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Research Insight

An Investor's Guide to Nature and Biodiversity Risks and Impacts

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Executive summary

Time for action

The biodiversity crisis shares drivers and impacts with the climate crisis. Despite this, many investors have only recently become aware of its severity and its connection to business and finance. Market participants must address biodiversity loss urgently because the two crises require parallel and mutually reinforcing efforts.

Investors can start their biodiversity journey now, addressing both risks and impacts from investee companies with a comprehensive approach, and start tracking progress. Despite data and model challenges, frameworks for management exist, regulatory pressure is growing and models are improving. Data limitations should no longer be an excuse for inaction.

The problem and how to address it

Biodiversity among our planet's living organisms is in rapid decline and human activity is to blame.

This loss poses an existential threat to nature and humanity. It also threatens to cripple business and investors, as more than half of the world's economic output depends highly or moderately on nature, for everything from air and water to food to medicine.[1]

Companies may depend on nature, either directly or indirectly, to function. They may also contribute to its destruction through their operations. And damage done by one company can elevate risks for others.

Some companies simultaneously operate on both sides of that relationship. The food industry, for instance, requires a variety of plants and animals to sustain agricultural services, while the global food system, which converts ecosystems for crop production, is also a primary driver of biodiversity loss.[2]

Some policymakers have mobilized to develop reporting frameworks in response to this crisis, while business-led initiatives such as the Taskforce on Nature-related Financial Disclosures (TNFD)[3] have launched voluntary frameworks.

1 While the term "biodiversity" refers to the diversity within and among species and ecosystems, the term "nature" is broader as it commonly refers to both living organisms and inanimate components that exist on Earth. Biodiversity ensures the resilience and intactness of natural processes. Both terms are often used interchangeably. For this reason, we use both terms interchangeably in this paper. World Economic Forum. 2020. "Half of World's GDP Moderately or Highly Dependent on Nature, Says New Report." https://www.weforum.org/press/2020/01/half-of-world-s-gdp-moderately-or-highly-dependent-on-nature-says-new-report/.

2 Benton, Tim G. et al. 2021. Food system impacts on biodiversity loss: Three levers for food system transformation in support of nature. Chatham House. https://www.chathamhouse.org/2021/02/food-system-impacts-biodiversity-loss.

3 Taskforce on Nature-related Financial Disclosures (TNFD). 2023. "Recommendations of the Taskforce on Nature-related Financial Disclosures." https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/

Institutional investors, who must navigate a new terrain of risk, impact and opportunity, have begun grappling with questions such as:

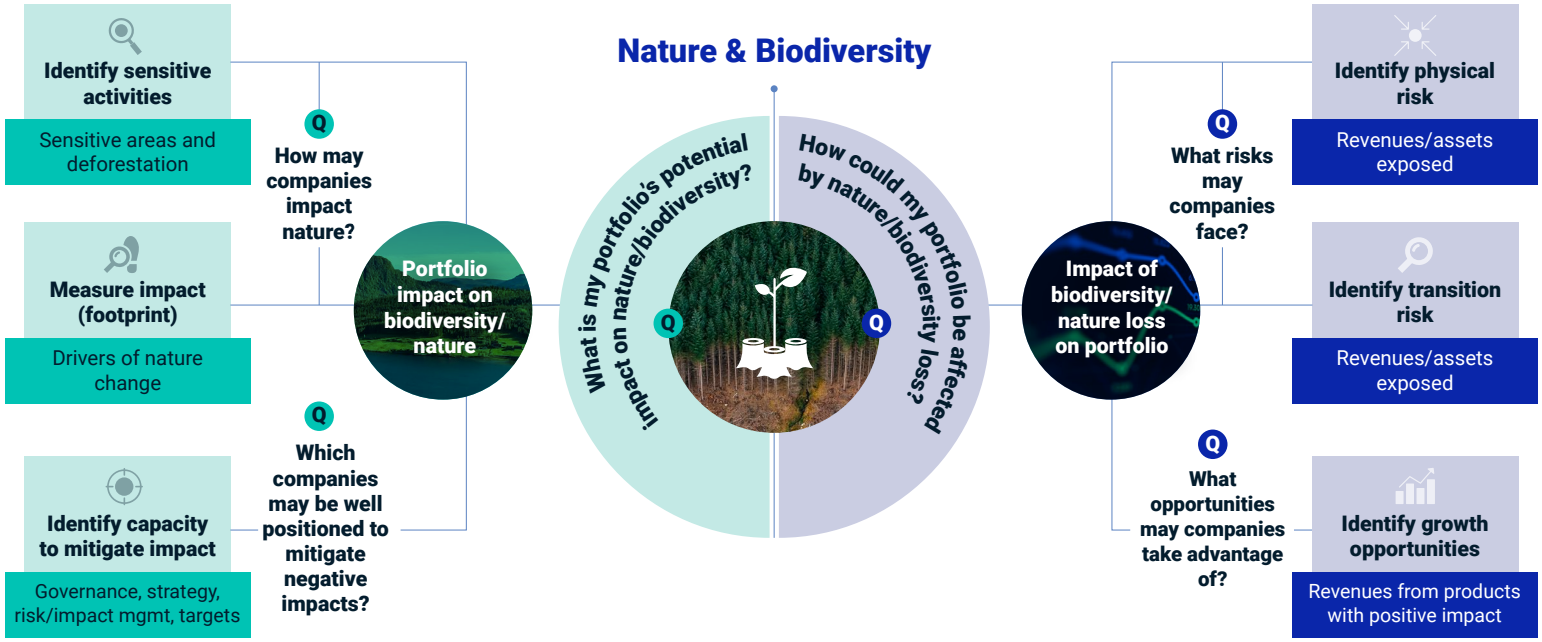
- How can I identify sectors, companies, products or activities that are key contributors to nature and biodiversity loss?
- Which of my portfolio holdings are most vulnerable to biodiversity loss?
- Are companies I invest in adequately managing biodiversity risks or impacts?
- Is it possible to measure biodiversity risk exposure or impact across my portfolio?
- How can I quickly and accurately align with voluntary or mandatory reporting frameworks?
- Which companies are developing products or services with a positive impact on nature and biodiversity?

For many investors, the biggest challenge is figuring out where to start. Specifically, they struggle to understand what type of data and metrics to use. Biodiversity loss has many drivers with many variables and proper analysis requires asset location data, an extra layer of complexity. Without standardized metrics to answer key questions, investors are often forced to rely on emerging conceptual metrics that can yield widely differing results.

However, the TNFD has released a voluntary global framework for nature-related disclosure metrics. The European Union (EU) also requires granular nature-related disclosures as part of its Sustainable Finance Disclosure Regulation (SFDR), particularly with its entity-level Principal Adverse Impact reporting mandates. Over time these initiatives and others may help address these data challenges.

This guide, its checklist and our **Nature and Biodiversity Metrics Framework** (Exhibit 1) are designed to help investors start identifying which questions to ask and which metrics to consider as they begin incorporating biodiversity into their investment process.

Exhibit 1: MSCI Nature and Biodiversity Metrics Framework



Source: MSCI ESG Research, December 2023

Checklist: Integrating biodiversity into investment decisions

1. Brief yourself on the basics of biodiversity and its connection to finance

- [ ] Familiarize yourself with definitions and concepts of nature, biodiversity and ecosystems.
- [ ] Understand the relationship between climate change and biodiversity loss.
- [ ] Be aware biodiversity loss can impact business — and businesses can impact biodiversity.
- [ ] Identify available metrics and geospatial analytical tools, and their use cases.

2. Follow biodiversity-related policy developments and market initiatives

- [ ] Regulatory mandates and strategies at a global and regional level.
- [ ] Voluntary reporting framework launched by TNFD.
- [ ] United Nations (U.N.) agreement: COP15 "Global Biodiversity Framework."
- [ ] Other initiatives led by groups such as Science Based Targets for Nature and Nature Action 100.

3. Assess your portfolio's exposure to biodiversity- and nature-related risks and impacts

- [ ] Measure exposure to nature-related transition and physical risks; identify opportunities.
- [ ] Evaluate the potential impact of your investee companies / investments on nature.

4. Define your strategy and targets (where mandates allow)

- [ ] Determine short-, medium- and long-term goals to mitigate risk and impact.
- [ ] Understand how goals align with your climate-related commitments.
- [ ] Set quantitative targets that specify scope such as direct operations vs value chain, global vs regional, or sector-specific vs entire economy.

