small holders, acting as a barrier to trade, so it is essential for stakeholders to participate in their design (see Watts *et al.,* 2021). Overall, certifications and standards developed by civil society play a crucial role in driving sustainability across various industries by encouraging responsible practices, influencing consumer behaviour, and fostering a competitive market for sustainable products and services.

Standard-setting bodies can guide sustainability accounting and reporting standards on how diverse values of biodiversity will be measured, accounted for, and reported on to investors, society and states, and considered in business decisions and decisions other stakeholders. They can also include diverse values of biodiversity as viewed by rights holders, the scientific community, stakeholders and society (Adams & Mueller, 2022).

6.3.4 Technology and data

6.3.4.1 Data collection and use

In most jurisdictions, government agencies – ordinarily across all levels of government – collect biodiversity data as part of their baseline or monitoring requirements. Biodiversity baseline assessments are usually required if an area is to be gazetted as a protected area. As such, data collected may relate to general biodiversity information such as vegetation cover and type or to more specific aspects such as species occurrence, diversity, nature's contributions to people and habitat characteristics. Other biodiversity-related data collected can include protected area boundaries, water quality data, soil type and topography. The data collected through this exercise may then be collated and maintained in a database that may or may not be publicly accessed.

Civil society's involvement in improving monitoring and data availability is crucial for evidence-based decision-making and accountability. They often fill data collection and analysis

gaps, advocate for transparency and empower communities to participate in monitoring efforts. Civil society also plays a key role in developing effective monitoring strategies and verification systems, catalyzing participatory approaches to ensure that local knowledge and perspectives are integrated into biodiversity monitoring and reporting processes (Danielsen *et al.,* 2014).

IPLCs can use measures of impact and dependence to track environmental change and leverage their knowledge of local ecosystems, given appropriate investments in infrastructure. By using measures at operational level, IPLCs can contribute, under free, prior and informed consent, to data collection, processing and storage and to biodiversity monitoring to help track real-time ecosystem changes and ensure that businesses protect biodiversity (Alessa *et al.,* 2016; Brofeldt *et al.,* 2018; Natcher & Brunet, 2020; Schmeller *et al.,* 2017; Wilder *et al.,* 2016). IPLCs can use such documentation to create databases and archives on Indigenous and local knowledge to safeguard their environmental and cultural heritage and share it for future generations (Powell, 2016). Indigenous and local knowledge systems include Indigenous sciences and technologies that often offer innovative and adaptive strategies that are finely tuned with the local environment (Sharma *et al.,* 2009; Stigter *et al.,* 2005).

Access to Earth observation technologies via remote-sensing or direct-contact tools can help IPLCs monitor land use changes and business activities affecting biodiversity in their territories (Maynard *et al.,* 2010; Woodley *et al.,* 2013). This data can be important for advocating for the protection of territories if they are suffering negative impacts, but also to flag positive impacts that management practices may have, especially with increasing interest in the traceability of products for more transparent sustainability disclosures (Giuliani *et al.,* 2021; Sangha *et al.,* 2019). It will thereby promote accountability and support more responsible sourcing of materials in the supply chain of businesses (e.g., commercial logging, agri-business, energy and mining activities).

Access to technological tools can also help IPLCs conduct environmental impact assessments of business activities in their territories and participate in analyzing risks and opportunities (Álvarez *et al.,* 2015; Toth *et al.,* 2021; Al-Roubaie, 2010; Jokhu & Kutay, 2020). For this, there is a need to build or improve infrastructure that supports the use of technological tools by IPLCs, i.e., ensuring reliable energy, such as small-scale renewable energy sources, to operate equipment in remote areas or expand internet coverage to IPLCs' territories to facilitate data leveraging and communication (Budka, 2015; Nakamura & Chow-White, 2013; O'Donnell & Beaton, 2018).

Mechanisms of know-how and technology transfer that focus on long-term cooperations, e.g., the Bio-Bridge Initiative, established at the 12th meeting of the Conference of the Parties to the Convention on Biological Diversity, are also essential to assist IPLCs identify specialized knowledge and biodiversity-related technologies and facilitate their transfer.

6.3.4.2 Standardization, metrics, and accounting frameworks

Standardized metrics and protocols are needed in gathering data for reliability and usability. Biodiversity data can be linked with national economic accounts for mainstreaming biodiversity into economic planning and monitoring processes (King *et al.,* 2021). The Ecosystem Accounting framework of the System of Environmental-Economic Accounting was adopted in March 2021 by the United Nations Statistical Commission as a statistical standard in biophysical accounts and as a recommendation in monetary accounts (Kervinio *et al.,* 2023). These accounting systems can support measuring progress towards the goals and targets of the Kunming-Montreal Global Biodiversity Framework.

Standard-setting bodies can develop accounting methods for measuring business value beyond profit valuation and financial materiality assessment to prevent greenwashing. As an example, the European Financial Advisory Group on behalf of the European Commission published the draft European Sustainability Reporting Standards, including the E4 reporting standard on biodiversity and ecosystems (EFRAG, 2022). The Global Reporting Initiative also promotes corporate accountability through the Biodiversity Standard GRI 101 to help organizations better understand how their decisions and business practices lead to biodiversity loss throughout their operations and value chains and provides support to comprehensively disclosing and managing their impacts (GRI, 2024).

6.3.4.3 Decision support tools and repositories

Governments and civil society can provide reliable and robust biodiversity data to be utilized by businesses and financial institutions to assess dependencies and impacts on biodiversity. For example, decision support tools (like the biodiversity forecasting toolkit) and science outputs to support the integration of the best available science into the development and implementation of policies and programs have been implemented by the New South Wales Government in Australia and are routinely used by a range of industry and community users and decision makers (Drielsma *et al.,* 2014). Another example is Malaysia's one-stop repository database system, MyBIS, that provides and facilitates access to information

on biodiversity studies and management in Malaysia (Qamruddin *et al.,* 2023).

There is also great potential to co-develop tools with communities to ensure actionability and effectiveness (Mc Cartney *et al.,* 2023). However, if the documentation turns Indigenous and local knowledge into new innovations owned by those who learned from IPLCs, it will be extractive and will not secure this knowledge for future generations. It is important that research and documentation processes respect the full and effective participation of IPLCs and the appropriate rights for intellectual property (Karmushu, 2024).

6.3.4.4 Innovation in modelling

Central banks and financial supervisors that have conducted assessments of nature-related financial risks can foster dialogue between businesses and financial institutions on the limitations of dominant modelling frameworks and encourage the development of alternative modelling approaches. The most often used economic models in assessments of nature-related financial risks – computable general equilibrium models – tend to downplay the economic impacts of biodiversity loss due to a number of assumptions and constraints, including the fact that they are not suited for short-term assessments, that they assume a return to equilibrium, and that nature is fully or partially substitutable with manufactured capital (NGFS, 2023b). Another reason the economic impacts from biodiversity loss are underestimated is the fact that the interactions between climate change and biodiversity are rarely considered in such modelling exercises.

A plurality of modelling approaches, including input-output modelling and ecological stock-flow consistent modelling, being used by the financial system would ensure that not only the long-term equilibrium macro financial impacts of biodiversity loss are assessed but also their short-term aftermath (Kedward & Poupard, 2024). These approaches could support businesses in understanding their impacts and dependencies on biodiversity.

