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Prioritising Nature-related Disclosures

Considerations for high-risk sectors

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Glossary

The following key terms are used throughout this document.

Biodiversity: The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity (CBD) 1992).

Biome: Global-scale zones, generally defined by the type of plant life that they support in response to average rainfall and temperature patterns e.g. tundra, coral reefs or savannas (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019).

Dependencies: Aspects of ecosystem services that a business or other actor relies on to function. Dependencies include ecosystems' ability to regulate water flow and water quality, as well as hazards like fires and floods, their ability to provide a suitable habitat for pollinators (who in turn provide a service directly to economies), and also their ability to sequester carbon (in—terrestrial (land), freshwater and marine—ocean-realms) (Science Based Targets Network (SBTN) 2022).

Ecosystem: A dynamic complex of plant, animal, and microorganism communities and the non-living environment, interacting as a functional unit (CBD 1992).

Ecosystem services: The contributions of ecosystems to the benefits that are used in economic and other human activity (System of Environmental-Economic Accounting Ecosystem Accounting (SEEA-EA) 2021).

Financial institutions: A broad term which encompasses banks, insurers and other financial services (including asset managers) (Taskforce on Nature-related Financial Disclosures (TNFD) 2021).

Impacts: Changes in the state of nature, which may result in changes to the capacity of nature to provide social and economic functions. Impacts can be positive or negative. They can be the result of companies' or other actors' actions and can be direct, indirect or cumulative (adapted from SBTN 2022 and Climate Disclosure Standards Board (CDSB) 2021).

Nature: The natural world with an emphasis on the diversity of living organisms (*including people*) and their interactions among themselves and with their environment (Diaz et al, 2015—IPBES Conceptual Framework).

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 (Capitals Coalition 2016).

Nature-related opportunities: Potential positive outcomes for businesses/investors and nature linked to the avoidance or reduction of impact on, and restoration of, nature. Nature-related opportunities can occur i) when businesses mitigate the risk of natural capital and ecosystem services loss and ii) through strategic transformation of business models, products, services and investments that actively work to halt or reverse the loss of nature e.g. implementation of nature-based solutions (or support for them through financing or insurance) (TNFD 2021).

Nature-related risks: Potential threats posed to a business or investor linked to its impacts and dependence on nature. These can derive from physical, transition and systemic risks (adapted from CDSB 2021 and Task Force on Climate-Related Financial Disclosures (TCFD) 2017).

Executive summary

Given the current scale and pace of nature loss (IPBES 2019), concerted action across society is needed to shift from practices with negative outcomes for nature towards those that have positive outcomes for nature. For this to happen, organisations (including businesses and financial institutions) need to assess, disclose and report on their nature-related impacts and dependencies. Not only do organisations directly or indirectly impact nature (e.g. deforestation to provide arable lands), they also depend on nature either directly or through their supply chains (e.g. pollination is essential to growth of many crops like apples). Precise assessment and disclosure of impacts and dependencies is important to enable implementation of actions to minimise nature-related risks, and to create new nature-related opportunities.

This report aims to assist financial institutions with developing a sectoral focus towards assessing nature-related risks and guide the development of potential tools and data collection methodologies. It focuses on high-dependency and high-impact sectors as priorities for initial action, providing an overview of the main dependencies and impacts for 10 high-risk sectors (adapted from the Global Industry Classification Standard, GICS) as detailed in Table 1. This can be used by FIs wishing to embark on the journey of assessing, measuring, and reporting on their nature-related risks. The list of priority sectors is based on a review of previous analyses and resources that identified nature-related risks at a sectoral level (sources provided in the Context section).

The patterns identified in this report include similarities and differences between types of nature-related risks, as shown in Table 1 below, and the data needs across key sectors. For example, for several sectors, the most material impacts on nature are land/sea use change and direct resource exploitation (two of the main drivers of biodiversity loss according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES 2019). However, there is greater variability in dependencies on nature across sectors. Additionally, while several core data needs are identical across high-risk sectors, key differences exist in the typical data availability across these.