5. Take action

- [ ] Reduce portfolio exposure to biodiversity-sensitive areas, deforestation and other risks as well as exposure to physical and transition risks.[4]
- [ ] Test biodiversity footprinting, risk assessment and other metrics to evaluate broad baseline.
- [ ] Join alliances and task forces to learn from peers and build collaborative momentum.

6. Embed risks and impacts in day-to-day investment decision framework

- [ ] Connect your strategy with internal risk management processes.
- [ ] Incorporate impact and risk drivers into climate scenarios to improve view of risk landscape.
- [ ] Align your biodiversity- and nature-related targets with an investment policy benchmark.
- [ ] Capture opportunities in nature-based solutions providers.
- [ ] Ensure your expectations align with asset managers' capabilities where applicable.
- [ ] Ensure your commitments and policies align with clients' expectations where applicable.

7. Foster "nature-positive" real-world outcomes through voting and engagement

- [ ] Pursue stewardship, engagement individually and in collaboration with peers.
- [ ] Develop guidelines to inform decisions on whether to divest where engagement fails.
- [ ] Use proxy voting to hold companies accountable for biodiversity- and nature-related loss.
- [ ] Advocate for policies designed to speed transition to a nature-positive economy.

8. Adopt biodiversity-related financial reporting

- [ ] Align with TNFD guidelines, focusing on core global indicators and financial guidance.
- [ ] Align with other frameworks such as International Sustainability Standards Board guidelines or the European Sustainability Reporting Standards.

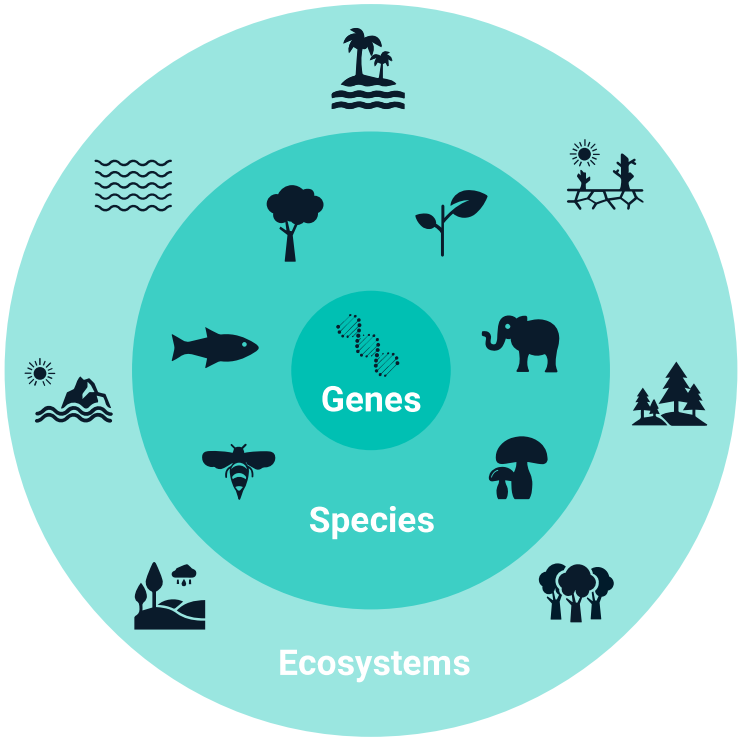
4 Nature related physical risks are risks from the degradation of nature to companies that depend on ecosystem services.
Nature related transition risks are risks due to changes in regulation and policy, litigation action, or changes in technology or investor sentiment and consumer preferences. See: Taskforce on Nature-related Financial Disclosures (TNFD). 2023. "Recommendations of the Taskforce on Nature-related Financial Disclosures." https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/

Key terms and concepts

"Biodiversity," "nature" and "natural capital" are often used interchangeably but these terms have distinct meanings.

Biodiversity, short for biological diversity, is the diversity within and among species and ecosystems.[5] It is the variability among all living organisms, whether from terrestrial, marine or other aquatic ecosystems, and the ecological complexes they belong to. It includes the diverse microorganisms in the soil, the fungi on tree trunks, the algae of the oceans, the wildlife of rain forests, the insects of mountain streams — and the connections among them all.

Exhibit 2: What is biodiversity?



Source: MSCI ESG Research, November 2023

Nature includes biodiversity and the geology, water, climate and other inanimate components of Earth.

Natural capital refers to stocks of natural assets, including land, soil, air, water and all living things. It serves as the foundation of our ecosystem services.[6]

Ecosystem services are the benefits we receive from ecosystems, generated from interactions within ecosystems. They include provisioning services, such as clean air and water, fertile soil, pollination, raw materials and climate stability sustained by natural capital assets.[7] These allow the Earth to sustain life — society thrives only when nature thrives. The interactions between those assets and ecosystem services are complex and their overall equilibrium is fragile. Other ecosystem services, less valued by business but key to society, include sociocultural services such as recreational and religious benefits, and the invaluable yet unquantifiable breathing space provided by nature.

5 United Nations. 1992. "The Convention on Biological Diversity." Last modified May 13, 2016. https://www.cbd.int/convention/text/.

6 Natural Capital Coalition, Natural Capital Finance Alliance and Dutch Association of Investors for Sustainable Development. 2018. Connecting Finance and Natural Capital: A Supplement to the Natural Capital Protocol. https://naturalcapitalcoalition.org/wp-content/uploads/2018/04/Connecting-Finance-and-Natural-Capital_Supplement-to-the-Natural-Capital-Protocol-1.pdf.

7 Natural Capital Coalition, Natural Capital Finance Alliance and Dutch Association of Investors for Sustainable Development. 2018. Connecting Finance and Natural Capital: A Supplement to the Natural Capital Protocol. https://naturalcapitalcoalition.org/wp-content/uploads/2018/04/Connecting-Finance-and-Natural-Capital_Supplement-to-the-Natural-Capital-Protocol-1.pdf.

How severe is biodiversity loss?

Biodiversity and ecosystems are dwindling at an unprecedented rate. The main direct drivers of biodiversity loss, as identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) are, in order of highest impact: changes in land and sea use, direct exploitation of organisms, climate change, pollution and invasion by alien species. Behind these drivers are human behaviors such as consumption and production, population shifts, technological innovation, trade and global governance.[8]

Exhibit 3: Main drivers of biodiversity impact according to IPBES

Changes in land and sea use	30%	Agricultural, urban and infrastructure expansion
Overexploitation of organisms	23%	(Over-) use of animals, plants, and other organisms
Climate change	14%	Extreme weather events, fires, floods droughts, sea level rise
Pollution	14%	Air, water and soil pollution
Invasive alien species	11%	Plant and animal invasions impacting native species and ecosystem functions

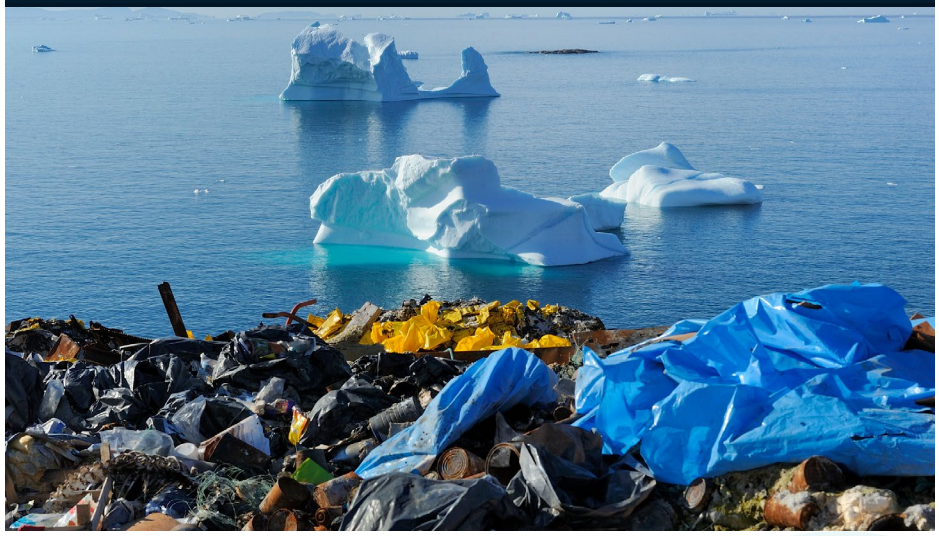
Contribution of driver to global biodiversity loss

Source: IPBES. 2019. "Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services."