6.3.5 Capacity and knowledge

6.3.5.1 Training, education and capacity-building

Governments can provide training and education programmes for sharing biodiversity-related information and building capacity in managing and using biodiversity data in business operations and practices. Many companies currently rely on external consulting organizations for environmental impact assessments and biodiversity monitoring techniques and training (Stephenson *et al.,* 2022), but this can be costly. Czett *et al.* (2024) and Kopnina *et al.* (2024) emphasize the role of government for capacity-building efforts in conservation, stressing the importance of education, public awareness campaigns and community outreach programmes to help society understand the interconnectedness of environmental and social issues and foster a conservation ethic that promotes sustainable living. This role also ensures business' capacity in handling biodiversity-related issues. For example, to improve the productivity and sustainability of the agricultural sector, the Kenyan government, through the Agricultural Sector Development Support Programme in collaboration with international donors and local organizations, includes capacity-building components such as training farmers in modern agricultural practices, providing technical assistance, and supporting the development of agricultural cooperatives (Czett *et al.,* 2024).

International financial institutions can provide capacity-building and technical assistance, working with governments to develop regulatory frameworks that require businesses to incorporate biodiversity and nature-related metrics into their operations. International financial institutions can enhance the capacities of companies in biodiversity conservation efforts and accounting by providing targeted loans or grants for companies committed to biodiversity conservation or restoration, and they can mainstream biodiversity by promoting natural capital accounting in national and corporate accounts (World Bank - IEG, 2024). Public development banks can support capacity by promoting the mainstreaming of biodiversity, for example by developing ambitious institutional commitments for nature-positive investments (WWF & The Biodiversity Consultancy, 2021).

Civil society plays a key role in educating consumers on the implications of their purchasing decisions. This action involves providing information on how products or services contribute to or mitigate biodiversity loss, empowering consumers to support businesses with positive environmental practices. For example, civil society organizations are instrumental in promoting sustainable agricultural practices. They provide training and capacity-building opportunities to farmers, empowering them with the knowledge and skills needed to adopt sustainable practices. These training programmes often focus on organic farming, agroforestry, integrated pest management and conservation agriculture, which promote ecologically sound farming methods while maintaining or improving crop yields (Anuga *et al.,* 2020; Davila *et al.,* 2024).

To bridge the gap between traditional knowledge and modern tools, it is essential to establish programs that provide IPLCs with access to technology and expertise to use tools for measuring biodiversity and assessing business impacts. For example, training in data collection,

analysis, and the use of relevant software and hardware can equip community members with the skills to monitor and manage natural resources on their territories effectively (Toth *et al.,* 2021; Al-Roubaie, 2010; Jokhu & Kutay, 2020). Building capacity can facilitate the use of new technology and tools by IPLCs to measure business impacts and dependencies on biodiversity. It can also support opportunities for businesses to broaden their capacity-building programs to include diverse values and cultural competencies by collaborating with IPLCs. Additionally, businesses and educational institutions can create spaces for the inclusion of diverse values and cultural competencies in mainstream education and development programs (Suarta *et al.,* 2022). These programmes can also ensure that youth are involved in decision-making spaces and that knowledge transfer between generations is facilitated through schooling processes that respect and incorporate land-based learning with elders, thus preserving biocultural heritage (Fernández-Llamazares *et al.,* 2021; Sarigumba *et al.,* 2023).

6.3.5.2 Stakeholder engagement and mutual learning

Civil society possesses valuable networks and expertise in engaging IPLCs, supporting their knowledge-based land management approaches, and ensuring that their voices are heard in business decision-making processes related to biodiversity conservation. Civil society can also promote other stakeholder engagement, including government, non-governmental organizations and academia, allowing businesses to gather diverse perspectives. By facilitating dialogues between businesses and these stakeholders, they can ensure that the interests and concerns of all parties are considered in the decision-making process. This engagement is key to the success of actions on the ground, including, for example, the promotion of sustainable agriculture by improving productive practices and planning for and implementing ecosystem restoration projects (Blesia *et al.,* 2021; Murphy & Arenas, 2010).

IPLCs are vital actors when considering building capacity on intercultural competencies, and businesses can benefit from involving these communities in their training programmes (Jonas *et al.,* 2014). To enable such collaborative actions between communities and businesses around capacity-building, it is critical to support the knowledge of place-based biodiversity within IPLCs' traditional systems, particularly considering the challenges to the continuity and dynamism of these systems (Fernández-Llamazares *et al.,* 2021).

Understanding, respecting and learning from the world views and values of IPLCs can help scaling up successful stories of biodiversity conservation in IPLCs' territories (Carling, 2024). For example, after years of council and open-house meetings with Indigenous and non-indigenous participants and learning of each other's practices, the Tla-o-qui-aht First Nation, in Canada reached an official protocol agreement with a local salmon farm business to create a harmonized operational environment using an approach that respects the community's guiding principle of *Hishuk ish ts'awalk* (Huemer, 2017). In the protocol, the business model is based on practices that are considered sustainable by both the First Nation and the company, and the Tla-o-qui-aht People engage in regular meetings and have a say in future development.

Respect is essential as a basis for mutual learning, and it is important to guarantee that this exchange does not place undue burden on IPLCs or lead to the appropriation of their knowledge. True mutual learning fosters collaboration based on equal partnership, where both parties contribute and learn from one another, while ensuring that IPLCs' knowledge remains protected and used in accordance with their wishes and customary law (Jonas *et al.,* 2014).

6.3.5.3 Knowledge retention, empowerment and rights

Traditional knowledge systems are increasingly threatened by external forces such as land encroachment, resource exploitation and the erosion of cultural heritage. Therefore, it is important to establish education and empowerment programs that raise awareness of Indigenous rights, and also other applicable rights of local communities, enable informed decision-making, and promote active participation in business and conservation activities (Williams, 2018; Zanotti & Chernela, 2008). Such approaches can lead to better business decisions, for example in Botswana, a country that experiences frequent unplanned fires, a community inclusive fire management strategy has been developed that focuses on fire prevention (Dube, 2013).

It is crucial to emphasize that rather than 'capacity-building' in the traditional sense of teaching new skills and values, the focus should be on empowering these communities to retain and strengthen their own knowledge systems and governance structures. The term 'capacity-building' is often misused when referring to IPLCs. The communities already possess significant capacity, rooted in their deep understanding of local ecosystems, biodiversity, and sustainable practices. Support is required to maintain, protect and further develop this capacity, especially in the face of the ongoing external pressures.

As seen in the example of a community in Kenya, Indigenous elders without formal education were able to establish a renowned and successful lodge, demonstrating not only their business acumen but also their ability to use traditional knowledge in a modern context (Karmushu,

2024). The community made strategic decisions, including hiring external expertise when needed, yet they retained control over the development and governance of the lodge. This case illustrates that capacity-building in business management can be also strongly linked with empowering communities to manage resources on their lands.