Those patterns will also be of use to the Taskforce on Nature-related Financial Disclosures (TNFD), which was established in 2021 in response to the need for a consistent framework for risk management and disclosure of nature-related risks and opportunities. As the TNFD looks to pilot and refine its disclosure framework, similarities and differences across sectors should be accounted for to ensure the success of the final framework.

Table 1: Most significant direct impacts and dependencies on nature, by priority industry, identified through analysis of the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) knowledge base. For impacts, the figure shows very high (dark orange), or high (light orange) material impacts for each sector. For dependencies, the figure show categories of ecosystem services upon which the sector depends, with either very high (dark green) or high (light green) materiality.[1]

	Direct impacts dark orange = very high materiality light orange = high materiality					**Direct dependencies** dark green = very high materiality light green = high materiality			
	Land/sea use change	Resource exploitation[2]	Climate change	Pollution	Invasive species/ other	Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
Agriculture, forestry & fisheries									
Energy									
Mining									
Transportation									
Food and beverages									
Apparel									
Utilities									
Chemicals									
Manufacturing									
Construction									

1 Adapted and expanded from Finance for Biodiversity (2022).
2 Resource exploitation includes water use.

1. Context

There is an urgent need to work together to enable transformative change in the way economies interact with nature (IPBES 2019). This is crucial, not least because global economies are intrinsically dependent on a healthy natural world (World Economic Forum (WEF) 2020). Enabling this shift will require concerted efforts from all organisations across society, including governments, financial institutions, and businesses. Financial institutions and businesses need to understand, and address nature-related risks associated with their activities. They need to do so in the context of an enabling environment, which can be provided by governments that set in place the right policy and legislation.

Nature-related risks to businesses and financial institutions take many forms. As such they cannot be addressed through a single lens. Two key factors need to be considered when looking at these risks at the level of individual organisations: 1) their dependencies on nature; and 2) their impacts on nature. Organisations depend on nature either directly or through their supply chains (UNEP, UNEP FI and Global Canopy 2020). For example, a water utility company directly depends on the continued provision of water. A food retail company depends indirectly on natural processes such as climate regulation, which are important for the production of food crops. Similarly, organisations directly or indirectly impact on nature. These impacts can be either negative or positive. For example, a negative impact may occur through conversion of natural habitats for construction of urban infrastructure. Conversely, a positive impact may occur through restoring a degraded habitat back to a semi-natural or natural state.

While impacts are relatively well documented, dependencies remain a new topic for most sectors. Studies related to the dependencies of different economic activities on nature remain very limited. Questions over how risks arising from dependencies differ across sectors are inhibiting action to address these risks.

Demand for disclosure and accountability for nature-related risks is increasing

Recognition of the scale of nature-related risks facing businesses has driven increasing demand for greater disclosure and accountability relating to these risks. This will affect not only businesses but also their stakeholders such as investors, financiers, and insurers.

The Taskforce on Nature-related Financial Disclosures (TNFD)[3] was established in response to this need for corporate disclosure, to help the finance sector act on nature-related risks and opportunities. Launched in 2021, the TNFD is a market-led initiative to develop a disclosure framework for organisations to report and act on evolving nature-related risks. The TNFD aims to support a shift in global financial flows away from nature-negative outcomes and toward nature-positive outcomes. The TNFD will not create a new disclosure standard but will establish and promote the adoption of an integrated risk management and disclosure framework that aggregates the best tools and materials.

Progress on disclosure of nature-related performance to date has been slow (Addison, Bull and Milner-Gulland 2018; UN Environment Programme 2022a). As such the rapid, market-led and cohesive approach of the TNFD is necessary to achieve required changes in business and financial decision-making. To meet the pace set out in the TNFD's two-year workplan, there needs to be a focus on high-dependency and high-impact sectors. In addition to this sectoral prioritisation, key considerations for the success of the TNFD risk management and disclosure framework are the readiness of the corporate market for disclosure, and availability and suitability of public nature-related data to support financial decision-making—both of which are discussed in other publications (UN Environment Programme 2022a, 2022b).