Climate change is often discussed simultaneously with nature and biodiversity loss. The two are inextricably linked, even though the solutions to address each are different. **Biodiversity loss reduces nature's ability to absorb greenhouse gases (GHG)**.

Intact ecosystems protect against the consequences of climate change. Forests, for instance, supply cooling during heat waves, while mangroves reduce the impact of cyclones.

Climate change, in turn, takes a bigger toll on nature. For example, extreme droughts destroy species of habitats while changing weather patterns disrupt the balance of nature.



8 IPBES. 2019. "Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services". https://www.ipbes.net/global-assessment.

As a result, we have imperiled three-quarters of terrestrial ecosystems and two-thirds of the oceans. Global populations of mammals, birds, amphibians, reptiles and fish have declined by an average of 69% between 1970 and 2018 and one million known species could go extinct within decades.[9]

A snapshot of dependencies and impacts

75% of global food crop types rely on pollination

40% of invertebrate pollinator species are threatened with extinction

60% of irrigated wheat production occurs in areas of extremely high water stress

50% of crops are at risk from soil erosion

23% of land globally has diminished productivity because of degradation

2 billion tons of CO2 emission are absorbed by forests every year, making forest ecosystems the largest terrestrial carbon sink

420 million hectares worldwide were lost to deforestation in the 30 years that ended in 2020

70% of cancer drugs are natural or inspired by nature

Sources: Food crop types: "The Global Assessment Report on Biodiversity and Ecosystem Services," Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019. Pollinator extinction: "The Assessment Report on Pollinators, Pollination and Food Production, IPBES, 2016. Wheat production: World Resources Institute Aqueduct Food tool, wri.org. Soil erosion: "Let's #StopSoilErosion to ensure a food secure future," Food and Agriculture Organization of the United Nations, May 14, 2019. Degradation: IPBES report, supra. CO2 emissions: "The Global Forest Goals Report 2021," U.N. Department of Economic and Social Affairs, 2021. Land lost: "Global Forest Resources Assessment 2020," Food and Agriculture Organization of the United Nations. Cancer drugs: IPBES report, 2019.

9 WWF. 2022. Living Planet Report 2022: Building a nature-positive society. https://livingplanet.panda.org/en-US/. and IPBES. 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. https://ipbes.net/global-assessment.

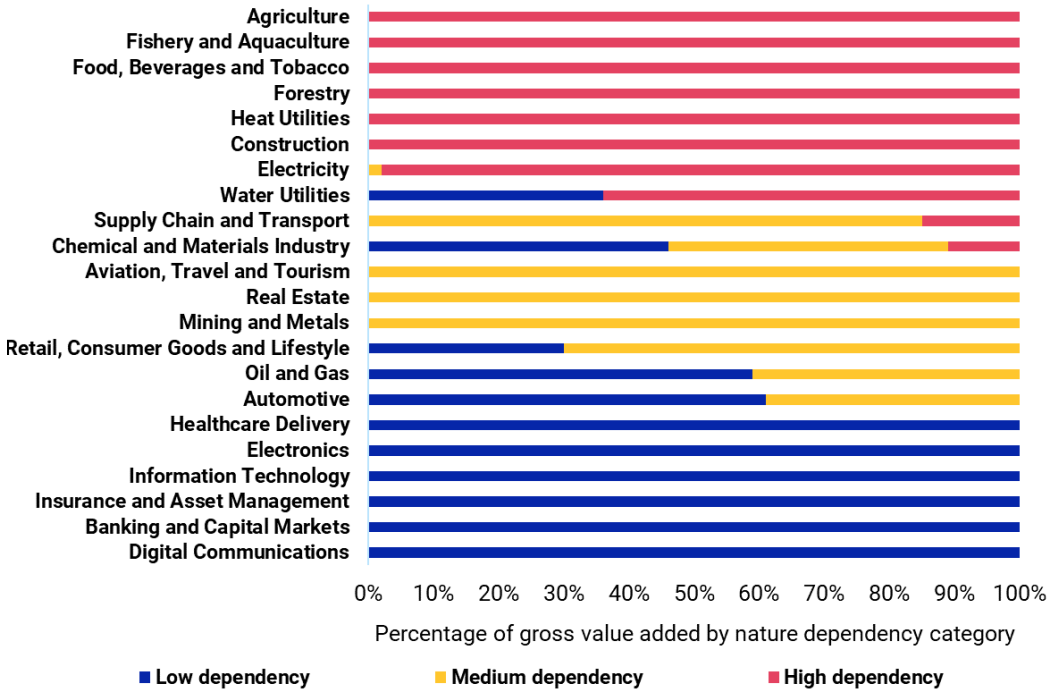
Economic implications of biodiversity loss

Nature underpins the global economy and works to support it for free. The World Economic Forum (WEF) estimates that more than **half the world's economic output** — USD 44 trillion — **depends either highly or moderately on intact ecosystems and their benefits**.[10] Others place that price tag as high as USD 125 trillion. It can be argued that, ultimately, any human activity depends on nature.

The WEF identified industries such as forestry, agriculture, fishery and utilities as highly dependent on natural capital and industries such as information technology, digital communications, banking and insurance as minimally dependent in terms of their direct operations. For example, 75% of global food crops rely on animal pollination while 70% of cancer drugs are inspired by or based on nature. Here are some of the effects and potential effects of biodiversity loss on the planet and profits:

- Fewer varieties and breeds of plants and animals mean ecosystems that support **food production** have less resilience to pests, pathogens and future warming.[11]
- Tropical forest degradation could limit the discovery of **genetic material** for pharmaceuticals.[12]
- Deforestation threatens the **water security** of more than 90% of cities and 75% of accessible freshwater sources.[13]
- Invasive, nonnative species have caused as much as 16% in annual losses to **global production of rice, wheat and maize** — staples that provide half the world's food.[14]

Dependencies of industries on natural capital



50%
of global GDP is dependent on nature

75%
of global food crops rely on animal pollination

50%
of crops at risk due to soil erosion

Sources: MSCI ESG Research, November 2023; World Economic Forum and PwC. 2020. "Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy."

10 WEF. 2020. "Half of World's GDP Moderately or Highly Dependent on Nature, Says New Report." https://www.weforum.org/press/2020/01/half-of-world-s-gdp-moderately-or-highly-dependent-on-nature-says-new-report/.

11 IPBES. 2019. "Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." https://www.ipbes.net/global-assessment.

12 WEF. 2020. "Half of World's GDP Moderately or Highly Dependent on Nature, Says New Report." https://www.weforum.org/press/2020/01/half-of-world-s-gdp-moderately-or-highly-dependent-on-nature-says-new-report/.

13 Global Canopy. 2021. The Little Book of Investing in Nature. https://globalcanopy.org/insights/publication/the-little-book-of-investing-in-nature/.

14 WEF. 2020. "Half of World's GDP Moderately or Highly Dependent on Nature, Says New Report." https://www.weforum.org/press/2020/01/half-of-world-s-gdp-moderately-or-highly-dependent-on-nature-says-new-report/.

Why does this matter for investors?

Biodiversity loss poses an existential threat not only to ecosystems and to the global economy, but also, in turn, to investors, who depend on a thriving economy. Biodiversity loss presents a complex web of risk that could surface across industries at the company or portfolio level. It may also present new opportunities.

Similar to how we now understand climate risks and impacts, the relationship between business and biodiversity can be understood along two dimensions: how a business activity (negatively or positively) *impacts* nature and how much a business activity *depends* on nature. Investors need to understand the connection between the two.

While businesses can contribute to the loss of natural capital and biodiversity through pollution, GHG emissions and other activities, for example, they can also be adversely impacted by these losses because they rely on ecosystem services including climate regulation, freshwater and raw materials supply, soil quality and disease control. Some companies may be impacted by nature loss even as they impact nature.

Companies that negatively impact nature create a ripple effect, elevating risk for other companies and, in cases where they operate simultaneously on both sides of that relationship, for themselves.

Companies can perpetuate biodiversity loss through operations and products linked to the five IPBES loss drivers. Conversely, they can also develop technologies and other solutions to protect water or prevent pollution to restore ecosystems, potentially creating new opportunities for investors. Ignoring risks and opportunities stemming from this loss could seriously negatively impact companies and investors, particularly those operating in industries that are highly dependent on natural capital.

Despite this potential impact, **many lenders, investors and companies appear to insufficiently account for nature-related risks and opportunities**.[15]

To assess the relationship between business and nature, investors can ask:

- What is my portfolio's potential **impact** on biodiversity/ nature?
- How could my portfolio be **affected** by biodiversity/ nature loss?