6.4 BARRIERS TO ACTION

Significant barriers towards an enabling environment for businesses include, but are not limited to, misalignment of objectives between actors, short-termism, siloed or ineffective governance, lack of political priority for biodiversity, power asymmetry between actors, lack of recognition of Indigenous rights and other rights of local communities, limited technical and financial resources, and uneven exposure to nature-related financial risks, which are detailed below. Addressing these barriers will be key for creating an enabling environment and enacting transformative change.

6.4.1 Misalignment of objectives between actors

Cross-sector partnerships are institutional arrangements designed to integrate complementary competencies and resources across businesses, civil society and governments (Austin & Seitanidi, 2012, 2012). While cross-sector partnerships are increasingly recognized as essential for addressing global economic, social and environmental issues, inconsistencies across these arrangements create barriers to their effectiveness (Nicholls & Huybrechts, 2016; Saz-Carranza & Longo, 2012; Vogel *et al.,* 2022; Vurro, & Dacin, 2014). Business and civil society partnerships have become increasingly common as organizations seek to address complex societal issues that require collaborative efforts (A. C. F. Aguiar *et al.,* 2023). These partnerships combine the resources, expertise and influence of the private sector with the grassroots reach and social mission of civil society organizations. However, despite their potential, these collaborations often face significant challenges that can impede their effectiveness.

Business and civil society partnerships can face challenges due to their differing objectives regarding economic profits (Addy & Dubé, 2018; Ahmadsimab & Chowdhury, 2021; Yin & Jamali, 2021). This misalignment can hinder collaboration and compromise the effectiveness of solutions. Businesses typically operate with the primary goal of maximizing economic profits. This profit-driven motive influences their decision-making processes, strategic planning and resource allocation. On the other hand, civil society organizations are usually mission-driven, focusing on social, environmental or humanitarian goals. Their primary objective is to create a positive social impact, often prioritizing long-term sustainability and community well-being over immediate financial returns. This misalignment of objectives between businesses and civil society organizations can create several obstacles to effective collaboration, such as:

- Conflicting priorities: businesses may prioritize projects that promise short-term financial returns, while civil society organizations may focus on initiatives that yield long-term social benefits. This divergence can lead to disagreements over which projects to pursue and how to allocate resources.
- Different resource allocation: businesses may have substantial financial resources but could be less willing to invest in initiatives that do not directly contribute to their bottom line. Conversely, civil society organizations might struggle with limited funding and rely heavily on partnerships to advance their mission. This disparity can cause friction in determining the scale and scope of collaborative efforts.
- Different decision-making processes: the decision-making frameworks in businesses and civil society organizations often differ. Businesses may employ hierarchical, top-down approaches, while civil society organizations favour participatory, consensus-driven processes. These differing approaches can slow decision-making and hinder implementation of joint initiatives.
- Lack of common performance metrics: businesses often measure success through financial indicators such as revenue growth, profit margins, and return on investment. Civil society organizations, however, assess their impact through social metrics like community engagement, environmental sustainability and public health improvements. The lack of common performance metrics can make evaluating the overall success of any potential partnerships between business and civil society difficult.

6.4.2 Short-termism

Politicians and policymakers often face pressure to deliver quick results and show immediate progress to gain public support or meet short-term political goals (Böhme, 2023). This can result in policies and decisions that prioritize short-term benefits over long-term considerations, which may create uncertainty for businesses and hinder long-term planning and investment in sustainable practices and technologies (Paulson Jr., 2015). Short-term thinking often neglects the importance of biodiversity conservation, which

can then have severe consequences for biodiversity and nature's contributions to people.

Investments needed to protect and restore biodiversity are typically long-term and provide low or no returns in the short-term. Such investments do not therefore lend themselves to private investments (Kedward, zu Ermgassen, *et al.,* 2023). An additional challenge is the lack of investable, scalable nature recovery projects; there is not a similarly straightforward and scalable investment strategy as there is for investing in renewable energy as part of climate mitigation efforts, for example. Against this backdrop, and due to the fact that many environmental 'externalities' remain largely unpriced (S&P Global, 2024), the ways in which private actors can naturally seek to generate returns to protect an ecosystem can lead to environmentally and socially suboptimal outcomes. For instance, private businesses and financial institutions may be tempted to generate rents to protect ecosystems (e.g., charging high fees to local communities or tourists for protecting an area) (Stratford, 2020). Moreover, depending on external variables such as the regulatory environment, private actors may still find it more efficient to deplete an ecosystem than protect it (for instance, based on standard economic theory, if interest rates are high, it may be more profitable to deplete a resource and place the returns in financial products with high interest rates).

6.4.3 Siloed or ineffective governance

Political instability around existing legislation, including governmental bureaucratic hurdles have been reported to be a challenge especially at the local level. Government initiatives are important to promote biodiversity actions, and some countries have designed and implemented policies that seek to regulate the environmental performance of the private sector (D. Aguiar *et al.,* 2023).

Incoherent governmental actions exist, such as biodiversity-harmful incentives like pesticide, fertilizer and energy subsidies (e.g., for fossil fuels) (OECD, 2022) and when considering conflicting interests of multiple sectors, biodiversity is often accorded low priority (Pröbstl *et al.,* 2023). Transformative national planning needs to overcome institutional lock-ins and empower agencies to develop innovative solutions to halt and reverse the loss of biodiversity and achieve the goals and targets of the Kunming-Montreal Global Biodiversity Framework (Pröbstl *et al.,* 2023). Accountable governance requires leadership and social capital to organize an actor network in cooperative and complementary governance functions (Pröbstl *et al.,* 2023).

6.4.4 Lack of political priority for biodiversity

According to Rydén *et al.* (2020), the electorate may have diverse and sometimes conflicting priorities when it comes to policy issues, including biodiversity conservation. They recognize that while democracy provides opportunities for citizen involvement and participation in decision-making, it can also lead to short-term focus and conflicting priorities that may hinder long-term conservation goals. In combination, political short-termism and inconsistent demands from the electorate may give rise to nationalism and a move away from multilateralism.

While coordinating with governments could make it easier for businesses to shape corporate and financial behaviours toward greener outcomes, this could also lead to trade-offs between the primary mandates of price and financial stability and the goal of enabling an ecological transition over the medium term (Dafermos, 2021; Maurin *et al.,* 2022; Oman *et al.,* 2024). Moreover, actions may be more difficult to implement in developing countries, given the hierarchical nature of the international monetary and financial system. Indeed, the latter is characterized by a hierarchy of currencies, dominated by currencies from high-income countries, which makes it difficult for developing economies to attract the long-term funding they need to finance their ecological transition (Svartzman *et al.,* 2023; Svartzman & Althouse, 2022), while often forcing them to resort to short-term, export-led strategies based on agricultural commodities and natural resources (Vernengo, 2016).

6.4.5 Power asymmetry between actors

There is disparity between corporate and environmental lobbying efforts and the sophisticated tactics used to shape legislative outcomes, as evidenced in the climate change legislation lobbying in several jurisdictions. Brulle (2018) concluded that lobbying involves various tactics beyond direct efforts, including funding think tanks and public relations campaigns, influencing decision-makers' perceptions and the political environment, where over $2 billion was spent on climate change lobbying in the United States of America Congress, making up 3.9 per cent of total lobbying expenditure from 2000 to 2016. Although this is the case, studies have also concluded that environmental lobbying is more effective in countries with higher levels of corruption, and that support for environmental lobby groups in such countries may be particularly effective (Fredriksson *et al.,* 2007).