This report provides an overview of main dependencies and impacts for 10 high-risk sectors. The information presented here is based on synthesis of sector-level analyses from the ENCORE tool[4] as well as several other key sources (see Annex 1). Its primary audiences are TNFD Taskforce Members and the wider TNFD Forum. However, it is also of relevance to other interested businesses and FIs who have a nascent understanding of their impacts and dependencies on nature, and who are looking to understand which sectors are high-risk and should be prioritised for nature-related disclosures. Additionally, this report aims to guide the potential development of tools or data collection methodologies, either by companies or specialised organisations.

3 More information available at: tnfd.global/

4 Available at: encore.naturalcapital.finance/en. See also Box 1.

The list of high-risk sectors covered in this report is as follows (in alphabetical order; adapted from the Global Industry Classification Standard, GICS):

1. Agriculture, forestry and fisheries
2. Energy (including oil, gas and renewables)
3. Mining
4. Transportation
5. Food and beverages
6. Apparel
7. Utilities
8. Chemicals
9. Manufacturing, including pharmaceuticals and healthcare
10. Construction

Box 1: About ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure)

ENCORE was developed by the ENCORE Partners (Global Canopy, UNEP FI and UNEP-WCMC). The first phase of work was funded by the Swiss State Secretariat for Economic Affairs (SECO) and the MAVA Foundation. The aim was to help financial institutions better understand, assess and integrate natural capital risks in their activities. In addition to the development of the knowledge base underpinning ENCORE, the project looked at how financial institutions can apply this information to screen their portfolios for natural capital risk and integrate the insights into their existing risk management processes. Initially, these pilot studies were carried out with banks in Colombia, Peru, and South Africa.

The second phase of work, funded by the Swiss Federal Office for the Environment (FOEN), further developed ENCORE by adding a biodiversity module to the tool. This helps financial institutions explore the potential alignment of their financial activities in the agriculture and mining sectors with a nature-positive future.

2. Key findings

2.1 Comparing nature-related risks for key sectors

In this section, we look at similarities and differences between the types of nature-related risks faced by priority sectors. This can complement any approaches that start with a different focus, such as on biomes. The focus on high-risk sectors can support financial institutions and other interested parties take a prioritised approach to developing their understanding of the main nature-related risks associated with different economic activities. For example, a financial institution might review the list of sectors presented here and compare this to its own portfolio to understand which sectors it should be addressing in the first instance. Additionally, the patterns in nature-related risks identified here can help the financial institution understand which elements of its nature-related reporting requirements would be common across sectors, versus those that might need to be adapted to be sector-specific.

Details can be found in Table 1 below and the main key trends and their potential implications are outlined in the following points.

- **Developing an impact disclosure framework that applies to all sectors is a viable option because there are clear similarities of impact types across the sectors.** Out of five impact categories, four are at least highly material to eight out of ten priority sectors.
- **The impacts on nature that are most frequently material are land/sea use change and direct resource exploitation, including water consumption**, especially for sectors such as mining, energy and agriculture, followed by pollution and climate change. A common framework would prioritise disclosure of land use change and resource exploitation (e.g. water use). The next priority disclosure would be pollution, while climate change is already covered by TCFD. Invasive species and other impacts (e.g. disturbances) should be covered subsequently.[5]
- **Dependencies vary more than impacts across different sectors and types of dependency.** If a common framework is designed, it needs to have some flexibility for the different sectors, alternatively, distinct sector-specific recommendations could be developed.

5 While the invasive species/others category is the one that is less often very highly or highly material, it is still highly material for four sectors, including agriculture and transportation. It therefore should still be included, in particular for those four sectors, albeit slightly lower in the overall priority order.

- **The only type of dependency found across all sectors is direct physical input, while mitigation of direct impacts appears less commonly material.** There is more variability between different sectors for the ecosystem services enabling production and protecting from disruption. Disclosures of dependencies on direct physical input should be a priority for all sectors, while those of dependencies on mitigation of direct impacts could be lower priority for all. Disclosures of dependencies on ecosystem services that enable a company's production (e.g. pollination for agriculture) and that protect the company from disruption (e.g. climate regulation for extreme weather events) could be mandatory only for some sectors.