15 See, e.g., Annelisa Grigg, Lara Yacob and Gemma James. 2020. "Investor action on biodiversity: discussion paper." PRI Association.; and Torsten Kurth et al. 2021. "The Biodiversity Crisis is a Business Crisis." Boston Consulting Group.

A growing regulatory focus

As nature loss intensifies and its economic, business and investment impacts emerge, regulators and policymakers are beginning to focus more on biodiversity-related financial risks as well as impacts. Financial regulators and standard setters are sharpening their focus on biodiversity and nature-related risks (see examples below).

Global

The **Kunming-Montreal Global Biodiversity Framework**,[16] a landmark agreement to protect biodiversity reached at the U.N. biodiversity conference known as COP15,[17] includes requirements for its 190 ratifying governments to protect and restore 30% of the planet's land and water by 2030 and phase out subsidies that harm nature. Its Target 15 also calls for governments to map out national action plans to produce regulations requiring companies and investors to publish nature-related risks, dependencies and impacts. Target 15 may thus, in due course, contribute to the development of biodiversity risks and impacts data and metrics. See our February 2023 analysis of the framework for more details.[18]

The **International Sustainability Standards Board** (ISSB) identified biodiversity as one of its next priority areas. In proposals released for public consultation in May 2023, the ISSB stated it may seek to focus on the sustainability-related risks and opportunities associated with biodiversity loss and ecosystems in order to lay the groundwork for potential future standard-setting.

16 The Secretariat of the Convention on Biological Diversity. 2022. Kunming-Montreal Global Biodiversity Framework. https://www.cbd.int/article/cop15-final-text-kunming-montreal-gbf-221222

17 The 15th meeting of the Conference of Parties to the U.N. Convention on Biological Diversity.

18 MSCI ESG Research. 2023. What Biodiversity Loss and the COP15 Agreement Mean for Investors: Nature-Related Risk Moves to the Forefront of Sustainable Finance. https://www.msci.com/documents/1296102/36593353/MSCI+COP+15+Biodiversity.pdf.

EU

Biodiversity Strategy for 2030 — a comprehensive long-term plan to protect nature and reverse ecosystem degradation.[19]

Deforestation-free products — companies must ensure goods they import into the EU do not use certain commodities that have been attributed to deforestation.[20]

EU Taxonomy requirements — Under the EU Taxonomy, an economic activity cannot be qualified as sustainable if it results in an "adverse impact" to any one of six environmental objectives which include the protection of biodiversity and ecosystems. Consequently, companies that want to claim taxonomy alignment of economic activities on an environmental objective must do no significant harm to any other objective, including the protection of biodiversity and ecosystems.[21]

SFDR-related reporting requirements — The Sustainable Finance Disclosure Regulation requires financial market participants to consider and disclose adverse impacts of investment decisions on sustainability factors at the entity level. This includes biodiversity considerations and reporting requirements among both mandatory and optional Principal Adverse Impact indicators.[22]

The European Sustainability Reporting Standards (ESRS) required for companies in scope of the EU Corporate Sustainability Reporting Directive (CSRD) — include biodiversity- and ecosystem-related disclosure requirements with reporting to start in 2025 for fiscal year 2024. ESRS E4, on biodiversity and ecosystems, is particularly detailed.[23]

France

Biodiversity targets and disclosure — Article 29 of the Energy-Climate Law requires financial firms to publish biodiversity-related risks and align with global biodiversity targets such as the Kunming-Montreal Global Biodiversity Framework.[24]

UK

Ban on illegal deforestation in supply chains — the Environment Act bars covered businesses from using commodities produced on illegally used or occupied land.[25]

19 European Commission. 2020. "EU Biodiversity Strategy for 2030." https://commission.europa.eu/document/020f7141-d73d-4191-853e-c5918a52f9f3_en.

20 European Commission. 2023. "Deforestation-free products." Accessed November 2, 2023. https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en.

21 European Commission. 2021. "EU Taxonomy for Sustainable Activities: What the EU is doing to create an EU-wide classification system for sustainable activities."

22 European Commission. 2022. "Annex 1 to the Commission Delegated Regulation (EU) 2022/1288."

23 European Commission. 2023. "Annex to the Commission Delegated Regulation (EU) supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards."

24 French Ministry of Economics, Finance and Industrial and Digital Sovereignty. 2021. "Publication of the implementing decree of Article 29 of the Energy-Climate Law on non-financial reporting by market players." Last modified June 8, 2021. https://www.tresor.economie.gouv.fr/Articles/2021/06/08/publication-of-the-implementingdecree-of-article-29-of-the-energyclimate-law-on-non-financial-reportingby-market-players.

25 Department for Environment Food & Rural Affairs. 2022. "Implementing due diligence on forest risk commodities." Last modified September 6, 2022. https://consult.defra.gov.uk/international-biodiversity-and-climate/implementing-due-diligence-forest-risk-commodities/.

A new milestone in global disclosure: The TNFD framework

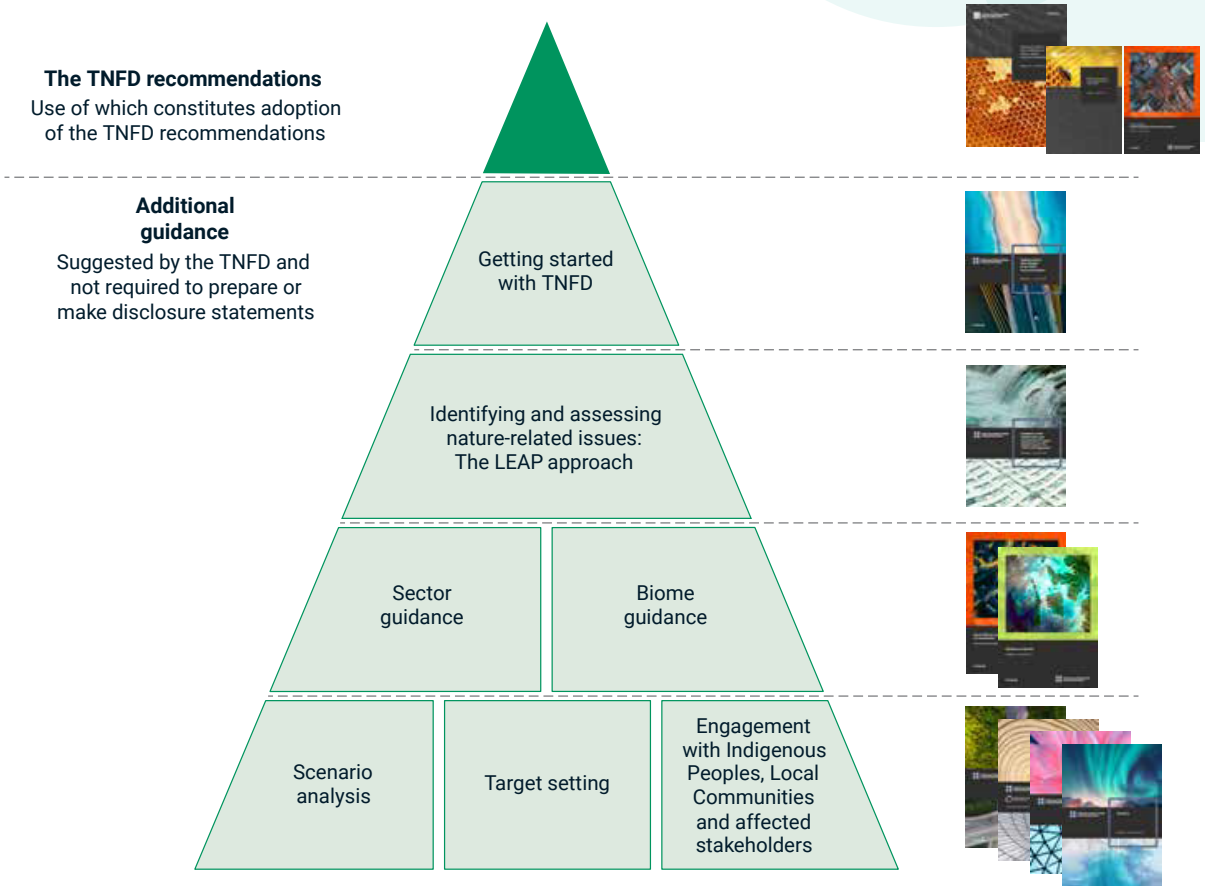
As investors and regulators have become more aware of these issues, the demand for standardized reporting has increased, but until recently there was no generally accepted way to assess and report on biodiversity- and nature-related risks.