There is significant evidence that private businesses and financial institutions can use lobbying strategies to block

transformative change (Folke *et al.,* 2019; Lucas, 2021; 'UN Plastics Treaty', 2024; Virdin *et al.,* 2021). This was also evidenced in the exclusion of financial actors from the European Union Corporate Sustainability Due Diligence Directive and Deforestation Regulation (EIRIS Foundation, 2024). This barrier can be overcome, for example by, mandating the disclosure of lobbying activities by corporates and financial actors and empowering and funding civil society and investigative journalism. In addition, vague and unsubstantiated claims of transformation may fail to deliver clear positive outcomes or may delay and distract from more tangible actions to mitigate corporate footprints (Booth *et al.,* 2024). Recommendations or standards are needed on how companies' actions can be structured and prioritized to promote integrity and innovation with SMART targets (i.e., specific, measurable, assignable, realistic and time-bound), while effectively preventing greenwashing (Booth *et al.,* 2024).

While partnerships between civil society and businesses have the potential to address complex social and environmental issues, the inherent differences in economic scale and resource availability can create imbalances that undermine the effectiveness and sustainability of these collaborations. This asymmetry could include:

- Economic scale differences: one of the primary sources of power asymmetry is the disparity in economic scales between civil society organizations and businesses. Businesses typically have access to substantially larger financial resources, which they can leverage to influence the direction and outcomes of collaborative efforts. This financial dominance can lead to civil society organizations becoming dependent on business funding, which can affect their autonomy and ability to act independently (Gray *et al.,* 2022).

- Funding dynamics and dependency: funding from businesses to civil society organizations is often crucial for the latter's operations. However, this financial dependency can create a power dynamic where businesses carry considerable influence over the activities and priorities of civil society organizations. Such funding relationships can erode the partnership's foundation, as the more powerful business entities may impose their agendas, potentially sidelining the original mission and values of the civil society organizations (Al-Tabbaa *et al.,* 2014; Ashraf *et al.,* 2017).

- Undermining collaborative processes: the imbalance in resources and influence can significantly undermine the process. When one party holds a disproportionate amount of power, the partnership risks becoming unidirectional, where the business sector's priorities overshadow the goals of civil society. This can lead to a misalignment of objectives, where the initiatives pursued may not fully address the issues at hand or reflect the needs and perspectives of the communities that civil society organizations represent (Gray *et al.,* 2022).

- Impact on shared goals: power asymmetry makes achieving shared goals challenging. The success of collaborative efforts hinges on equal participation and mutual respect between partners. When civil society organizations are not equally empowered, their contributions may be undervalued, leading to less innovative and effective solutions. This imbalance can also foster mistrust and reduce the willingness of civil society organizations to engage in future collaborations, further diminishing the potential for long-term positive impacts (Gray *et al.,* 2022)

While the differing objectives and power asymmetry among businesses and civil society organizations pose significant challenges to partnerships, these obstacles are not insurmountable. Businesses and civil society organizations can create effective collaborations that leverage their unique strengths by adopting strategies that promote alignment and mutual understanding. Investing in the development of clear institutional arrangements for partnerships between civil society organizations and businesses is one way to address these barriers to action. This involves establishing common goals and collective performance metrics, ensuring decision-making processes that recognize sectoral differences in motivators and practices, and mitigating the risks that these differences pose to collaboration. These institutional arrangements are best documented in an action plan to guide collaboration, promote transparency and ensure mutual accountability.

6.4.6 Lack of recognition of Indigenous rights, and other applicable rights of local communities

Governments and legal systems often inadequately recognize custodianship over traditional lands and resources due to a lack of recognition of rights, which undermines their ability to use measures of business impact and dependence related to their communities (Stevens *et al.,* 2016). Additionally, IPLCs are frequently neglected in the development and implementation of national legislation and policies on business activities, leading to insufficient safeguarding of rights and interests, perpetuating systemic disparities and hindering IPLCs' representation in decision-making procedures (Girard *et al.,* 2022). Businesses operating within IPLCs' territories and in regions with fragile legal structures for Indigenous rights, and other applicable rights of local communities, might encounter legal ambiguity and contribute to land conflicts and environmental degradation, which can adversely affect their

social legitimacy to operate, risking reputational damage and long-term sustainability objectives (Franks *et al.,* 2014). Implementing equitable governance mechanisms based on equal partnership or primary control for IPLCs, i.e., recognizing and respecting all relevant actors' knowledge and diverse values, rights to ancestral territories, and cultural practices as well as ensuring full and effective participation in decision-making, will likely enhance positive ecological and social outcomes (Dawson *et al.,* 2024).

Limited documentation of territories, land and water that belong to IPLCs can create significant challenges for biodiversity conservation and sustainable development efforts by businesses. The absence of documentation can make it difficult for IPLCs to assert their rights and negotiate with external stakeholders like businesses (Sajeva *et al.,* 2019) as the systems in place often do not enable other forms of knowledge transmission, such as oral tradition, to be valid (Anderson *et al.,* 2022). Additionally, businesses that depend on these resources may face uncertainties and interruptions in their value chains, adversely affecting their operations. Beyond documentation, Indigenous stewardship is important, so that any documentation in place follows free, prior and informed consent principles for sharing and accessing Indigenous knowledge (IPBES, 2024b). Supporting the strengthening and creation of knowledge centres owned and managed by Indigenous communities can enhance the preservation of traditional knowledge through songs, language, stories and traditions, while also contributing to the wider global community (Pilot, 2005).

When measuring impacts and dependencies, the exclusion of IPLCs from research and development can slow down the progress towards creating appropriate solutions for biodiversity conservation and sustainable development (Powell, 2016). IPLCs have a deep understanding of local ecosystems that can inform decision-making based on evidence and enhance the effectiveness of conservation efforts, as learning by doing and practicing has been the best traditional knowledge transfer system within IPLCs (Karmushu, 2024). Businesses and research institutions can benefit from addressing and working with Indigenous and local knowledge, prioritizing IPLC-led research initiatives and meaningful participation of IPLCs in research agendas and projects. By doing so, this can ensure more inclusive and culturally sensitive approaches to environmental management.

6.4.7 Limited technical and financial resources

Karlsson-Vinkhuyzen *et al.* (2018) reported a lack of technical knowledge, time and financial resources as barriers to mainstreaming biodiversity into economic sectors that have significant impacts on biodiversity, especially the agriculture, forestry and fisheries sectors. Many studies describe the different biodiversity policies in place, however, only a few studies examined policy instruments and performance using measures of dependence and impact on biodiversity to promote and evaluate business actions and performance. When they do, this is restricted to just a few industries, such as agriculture, forestry and fisheries.

IPLCs often face financial constraints and lack opportunities to preserve, perpetuate and develop their systems of knowledge transmission. Businesses can financially support communities to implement sustainable development initiatives and biocultural conservation efforts. These investments will enable IPLCs and businesses to collectively invest in ecosystem restoration and adapt to the impacts of climate change (Bruhn & Love, 2014; Swiderska & Argumedo, 2022). Limited access to services in remote areas creates major barriers for IPLCs, particularly in remote areas where delivering financial services is logistically complex (Gilroy *et al.,* 2021). The absence of supportive legal and policy frameworks further constrains the entry of alternative insurance providers, while businesses often cannot use community-oriented insurance models. Designing insurance products that align with IPLCs' cultural and social norms is essential for their acceptance and effectiveness (Van Gevelt *et al.,* 2017). The insurance industry can develop tailored products, such as micro-insurance or social insurance models, to mitigate risks associated with IPLCs' unique contexts. These products could cover healthcare, crop failures, natural disasters, or unexpected personal expenses, helping IPLCs manage immediate risks without resorting to land sales or exploitation of protected areas. Addressing this gap requires an integrated approach that considers the socio-economic, environmental, and political dimensions of IPLCs' vulnerability (Van Gevelt *et al.,* 2017).

6.4.8 Uneven exposure to nature-related financial risks

While the argument that climate change and biodiversity loss pose 'systematic portfolio risks' (Bauer, 2022) to highly diversified financial actors is becoming increasingly popular, it is important to remember that there are notable differences between the risks that environmental degradation poses to societies, economies, individual financial actors, and financial stability at large. Exposure to nature-related financial risks is unevenly distributed (Prodani *et al.,* 2025), and this constitutes an important barrier to action. The portfolios of the biggest three asset managers, for example, are increasingly invested in large companies in the technology and financial sectors in the global North, not in primary producers in the global South

(Bonizzi & Kaltenbrunner, 2024; Gibadullina, 2024; Prodani *et al.,* 2025).

In some cases, organizations may wait for the nature-related risks or shocks to materialize and then take reactive action (BCBS, 2023; EBA, 2024). A fundamental complication here is that, like with climate, large uncertainties exist about future physical developments, like tipping points, and their interactions and potential cascading effects (Marsden *et al.,* 2024). Economic models are ill-equipped to take such effects into account (Maurin *et al.,* 2022; Trust *et al.,* 2023). Given the radical uncertainty and significant potential harm associated with nature-related risks, a more precautionary approach may be necessary, which involves working proactively and acting with incomplete information. The constitutional basis of the European Union is supportive of this course of action, with Article 191(2) of the Treaty of Lisbon stating: "It [EU policy on the environment] shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay". This precautionary principle is not broadly implemented to protect biodiversity, especially by those who guard prices and financial stability (Kedward *et al.,* 2020). A precautionary approach, however, can be legally contested on the basis that interventions in the market must be tied to robust evidence. Increasingly, emerging 'alignment-based' approaches (Van 'T Klooster & Prodani, 2025) focused on transition planning promise to chart a middle path between a precautionary approach and the dominant approach that requires precise quantifications of the probability of losses.

In addition, decision-making at the microeconomic scale does not naturally lead to the common good at a broader scale. For example, a sound risk assessment conducted by a private insurance company indicating that a region is particularly vulnerable to physical hazards could lead the company to stop insuring activities and businesses in this region or increase the cost of insurance; while this would be an efficient decision at the microeconomic level, it would leave the region even more exposed to the costs of physical hazards at the macroeconomic level (Bolton *et al.,* 2020; Dafermos, 2021; EIOPA, 2023). This underscores the limitations of self-regulation and regulation based on risk disclosure alone and the need for regulations that protect the public interest and promote an allocation of capital in line with environmental policies.

6.5 KNOWLEDGE GAPS

A set of knowledge gaps in knowledge and data can be identified from the assessment of the evidence associated to the creation of an enabling environment for businesses by diverse actors. A summary of these gaps is presented in **Table 6.3**.

Table 6 3 **Knowledge gaps.**

Category	Chapter/ section	Knowledge gap
Knowledge and data	6	Data from remote sensing tools and technology for monitoring land use change and business activities affecting biodiversity.
Methods and approaches	6.3	Approaches within environmental impact assessments to incorporate traditional knowledge.
Knowledge and data	3	Knowledge among the business community of the diverse contexts and specific characteristics of various IPLCs. This includes not only their distinct cultural, ecological, and historical aspects, but also their unique livelihoods, worldviews, and traditional practices.
Knowledge and data	6.2.2	Knowledge, data and documentation on Indigenous rights, and other applicable rights of local communities and knowledge on benefits arising from using genetic resources, under free, prior and informed consent, including traditional knowledge associated with genetic resources in some regions globally.
Policy-relevant studies	6.3	Studies of species that are important to IPLCs including plants, animals and materials integral to IPLCs cultural practices, under free, prior and informed consent.
Knowledge and data	6.4	Independent studies on the effectiveness of certification programs, and barriers to distribution of benefits to local communities.

Table 6 3

Category	Chapter/ section	Knowledge gap
Knowledge and data	6.4	Studies on the environmental outcomes achieved by changing human behaviour, especially consumer choice on improving biodiversity.
Policy-relevant studies	6.3	Studies on case studies of national policies that enable closer partnership for collaboration between civil society and businesses.
Policy-relevant studies	6.2.1	Studies on the role of the financial system to go beyond financing which reduces greenhouse gas emissions and addresses evidence on the efficacy of shifting financial flows away from industries that harm biodiversity and which consider how investments drive biodiversity degradation.
Knowledge and data	6.2.2	Time-series data over sufficiently long periods to show the effect of changes to monetary policy and climate or biodiversity related outcomes across national and sub-national economies.
Knowledge and data	6.3	Studies on the attitudes towards blended finance.
Policy-relevant studies	6.3	Studies which examine biodiversity policies based on evidence using measures of dependence and impact to biodiversity to promote and evaluate business actions and performance.
Policy-relevant studies	6.3	Studies about economic and financial instruments based on evidence using measures of dependence and impact to biodiversity which go beyond well-studied industries such as agriculture, forestry, and fisheries.

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ANNEXES

Annex I - **Glossary**

Annex II - **Acronyms**

Annex III - **List of authors and review editors**

Annex IV - **List of expert reviewers**

ANNEX I
Glossary

A

Accounting: Accounting is a set of practices that (primarily) focuses on the systematic recording, classifying and summarizing of organizational events in financial terms. The purpose of accounting is focused both internally (to support decision-making) and externally (to ensure accountability is discharged). While financial events are at the historical core of accounting, inclusion of social and environmental matters has become more prevalent, shaped by the wider policy governance contexts and accountability regimes in which they are developed and used (Bebbington *et al.*, 2021). Embedded into conventional accounting is a worldview that does not have nature within its foundations, but this is changing over time (Feger & Mermet, 2021). Accounting at the organizational level should also be seen in the context of national level accounting and ecosystem management approaches (in this respect, see also «national natural capital accounting » and «business biodiversity accounting» in this glossary).

Asset manager: An asset manager or an asset management company is a firm that invests a pooled fund of capital on behalf of its clients (Park, 2025).

Avoidance: The first step in the mitigation hierarchy and refers to measures taken to anticipate and avoid creating impacts from the outset. Measures include: careful spatial or temporal placement of elements of infrastructure to prevent adverse impacts on any component of biodiversity (BBOP, 2012a; IPIECA, 2015). See also mitigation hierarchy.

B

Baseline: A minimum or starting point with which to compare other information (e.g. for comparisons between past and present or before and after an intervention) (IPBES, n.d.).