To close this gap, the Taskforce on Nature-related Financial Disclosures (TNFD) was launched in 2021, and in September 2023, it released a critical framework for companies and investors that includes disclosure recommendations and practical guidance on how to assess and incorporate biodiversity risks and opportunities into business and investment decisions.[26]

The framework is based on the concepts developed by the Task Force on Climate-related Financial Disclosures (TCFD) and standardizes reporting by businesses and investors regarding nature-related governance, strategy, risk and impact management, as well as metrics and targets used to assess not only nature-related risks and dependencies, but also impacts and opportunities. The framework is voluntary but could quickly become a market standard, much as the TCFD became the global baseline for corporate climate disclosure.

26 Taskforce on Nature-related Financial Disclosures (TNFD). 2023. "Recommendations of the Taskforce on Nature-related Financial Disclosures." https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/

Exhibit 5: A full picture of the TNFD framework



Source: Taskforce on Nature-related Financial Disclosures (TNFD). 2023. "Recommendations of the Taskforce on Nature-related Financial Disclosures."

The TNFD includes a core set of 14 indicators for reporting across sectors, together with recommendations for sector-specific reporting. The framework also recommends a set of additional disclosure metrics which organizations can use where relevant. Businesses and investors that want to be TNFD-aligned would, at a minimum, report data for the core disclosure metrics.

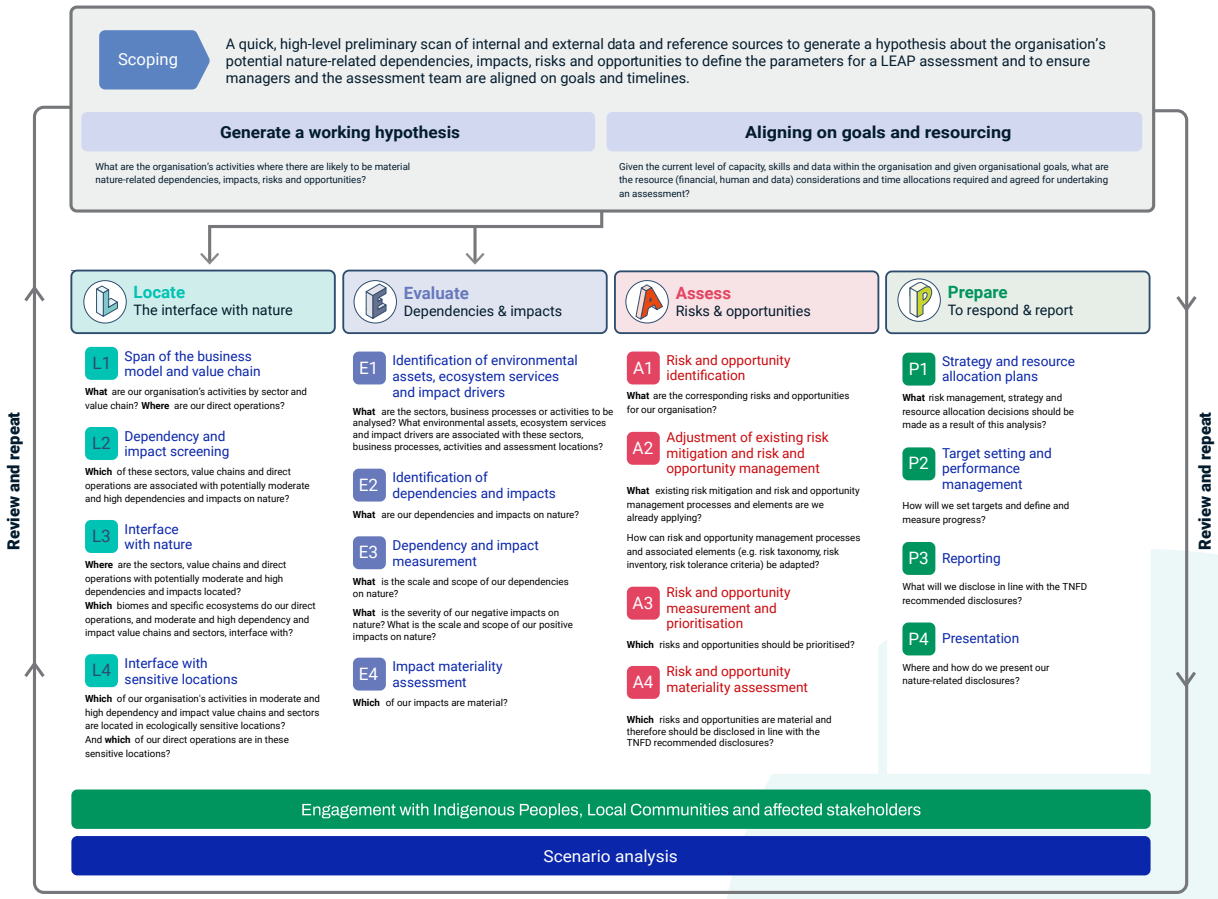
The TNFD's LEAP approach

The TNFD has also developed a structured process for reporting and management of nature-related disclosures called LEAP:[27]

- **Locate** your interface with nature.
- **Evaluate** your dependencies and impacts on nature.
- **Assess** your nature-related risks and opportunities.
- **Prepare** to respond to nature-related risks and opportunities and to report on your material nature-related issues.

The "L" emphasizes the critical importance of location-specific data. In contrast to climate change, where carbon emissions have a global impact regardless of their geographic origin, the severity of a company's impact on biodiversity and nature varies depending on the location of its operations. It matters whether the operations are in a city, a coastal zone or a tropical rainforest, for example.

Exhibit 6: TNFD LEAP approach



Source: Taskforce on Nature-related Financial Disclosures, 2023, "Recommendations of the Taskforce on Nature-related Financial Disclosures."

27 Taskforce on Nature-related Financial Disclosures (TNFD). 2023. "Recommendations of the Taskforce on Nature-related Financial Disclosures." https://tnfd.global/publication/recommendations-of-the-taskforce-on-nature-related-financial-disclosures/

Integrating biodiversity into investments

Biodiversity and nature-related data is inherently challenging.

Quantifying potential financial implications from biodiversity loss stemming from physical, regulatory, legal, market or reputational risks is intrinsically complex. Biodiversity loss stems from multiple pressures (as opposed to the ubiquitous ton of CO2) and quantifying it requires geospatial data, which presents a challenge because models are nascent and data is often scarce or inaccurate.

For instance, to assess a portfolio's dependency on ecosystem services, investors should, in theory, determine the price of each ecosystem service a company relies on for every region it operates in, whether for animal pollination, fertile soil or raw material supply. Such an assessment requires advanced models and granular data as well as precisely geocoded data because biodiversity loss drivers and impacts are local. In addition, several nature-related risks could have reverberating effects, which makes assessing financial risks from nature loss even more difficult.

Furthermore, some key data points are rarely disclosed and may be inaccurate when they are. Collecting data for supply chains is an even greater challenge.

However, none of these hurdles are insurmountable and investors may want to integrate biodiversity into their investment decisions for a number of reasons. Investors can take the following steps to begin incorporating biodiversity issues into their investment process:

Determine goals

An investor's objectives may include:

- Identifying companies' exposure to financial risks from biodiversity and nature loss.
- Measuring the negative impact of investee companies on nature.
- Meeting disclosure obligations from emerging regulations.
- Seizing investment opportunities related to growing demand for products and services that help tackle the biodiversity crisis.

Evaluate and reduce exposure to downside financial risk

Despite the data and model challenges mentioned above, investors no longer face a blank page when it comes to quantifying biodiversity-related risk: There are proxies, models, tools and data available for investors to use in their investment strategies. Exposure to a range of nature-related physical risks such as operational or supply-chain disruptions can be evaluated by looking at the share of revenues or assets dependent on ecosystem services or at-risk natural commodities. Similarly, to evaluate transition risks stemming from an evolving business environment, they could evaluate the share of revenues or assets exposed to regulatory, legal or reputational risks. The connections between those risk drivers and related metrics are illustrated in the MSCI Nature & Biodiversity Metrics Framework below.