Blended finance: The combination of catalytic capital from public or philanthropic sources with private sector investment to increase the availability of funds for sustainable development.

Biodiversity: The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and freshwater ecosystems, and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species, and ecosystems (CBD, 2011).

Biodiversity credits: Averifiable, quantifiable and tradeable financial instrument that rewards positive nature and biodiversity outcomes (e.g. species, ecosystems and natural habitats) through the creation and sale of either land or ocean-based biodiversity units over a fixed period (WEF, 2025).

Biodiversity enterprise: Also called a biodiversity business is a commercial enterprise that generates profits via activities which conserve biodiversity, use biological resources sustainably, and share the benefits arising from this use equitably (Bishop *et al.*, 2008).

Biodiversity mainstreaming: Integrating or including actions related to conservation and sustainable use of biodiversity at every stage of the policy, plan, programme and project cycle, regardless of whether international organizations, businesses or governments lead the process (CBD, 2019).

Biodiversity offset: The last step in the mitigation hierarchy. Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development, after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure and ecosystem function and people's use and cultural values associated with biodiversity (IUCN, 2016). See also mitigation hierarchy (Business and Biodiversity Offsets Programme (BBOP, 2012b).

Bioeconomy: The bioeconomy is the production, utilization, conservation, and regeneration of biological resources, including related knowledge, science, technology, and innovation, to provide sustainable solutions (information, products, processes and services) within and across all economic sectors and enable a transformation to a sustainable economy (IACGB, n.d.).

Business: An entity that is voluntarily involved in the production, exchange and distribution of goods or services that are sold for currency (Donaldson & Walsh, 2015).

Business-as-usual: Typically refers to a baseline scenario or reference trajectory in which current trends continue without significant structural change, intervention, or disruption. It represents a counterfactual "what if nothing new is done" path against which alternative (policy, mitigation, transformation) scenarios can be compared (Fei & Shuang-Qing, 2012).

Business biodiversity accounting: Refers to the diversity of approaches that seek to systematically identify, record, frame, organize, track over time and value business impacts and dependencies on biodiversity (in monetary or non-monetary terms). These approaches allow these metrics and values to be integrated with existing business management accounting and (non)financial accounting systems. Business biodiversity accounting supports key organizational and corporate governance functions, which ultimately command business interactions with nature and other concerned stakeholders. (Bebbington *et al.*, 2021; Blanco-Zaitegi *et al.*, 2022; Duncan, 1909; Feger *et al.*, 2019; Feger & Mermet, 2021; Houdet & Teren, 2022).

Business model: Conceptual tools that describe the principles by which an organization creates, delivers, and

captures value, and expresses a company's fundamental business logic by which it generates profitable and sustainable revenue streams (Osterwalder & Pigneur, 2010). Sustainable business models "help describing, analyzing, managing and communicating (a) a company's sustainable value proposition to its customers, and all other stakeholders, (b) how it creates and delivers this value, (c) how it captures economic value while maintaining or regenerating natural, social and economic capital beyond its organizational boundaries" (Schaltegger *et al.*, 2016).

C

Central banks: Public institutions that manage through their monetary policy the currency of a country or group of countries to preserve price stability and, depending on their specific mandate, to pursue secondary objectives like employment (ECB, 2015).

Circular economy: A regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling (Geissdoerfer *et al.*, 2017).

Civil society: Encompassing a broad spectrum of actors beyond formal organizations, such as grassroots community groups, indigenous peoples, local stakeholders, and concerned citizens. These actors often possess invaluable traditional and local knowledge about ecosystems and biodiversity, essential for effective conservation and management efforts. This chapter adopts the following definition: "Civil society is broader than the institutionally recognized organizations, unions, associations, and other pressure groups. It considers citizens as historical subjects capable of understanding and changing the world around them instead of being passive recipients of a ready-made ideology. The Internet and other new information and communication technologies facilitate the rise of self-organized, leaderless movements, allowing a rapid and efficient mobilization of citizens" (WEF, 2018).

D

Dependency: A dependency arises when organizations rely upon, or are affected or constrained by, nature's contributions including ecosystem products and services (Natural Capital Coalition, 2016; NCFA & WCMC, 2018).

Divestment: Generally, refers to the act of selling securities (e.g., shares, bonds etc.) held by an investor in its portfolio. Investors may decide to no longer hold shares in firms from specific industries for ethical reasons and to effect social change (Institute for Sustainable Finance, 2025).

Due diligence: A process of verification, investigation, or audit of a potential deal or investment opportunity to confirm all relevant facts and financial information (CFI, 2025a).

E

Ecosystem services: The benefits that people obtain from ecosystems (Millennium Ecosystem Assessment, 2003).

Ecosystem restoration: "Any intentional activity that initiates or accelerates the recovery of an ecosystem from a degraded state" (IPBES, 2018). This definition covers all forms and intensities of the degradation state and, in this sense, is inclusive of the definition adopted by the Society for Ecological Restoration.

Enabling conditions: Enabling conditions as relevant to businesses span legal and regulatory, economic and financial, norms and values, technology and data, as well as capacity and knowledge (Adapted from (IPBES, 2024).

Enabling environment: Set of conditions that facilitate action by a specific actor.

Environmental Social Governance (ESG): Set of criteria to measure an organization's societal and environmental impact to inform investment and decision-making processes to improve risk-adjusted returns.

F

Financial institution: In this assessment, financial institutions are those that provide financial goods and services to businesses and individuals in the form of loans, insurance and investments, and include, for example, banks, insurance companies, asset owners and managers, public development banks and investment funds. Financial actors include central banks, financial regulators and supervisors, and international financial institutions and standard-setting bodies which are financial institutions within the broader financial system. The financial system encompasses both financial institutions and financial actors, as well as the legal frameworks, regulations and business practices that govern financial transactions. Examples include banks, insurance companies, brokerage firms, and investment dealers (Legal Information Institute, n.d.).

Financial system: The entire set of actors and relationships that deal with the financial flows in a country or jurisdiction. Includes banks and nonbank lenders, insurers, securities markets, and investment funds. It also includes clearing counterparties, payment providers, central banks, and financial regulators and supervisors (IMF, n.d.).

Financial supervisors: Financial supervisors are public micro- and macro-prudential authorities that aim to promote financial stability and protect the customers of financial services (European Union, 2013).

Financing green: Banks and financial institutions finance projects that contribute—or intend to contribute—to the conservation, restoration, and sustainable use of biodiversity and its services to people (Blarel *et al.*, 2020).

Functional diversity: Genetic and trait differences among individuals and populations within a species.

G

Greening finance: I the context of biodiversity, it involves action undertaken by financial institutions aimed at directing financial flows away from business activities that have a negative impact on biodiversity (Blarel *et al.*, 2020).

I

Indicator: A quantitative or qualitative factor or variable that provides a simple, measurable and quantifiable characteristic or attribute responding in a known and communicable way to a changing environmental condition, to a changing ecological process or function, or to a changing element of biodiversity (IPBES, 2019).

Informal economy: Activities that create market value but that are not formally registered with the government. These activities often operate outside of the formal legal and regulatory frameworks, and may include unregistered businesses, street vendors, etc (Delechat, & Medina, 2020).

International financial institutions: Multilateral, regional, and national development banks with international operations that have been established (or chartered) by more than one country (UNDP, n.d.).

Impacts: Defined as changes in the state (quality or quantity) of biodiversity and/or nature's contributions to people. Impacts may be direct (resulting from a business's operational activities), through the value chain (resulting from a business's upstream or downstream value chain), or indirect (resulting from activities spurred by a business's actions but beyond its direct operations or value chain). Cumulative impacts arise when the consequences of a business's activities in a location and over time in combine with the impacts of other businesses and actors to have greater effects than would be expected from their individual activities occurring in isolation (Chapter 3 of this assessment).

Indigenous and local knowledge (ILK): The knowledge, practices and innovations embedded in the relationships of Indigenous Peoples and Local Communities to nature. ILK is situated in a place and social context, but at the same time open and hybrid, continuously evolving through the combination of written, oral, tacit, practical, and scientific knowledge attained from various sources, and validated by experimentation and in practice of direct interaction with nature (IPBES, 2019).

Institutional investor: A legal entity that accumulates the funds of numerous investors (which may be private investors or other legal entities) to invest in various financial instruments and profit from the process. In other words, an institutional investor is an organization that invests on behalf of its members (CFI, 2025b).

Indigenous Peoples and local communities (IPLCs): Individuals and communities who are, on the one hand, self-identified as indigenous and, on the other hand, are members of local communities that maintain inter-generational connection to place and nature through livelihood, cultural identity and worldviews, institutions and ecological knowledge (IPBES, 2019).

L

Life cycle assessment (LCA): A method that quantifies the potential environmental impacts of a product or service throughout its life cycle (ISO 14040). The life cycle spans from raw material extraction through materials processing, manufacture, distribution, use and disposal (or repurposing). Typically product LCAs are carried out in four stages: 1) Goal and scope (defining what the system and assessed function are to be), 2) life cycle inventory (collecting all in- and outputs and emissions throughout the life cycle), 3) life cycle impact assessment (quantifying the potential environmental impacts of the emissions and natural resource use, using a large number of impact categories simultaneously) and 4) interpretation.

M

Materiality: Refers to the concept of being important or material. Financial materiality refers to the issues that present monetary or asset consequences to a company. Double materiality or dual materiality, as advanced by European policy makers and regulators, incorporates a focus on impacts and risks to climate and nature as well as the business (TNFD, 2023b); societal materiality, used by the science based targets network (SBTN), emphasizes an obligation to contribute to social outcomes beyond what might be required by regulation; dynamic materiality emphasizes that material issues are dynamic and change over time (Science Based Targets Network, 2023). A distinction should also be made between potential materiality (i.e., potential to alter the decision) and actual materiality (i.e., decision made on the basis, at least partially, of that information).

Measurement: The process of determining the amounts, extent, and condition of biodiversity and associated ecosystem services, in physical terms, and associated impacts and dependencies (Natural Capital Coalition, 2016).

Method: Procedure for applying or analysing biodiversity and ecosystem service metrics and data, developed 'packages' of suggested data, approach to measurement and metrics with associated guidance (Chapter 4 of this assessment).

Minimization: The second step in the mitigation hierarchy**.** Actions taken to reduce the duration, intensity and/or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible (Business and Biodiversity Offsets Programme, 2012; IPIECA, 2015).

Mitigation hierarchy: A decision-making framework that can be applied at strategic and project levels to address negative impacts on biodiversity and nature's contributions to people. It refers to a sequence of actions taken to (a) anticipate and avoid impacts on biodiversity; (b) minimize or reduce impacts where avoidance is not possible; (c) restore or rehabilitate when impacts have occurred; and (d) compensate for or offset significant residual impacts. This concept is widely used throughout the world and is often embedded into national legislation as regards to environmental permitting. This is a common approach used in the Environmental Impact Assessments of project activities in multiple sectors (Arlidge *et al.*, 2018). The concept has been expanded to the mitigation and conservation hierarchy, explicitly going beyond addressing direct attributable impacts and to include actions and outcomes aimed at addressing impacts to include any other conservation actions and outcomes (e.g. those that improve the state of biodiversity independent of any impacts) (Arlidge *et al.*, 2018; Milner-Gulland *et al.*, 2021).

Models: Simplified representations of the relationships between key components of a system. Models are built to address a particular problem or (set of problems) about the system and can be quantitative, semi-quantitative, or qualitative. By applying generalized relationships, the current state of biodiversity and ecosystem services can be estimated at higher levels of integration and used to analyze effects of policy options. Models are constructed by deriving model parameters from a compilation of data that are field based or from expert judgement (IPBES, 2016). Models estimate are subject to several levels of uncertainty (e.g. model and parameter uncertainty).

N

Nature: The natural world with an emphasis on the diversity of living organisms (including people) and their interactions among themselves and with their environment (Díaz *et al.*, 2015).

Nature-based solutions: 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, resilience and biodiversity benefits, and recognizes that nature-based solutions (United Nations, 2022).

Natural capital: The stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people. These benefits may be cultural or economic, and can be valued in qualitative, quantitative and/or monetary terms. These benefits relate to the concept of ecosystem services, most of which are derived (to varying extents) from biodiversity. However, natural capital includes some abiotic services (e.g., the supply of minerals, metals, oil and gas, geothermal heat, wind, tides, and the annual seasons) (Natural Capital Coalition, 2016).

National natural capital accounting: Refers to integrated and standardized statistical frameworks for organizing biophysical information on ecosystems, measuring ecosystem services and assets and linking this information to measures of economic and human activity (European Commission *et al.*, 2024).

Nature's contributions to people: All the contributions, positive and negative, of nature to people's quality of life (Díaz *et al.*, 2015, 2018).

Nature-related physical risks: All physical risks to an organization that result from the degradation or loss of nature and nature's contributions to people that support economic activity (NGFS, 2023).

Nature-related transition risks: All risks to an organization that may result from its impacts on nature in the context of changes in regulation and policy, legal precedent, technology, and/or investor sentiment and consumer preferences that may cause adverse business consequences (NGFS, 2023).

Net gain: A goal for a development project, policy, plan or activity in which the impacts on biodiversity it causes are outweighed by measures taken to avoid and minimize the impacts, and to restore affected areas so that the gains exceed the loss (BBOP, n.d.).

No net loss: 'No Net Loss' is a goal for a development project, policy, plan or activity in which the impacts on biodiversity it causes are balanced or outweighed by measures taken to avoid and minimize the impacts, to restore affected areas and finally to offset the residual impacts, so that no loss remains (BBOP, n.d.).

O

Opportunities: Alternatives that open up for action. Nature-related opportunities for businesses and financial institutions can arise from both their dependencies and impacts on biodiversity and refer to activities that create positive outcomes for organizations and biodiversity through positive impacts or mitigation of negative impacts on biodiversity (TNFD, 2023b).

P

Public development banks: Legally independent and financially autonomous public financial institutions initiated by governments to pursue public policy objectives (Finance in Common, 2025).

Public goods: Goods or services for which consumption by one individual or group neither prevents nor diminishes consumption by others (e.g. they are non-rival) nor can one individual or group exclude others from benefiting or enjoying that good or services (e.g., they are non-excludable) (Costanza, 2008).