Seek exposure to opportunities

In addition to mitigating downside risk, investors can seek investment growth opportunities from solutions providers that improve or preserve biodiversity. One approach could be to identify companies with products that positively impact nature, such as:

- Sustainable or "regenerative" agriculture
- Waste management
- Alternative protein products
- Pollution prevention services
- Water treatment solutions
- Ecosystem restauration

Evaluate and reduce investee companies' impacts on nature: Screening and "footprinting"

Measuring and lowering a portfolio's negative impact on nature is an emerging investment objective. This is partly driven by regulations such as France's Article 29 and growing stakeholder awareness. Investors can start assessing their potential financed impacts by identifying companies whose activities could be considered key drivers of biodiversity loss. These activities might include converting natural land into farmland or mines, overusing natural resources, or polluting the air, water or soil. Investors, therefore, can begin identifying potential (via correlations rather than causation) drivers of biodiversity loss in their portfolios.

They may start with screening out activities that are considered key contributors to biodiversity loss in their portfolio, whether from a product, location or controversy perspective. This process often includes engaging with or excluding investee companies involved with **deforestation**, either in their own operations or through their supply chains. Companies may be linked to deforestation because of the commodities their business model relies on (such as soy, palm oil, beef or timber). They may have been reported to have contributed to deforestation in the past and have assets or operations in known deforestation fronts.

Location matters when assessing biodiversity impacts and risks. Investors, therefore, may also want to use geospatial data and tools to identify portfolio companies operating in biodiversity-sensitive regions. Investors can then better assess the potential negative impacts of their portfolio companies and understand their capacity to address it.

Finally, similar to assessing the carbon footprint of a portfolio, investors may want to quantify the negative impacts of their investments on biodiversity across portfolios, sectors or regions. This approach is now generally termed **biodiversity footprinting**.

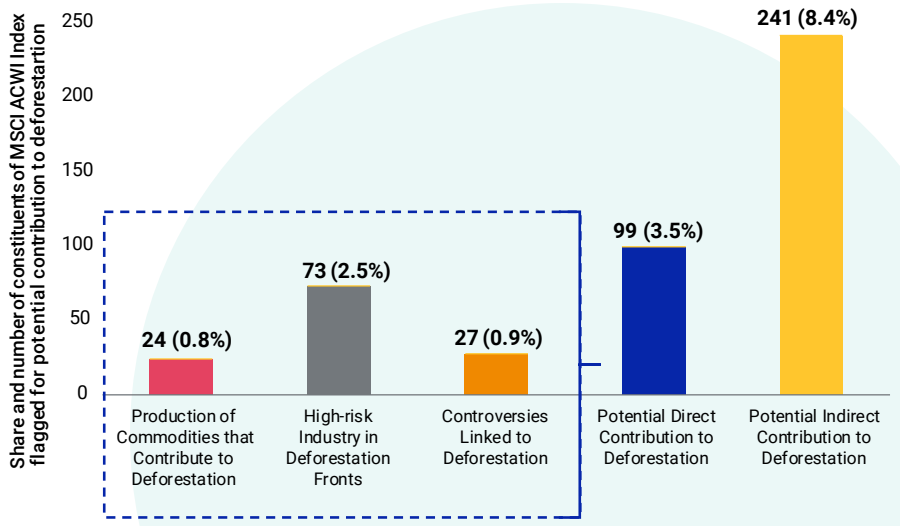
There is currently no universal definition of a biodiversity footprint.[28] There are metrics to quantify biodiversity impacts, such as the **Mean Species Abundance** and the **Potentially Disappeared Fraction of Species**, but no consensus yet on which are most helpful for investors. Such models can differ significantly, both in terms of input and scope of assessment, such as direct operations, supply chain or downstream activities. Unlike climate models, which include the standardized GHG emissions family of metrics, there are multiple metrics for the drivers of biodiversity impacts, such as land use, water consumption and emissions of sulfur oxides (SOx) and nitrogen oxides (NOx), all of which also require geospatial mapping. Data limitations require the use of estimated input data. As a result, varying approaches and models yield varying outputs. However, there is reason to be optimistic. Models are becoming more advanced (see Exhibit 9: "Biodiversity footprinting") and the TNFD guidelines are expected to improve the state of disclosures.

Start reporting

Investors face increasing pressure to report against emerging regulations such as the EU Taxonomy, the SFDR, the ESRS and the ISSB (see "A growing regulatory focus" section above). Market pressure to report on voluntary frameworks such as the TNFD also has the potential to grow. Our new Nature & Biodiversity Solutions are intended to help clients with their reporting needs.

28 The Partnership for Biodiversity Accounting Financials (PBAF) defines a footprint as the quantified impact of a portfolio, asset class, project or company measured in terms of biodiversity change as a result of production and consumption of particular goods and services." Source: PBAF. June 2022. https://pbafglobal.com/files/downloads/PBAF_FP2022.pdf.

Exhibit 7: MSCI ACWI Index constituents flagged for potential contribution to deforestation

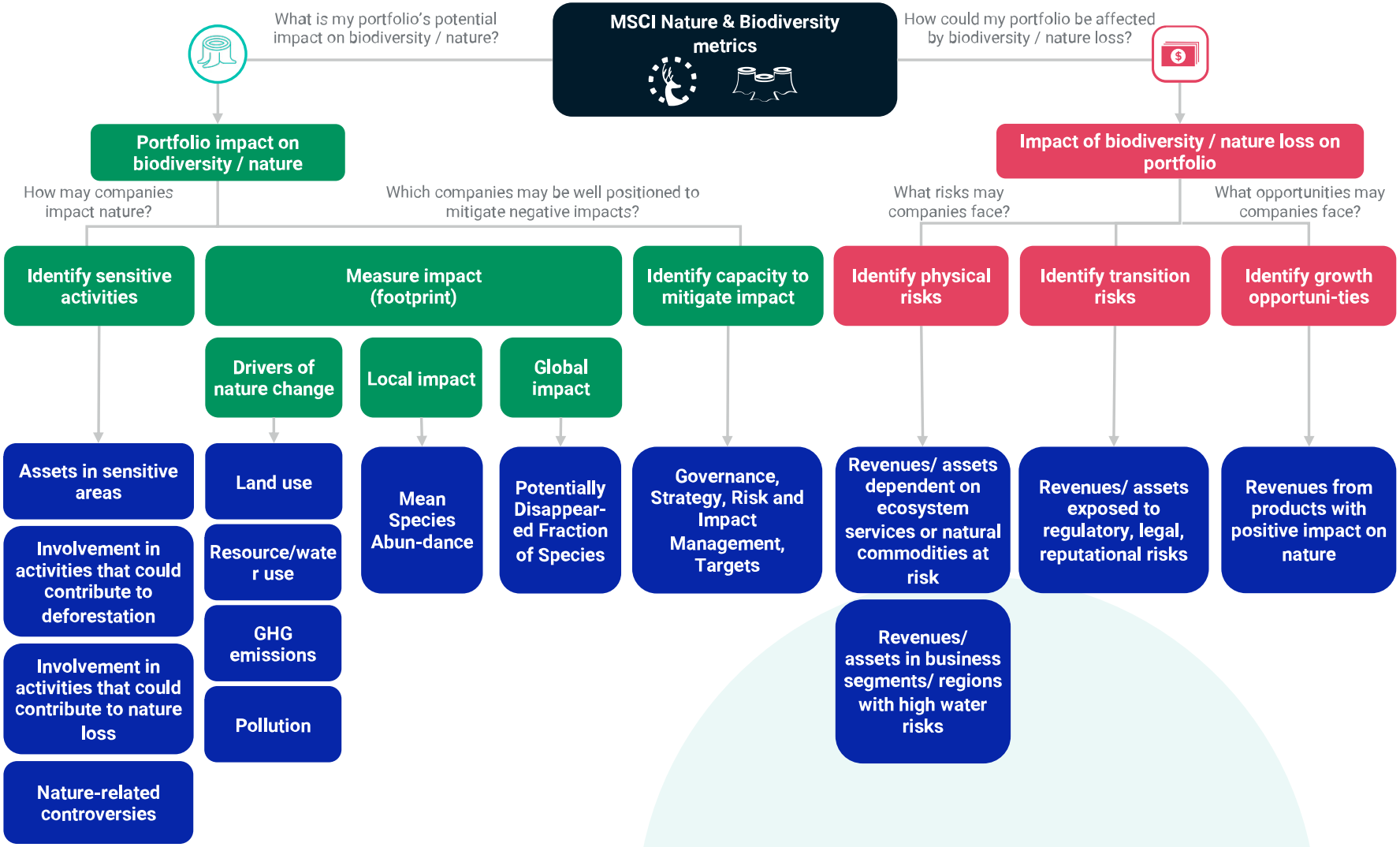


The number/ percentage for "Potential Direct Contribution to Deforestation" does not equal the results for the three criteria (blue box) since companies can be flagged for more than one criterion.
Source: MSCI ESG Research, constituents of the MSCI ACWI Index as of October 27, 2023

MSCI Nature & Biodiversity Metrics Framework

Investors working toward different biodiversity-related goals and implementation strategies will need to select the right set of metrics to help in that journey. These metrics can differ significantly in scope, objectives and applicability. Investors can start by asking two overarching questions: "What is my portfolio's potential impact on biodiversity/nature?" and "How could my portfolio be affected by biodiversity/nature loss?"