R

Risks: The potential for negative or adverse consequences for societies and ecosystems (IPCC, 2023; UNDRR, 2019). In the context of businesses, nature-related risks refer to the "potential threats posed to an organization that arise from its and wider society's dependencies and impacts on nature" (TNFD, 2023a).

Risk management: Actions, plans, strategies or policies to lower the likelihood and/or magnitude of negative or adverse consequences stemming from those identified/perceived risks (IPCC, 2023).

Restoration: Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. The goal is to achieve substantial ecosystem recovery relative to an appropriate reference model, regardless of the time required to achieve recovery. Reference models used for ecological restoration projects are informed by native ecosystems, including many traditional cultural ecosystems. Ecological restoration It is distinguished from other forms of environmental repair in seeking to assist recovery of native ecosystems and ecosystem integrity. The Society for Ecological Restoration has published best practice standards for ecological restoration (Gann *et al.*, 2019).

S

Societal decision: A decision taken by public or collective actors in relation to globally agreed goals and national contexts, including through policy, legal and regulatory frameworks.

Stakeholder engagement: An ongoing process of interaction and dialogue between an enterprise and its stakeholders that enables the enterprise to hear, understand and respond to their interests and concerns, including through collaborative approaches (UN Human Rights, 2012).

Standard setting bodies: International organizations that establish financial reporting standards are typically private sector, not-for-profit, self-regulated organizations with boards comprised mostly of experienced accountants, auditors, academics, and users of financial statements (IAASB, 2020; IMF, 2021).

Supply chains: The sequence of suppliers contributing to a final product (SustainAbility, UNEP & UNGC, 2008).

Supply chain traceability: The process of tracking the provenance and journey of products and their inputs, from the very start of the supply chain through to end-use (Norton, 2019).

T

Transformative change: A fundamental, system-wide reorganization across technological, economic and social factors, including paradigms, goals and values, needed for the conservation and sustainable use of biodiversity, long-term human wellbeing and sustainable development (O'Brien *et al.*, 2024).

Transition plan: A nature transition plan is an aspect of an organization's overall business strategy that lays out the organization's goals, targets – in a science-based approach, actions, accountability mechanisms and intended resources to respond and contribute to the transition implied by the Global Biodiversity Framework (GBF) (BfN & CDP, 2024).

V

Valuation: Formulating indicators of quantitative measures (monetary or non-monetary) and qualitative preference rankings/ratings, perceptions and Indigenous and local knowledge narratives that indicate importance of nature to people (Intergovernmental Science-Policy Platform On Biodiversity and Ecosystem Services *et al.*, 2022).

Value chain: The full range of activities, interactions, resources and relationships required to bring a product or service from conception through production, delivery, consumption, and end-of-life" (Kaplinsky & Morris, 2000). "Where a supply chain typically refers to the chain of suppliers inputting to a final product, value chain also encompasses thinking about the value created by the chain, particularly for end-use customers." (SustainAbility, UNEP & UNGC, 2008).

Value system: Value systems refer to both intrinsic value and human-centric values. We note that the terms "biodiversity", "ecosystem goods and services", and "human well-being" are mostly embedded within western science knowledge systems. This report intends to be inclusive of other knowledge systems, in particular Indigenous and local knowledge, and therefore fosters the use of terms and concepts that help understand the diverse values of nature, including "nature´s contributions to people" and "good quality of life" (Díaz *et al.*, 2015).

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ANNEX II
Acronyms

ABIOVE	Associação Brasileira das Indústrias de Óleos Vegetais
AFR	African Forest Landscape Restoration Initiative
ANEC	Associação Nacional dos Exportadores de Cereais
BABS	Bioprospecting, Access and Benefit Sharing
BIA-GBS	Biodiversity Impact Analytics powered by the Global Biodiversity Score tool
CBG	Compagnie des Bauxites de Guinée
CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
CFR	Community Forest Resource
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNAE	Classificação Nacional de Atividades Econômicas
DPSIR	Driver, Pressure, State, Impact, Response
DSI	Digital Sequence Information
DSSAT	Decision Support for Agro-technology Transfer
EEMRIO	Environmentally Extended Input–Output Analysis
ENCORE	Exploring Natural Capital Opportunities, Risks and Exposure
EP&L	Environmental Profit and Loss
ESG	Environmental, Social and Governance
ESRS	European Sustainability Reporting Standards
EU CSRD	European Union's Corporate Sustainability Reporting Directive
FAO	Food and Agriculture Organization of the United Nations
FPIC	Free, Prior and Informed Consent
FRA	India's Forest Rights Act
FSDA	Finance Sector Deforestation Action
GDP	Gross Domestic Product
GFCR	Global Fund for Coral Reefs
GICS	Global Industry Classification Standard
GLOBIO	Global Biodiversity Model for Policy Support
GLP	Green Loan Principles
GRI	Global Reporting Initiative
GTAP	Global Trade Analysis Project
GVA	Gross Value Added
HANPP	Human Appropriation of Net Primary Productivity
HCV	High Conservation Value
IAPB	International Panel on Biodiversity Credits
IBAT	Integrated Biodiversity Assessment Tool
ICMA	International Capital Market Association
IMAGE	Integrated Model to Assess the Global Environment
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IPCC	Intergovernmental Panel on Climate Change
IPLC	Indigenous Peoples and local communities
ISIC	International Standard Industrial Classification
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
LCA	Life Cycle Assessment
LEAP	Locate, Evaluate, Assess, Prepare
LMA	Loan Market Association
LULC	Land Use/Land Cover
MCDA	Multi-criteria decision analysis
MRIO	Multi-regional Input Output Model
MSC	Marine Stewardship Council
MSCI	Morgan Stanley Capital International
NACE	Activités Économiques dans la Communauté Européenne
NAICS	North American Industry Classification System
NBSAP	National Biodiversity Strategies and Action Plans

NCP	Nature's Contributions to People
NEPAD	New Partnership for Africa's Development
NGFS	Network for Greening the Financial System
NIC	Indian National Industrial Classification
NPP	Net Primary Productivity
OECD	Organisation for Economic Co-operation and Development
OECD MNE	Organisation for Economic Cooperation and Development, Guidelines for Multinational Enterprises
PBAF	Partnership for Biodiversity Accounting Financials
PDO	Protected Designation of Origin
PREDICTS	Projecting Responses of Ecological Diversity in Changing Terrestrial Systems
PRI	Principles for Responsible Investment
PSCI	Pharmaceutical Supply Chain Initiative
RSPO	Roundtable on Sustainable Palm Oil

SBTi	Science-based Targets Initiative
SBTN	Science-Based Targets Network
SEEA - EA	System of Environmental Economic Accounting – Ecosystem Accounting
SLBP	Sustainability-Linked Bond Principles
SMART targets	Specific, Measurable, Achievable, Relevant, and Time-bound Targets
SPLP	Siak Pelalawan Landscape Programme
STAR	Species Threat Abatement and Restoration Metric
TCFD	Task Force on Climate-related Financial Disclosures
TCGF	The Consumer Goods Forum
TNFD	Taskforce on Nature-related Financial Disclosures
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

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