Exhibit 8: MSCI Nature & Biodiversity Metrics Framework



Source: MSCI ESG Research, December 2023

Impacts on nature and biodiversity

As previously discussed, investors can start assessing the **potential negative impacts of investee companies** on nature by identifying companies whose activities could be considered key drivers of biodiversity loss. MSCI ESG Research provides various metrics and data for screening such sensitive activities.

Once investors have reviewed how extensively their portfolio companies might be contributing to biodiversity or nature loss, they might want to focus on finding out which companies are positioned to **mitigate** those negative impacts and which are not.

MSCI ESG Research collects data on a company's capacity to manage the impacts of direct operations or suppliers. Depending on the context, this data may be useful to understand companies' ability to mitigate either impact or risk, or both. For instance, as part of our assessment of risks relating to biodiversity and land use in the **MSCI ESG Ratings** tool, we review a company's efforts to reduce land or marine disturbances, conduct impact assessments and increase biodiversity protection. As part of the assessment of risks relating to the sourcing of certain high-impact raw materials such as beef, seafood and timber, we review a company's policies, initiatives and targets related to the materials of concern. Indicators include the percentage of externally certified products sold and collaboration with suppliers to address the impacts of raw materials sourcing.

Biodiversity footprinting

Investors striving to quantify the impacts of their investments on biodiversity across sectors or portfolios increasingly rely on biodiversity footprinting. This approach generally starts by identifying the various **direct drivers of biodiversity loss**, known as **pressures**, caused by a company.

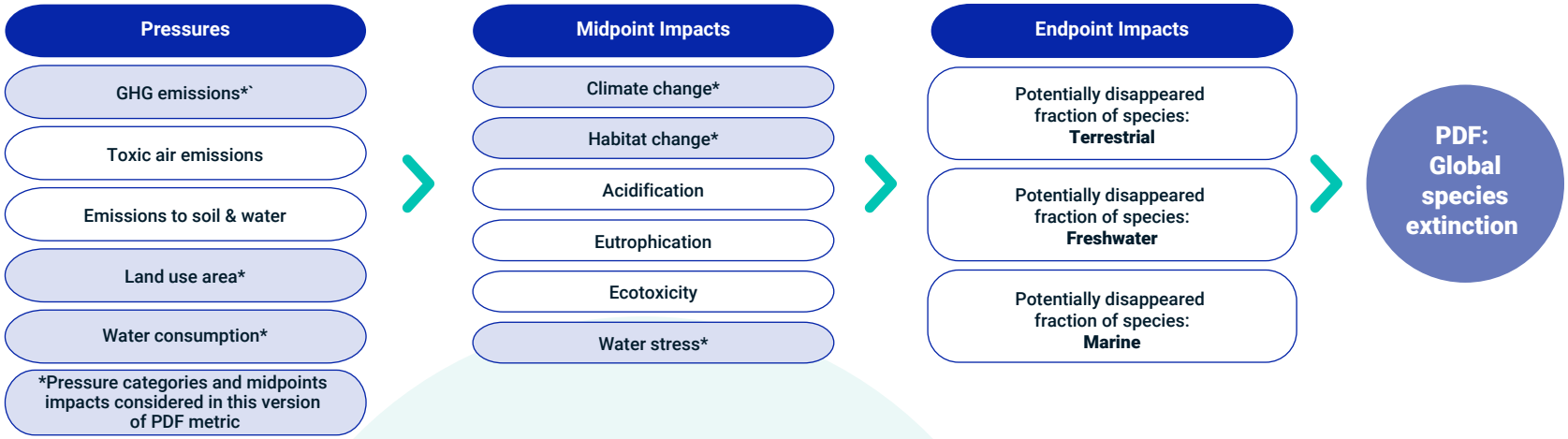
There are several academic approaches for modeling a pressure caused by a company, activity or product and its related impact on nature, also known as "pressure-impact models." These analyses can vary in scope. An impact assessment may cover pressures from a company's **direct operations** (sometimes called Scope 1), along its **supply chain** (Scope 2) or even in its **downstream phase** when products are used (Scope 3). Approaches can also differ in terms of time horizon: Impacts may be quantified annually and estimated from potential past and future impacts.

Despite the lack of a standard metric for biodiversity impact, the **Mean Species Abundance (MSA)** and the **Potentially Disappeared Fraction of Species (PDF)** metrics are commonly used. Both focus on species diversity as a proxy for the state of biodiversity. MSCI ESG Research provides both biodiversity footprint metrics.

Potentially Disappeared Fraction of Species (PDF)

The PDF metric is used within **life cycle assessment (LCA)** methodologies. It indicates a company's potential contribution to global species extinction due to pressures which may be caused by the company such as land use, GHG emissions, water consumption and toxic emissions. Once identified, these pressures can be modeled via LCAs into potential impacts that alter the state of nature and conditions across terrestrial, freshwater or marine ecosystems. These end impacts are then aggregated and attributed to companies.

Exhibit 9: How to calculate PDF



Source: MSCI ESG Research, May 23, 2024, based on life cycle assessment frameworks including: "LC-IMPACT: A regionalized life cycle damage assessment method." Verones F. et al., 2020; "ReCiPe 2016 v1.1. A harmonized life cycle impact assessment method at midpoint and endpoint level." National Institute for Public Health and the Environment of the Netherlands, 2016

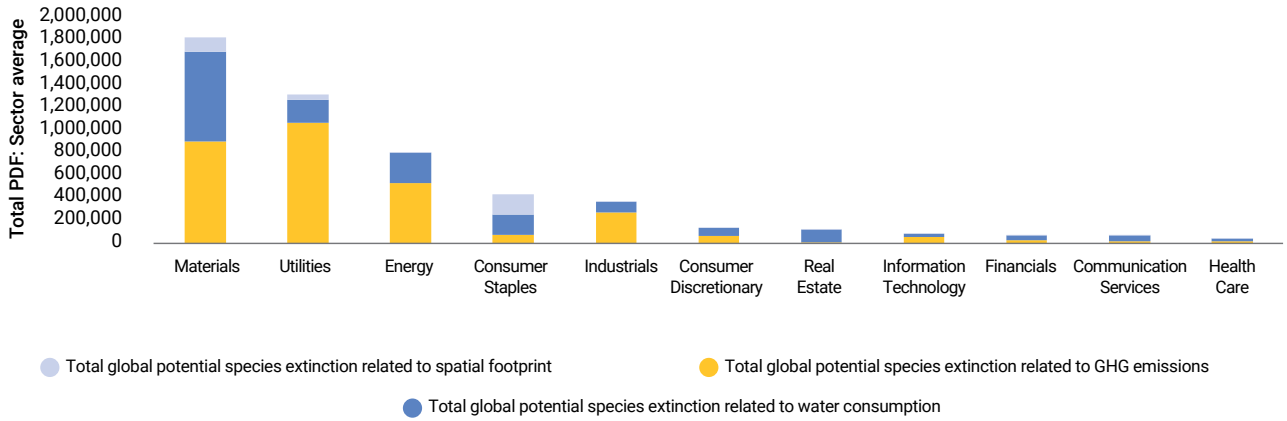
Note: We may review to integrate additional pressure categories in future versions of the biodiversity footprint metrics. This version of the metric (May 2024) is based on the categories highlighted in the blue boxes.

We calculate the PDF metric for the following pressure categories: land use, GHG emissions and water consumption.[29] The output of the PDF metric is a unitless fraction which indicates a company's potential contribution to global species extinction from the lowest (0) to the highest (1) potential contribution. We have scaled the PDF values by a factor of 100 million to increase their readability.[30]

A company's potential contribution to global species loss is driven by not just the extent of the pressures but also where the pressures occur. In biodiversity-sensitive regions, land use and water consumption tend to have higher impacts on biodiversity. We factored these geospatial-specific conditions into our biodiversity footprint metrics. As a consequence, PDF values differ within and between sectors.

At a sector level, utilities energy, and materials typically contribute to global species extinction due to their carbon- and water-intensive business. Agricultural companies in the consumer staples sector negatively impact biodiversity through their land and water use.[31]

Exhibit 10: PDF – Average by sector



Source: MSCI ESG Research, May 2024. We calculated the average PDF per sector. Sectors refer to GICS® sectors. GICS is the global industry classification standard jointly developed by MSCI and S&P Global Market Intelligence. Data refers to all constituents of the MSCI ACWI Investable Markets Index (IMI) as of May 23, 2024

29 Modeling supply chain-related impacts remains challenging due to the limited availability of consistent data across sectors and countries. Therefore, we focus on pressures caused within the direct operations of a company, but plan to review both the integration of additional pressures categories as well as potential supply chain-related pressures in future versions of our metric.

30 The highest potential PDF value is now 100 million, which corresponds to the upper range of one estimation for the number of species on our planet.

31 Based on MSCI Biodiversity Footprint methodology: Potentially Disappeared Fraction of Species (PDF) metric as of May 23, 2024

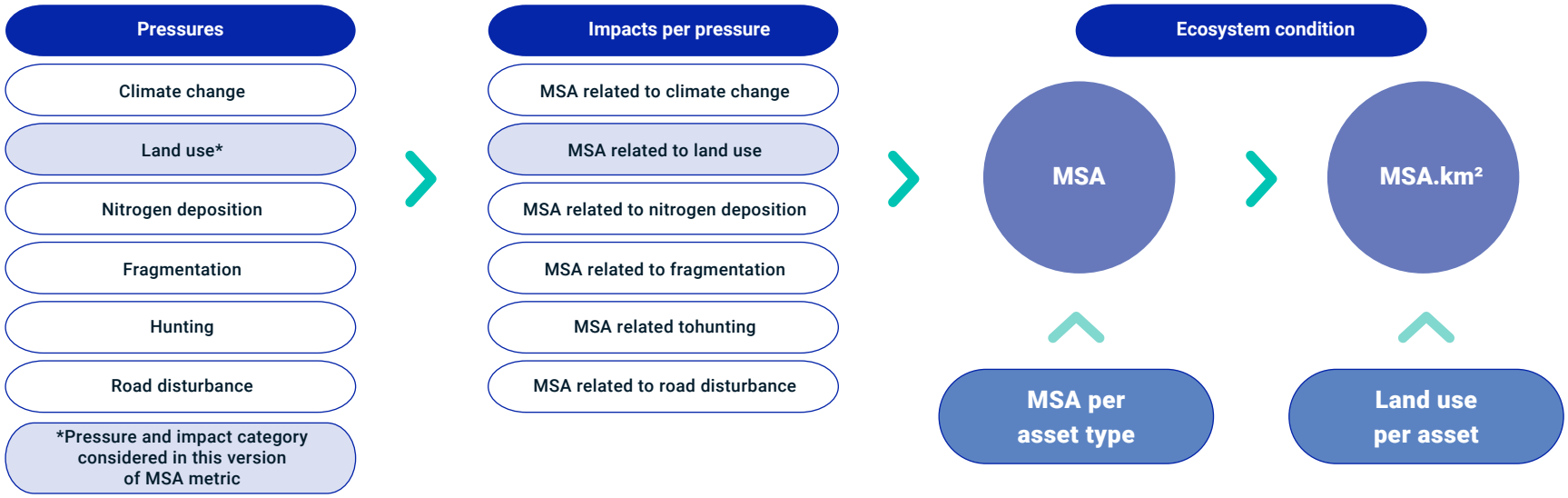
Mean Species Abundance (MSA)

In contrast, the MSA is an indicator for measuring **local biodiversity intactness** developed by the PBL Netherlands Environmental Assessment Agency. It measures the abundance of species relative to their abundance in an undisturbed ecosystem and understands any reduction through six drivers including climate change, land use, (habitat) fragmentation,[32] and road disturbance. An MSA value of 0 represents a disturbed state of an ecosystem where all (native) species are lost, while a value of 1 indicates a fully intact ecosystem.

Linking pressures categories such as hunting or fragmentation to corporate activities remains challenging. We calculate the MSA metric for the pressures that may be caused by the direct operations of a company (Scope 1) through its land use. Our MSA metric approach therefore focuses on the pressures that may be caused by the spatial extent of a company's potential contribution to the degradation of local ecosystem intactness, expressed in MSA per square kilometer (MSA.km²).

In addition, we provide intensity metrics (normalized by revenues) and percentile rankings relative to a global peer set. Investors might use these metrics for benchmarking, for example.

Exhibit 11: How to calculate MSA



Source: MSCI ESG Research, May 2024, based on the GLOBIO Model, developed by the Netherlands Environmental Assessment Agency and "Projecting terrestrial biodiversity intactness with GLOBIO 4." Aafke M. Schipper and Jelle P. Hilbers, 2019

32 Habitat fragmentation refers to the division of habitats into smaller patches that might be isolated from each other.

How can we help?

PORTFOLIO IMPACT ON BIODIVERSITY/NATURE

IDENTIFY SENSITIVE ACTIVITIES

- **Operations in biodiversity-sensitive areas:** We help investors identify companies that could directly contribute to biodiversity loss due to their operations in geographic regions that are especially vulnerable to the effects of environmental degradation and biodiversity loss.
- **Deforestation:** Our metrics can help investors identify companies that could directly or indirectly contribute to deforestation (see Exhibit 8).
- MSCI ESG Research provides data on companies involved in **business activities** that could be linked to potential loss of biodiversity, such as the production of **biocides, palm oil, or tobacco**
- Nature-related **controversies**: MSCI ESG Research captures companies associated with alleged impact on biodiversity/nature.

MEASURE IMPACT (FOOTPRINT)

- MSCI ESG Research provides quantitative data on **drivers of nature change** such as water consumption, toxic air emissions, emissions to water or GHG emissions.
- Our Biodiversity Footprint Metrics are designed to help clients quantify the local and global biodiversity footprint of investee companies. We provide both the Potentially Disappeared Fraction of Species (PDF) and Mean Species Abundance (MSA) metric.

IDENTIFY CAPACITY TO MITIGATE IMPACT

- MSCI ESG Research provides data to help identify companies well positioned to mitigate negative impacts on nature / biodiversity. This includes metrics to assess the strength of companies' policies, strategy, risk/impact management and targets on nature.

IMPACT OF BIODIVERSITY/NATURE LOSS ON PORTFOLIO

IDENTIFY PHYSICAL RISKS

- MSCI ESG Research provides metrics and data that may be used to estimate **nature-related physical risks**: data on the share of a company's operations in business segments with high potential disturbances to land and marine areas, high water intensity or high toxic emissions and waste intensity.
- In addition, we assess companies' dependency on natural commodities in certain key sectors.

IDENTIFY TRANSITION RISKS

- MSCI ESG Research provides metrics and data that may be used to estimate nature-related transition risks, such as data on the share of a company's operations in business segments with high potential disturbances to land and marine areas, high water intensity or high toxic emissions and waste intensity.

IDENTIFY GROWTH OPPORTUNITIES

- **Nature-related opportunities**: We provide data and metrics to identify companies whose products and solutions tackle the biodiversity crisis such as pollution prevention, sustainable agriculture, water treatment or other solutions.

Conclusion

Nature works for free: Half of the world's GDP depends on nature, but its services are severely overexploited. Climate change compounds nature loss but many other factors place pressures on nature. The nature loss crisis is poised to impact the global economy as well as investors who depend on a prosperous economy. Simply put, society cannot thrive without a thriving nature.

This situation is being tackled by policymakers, businesses and investors with a growing sense of urgency. Financial institutions have started to focus on risks and opportunities related to nature loss.[33] New alliances are formed, new reporting requirements are launched and an expanding body of solutions is emerging to answer different investor use cases.

Understanding connections to portfolio management and interpreting the data relevant for investors is a challenge requiring additional work. Yet this data is evolving rapidly, leveraging the latest science and academic inputs, and is now ready for investor use. MSCI ESG Research stands ready to support its clients with a new range of metrics, data solutions and research insights to guide them in this journey.

Find out more about our biodiversity-related research here: https://www.msci.com/our-solutions/climate-investing/biodiversity-sustainable-finance.

33 PRI Association. "Financial sector statement on biodiversity for COP15." Last modified November 2, 2022. https://www.unpri.org/biodiversity/financial-sector-statement-on-biodiversity-for-cop15/10750.article.

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