Table 1: Most significant direct impacts and dependencies on nature, by priority industry, identified through analysis of the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) knowledge base. For impacts, the figure shows very high (dark orange), or high (light orange) material impacts for each sector. For dependencies, the figure show categories of ecosystem services upon which the sector depends, with either very high (dark green) or high (light green) materiality.[6]

	Direct impacts dark orange = very high materiality light orange = high materiality					**Direct dependencies** dark green = very high materiality light green = high materiality			
	Land/sea use change	Resource exploitation[7]	Climate change	Pollution	Invasive species/other	Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
Agriculture, forestry & fisheries									
Energy									
Mining									
Transportation									
Food and beverages									
Apparel									
Utilities									
Chemicals									
Manufacturing									
Construction									

6 Adapted and expanded from Finance for Biodiversity (2022).
7 Resource exploitation includes water use.

2.2 Comparing data needs and availability for key sectors

The main trends identified through this review and their implications are outlined in the following points, with further detail provided in Table 2 below. Similar to the previous section, this can help financial institutions and other reporting entities understand which patterns in data needs and availability they should account for when developing their nature-related reporting.

- **Several core data requirements are identical for all sectors.** This includes, among others, the need for data on the locations of activities and the pressures they are exerting on nature. These requirements could constitute a common framework that would be applicable to all companies.
- **A common framework should offer flexibility in the data collection process and the final output**. Differences in data needs between sectors are still to be expected. This means the sectors will differ in the main focus of the data required (e.g. direct operations or upstream in their supply chain) and the type of data collected.
- **There should be initial flexibility in the amount and the precision of data required to be disclosed by less advanced sectors, with the aim to strengthen requirements progressively**. While public nature-related data is available for certain sectors (e.g. on average pressures or on the state of nature, see in particular UNEP (2022b)), and some measurement approaches work for most sectors, this is not consistent across all sectors. The TNFD's concepts of data stacks and staged data collection are essential for successful uptake of the framework.

Table 2: Review of the similarities and differences in potential data needs and availability across industrial sectors to disclose nature-related risks, for four key types of data: location, state of nature, impacts and dependencies, and response data.

		Location data	State of nature data	Impacts and dependencies data	Response data
Needs	Similarities	▪ Precise geolocation of extraction/ production /operation locations, and their associated surface area, is needed	▪ Data on the state of nature at these locations is needed, e.g. through ecological assessment on sites or publicly available through tools or data layers accessible online (see examples in "Already available" category).	▪ All impacts and dependencies with a high and very high materiality rating need to be assessed ▪ Direct physical measurement is key (e.g. water use in m3) along with financial materiality[8] assessment for dependencies	▪ Details of actions taken to address impacts and dependencies is needed
	Differences	▪ In primary productive sectors, the focus will be on the location of their direct operations, whereas secondary and tertiary sectors should consider both their direct operations and their upstream supply chains	▪ In primary productive sectors, the focus will be on the state of nature for their direct operations, whereas secondary and tertiary sectors should consider both their direct operations and their upstream supply chains	▪ Different sectors might need to measure the same pressures differently e.g. substance-specific assessment of pollutants	▪ Management responses are often sector-specific, based on companies' dependencies

8 See Biodiversity Guidance to the Natural Capital Protocol, available at: capitalscoalition.org/guide_supplement/biodiversity-4/

		Location data	State of nature data	Impacts and dependencies data	Response data
Availability	Already Available	▪ Country-level location data is available across sectors ▪ Specific sectors have public databases of operations (e.g. mining sector)	▪ Public data on the state of nature is applicable across sectors, but is not available for all countries/types of ecosystems ▪ Tools and data layers already available to companies include spatial layers on hotspots of natural capital depletion[9], the Red list Index[10] for biodiversity, the World Resources Institute (WRI) Aqueduct[11] and WWF Water Risk Filter[12] tools for water, etc.	▪ Water, climate, of life-cycle assessment approaches applicable across sectors to generate impact/dependency data ▪ Some methodologies are already available to support companies in assessing their impacts and dependencies, e.g., at sector-level the ENCORE[13] methodology, or sector-specific, e.g. the Cool Farm Tool[14] for agri-commodities.	▪ Sustainability reporting is carried out across sectors, providing qualitative information as a minimum
	Shortcomings	▪ Extremely limited visibility of operation locations across supply chains, in particular associated with agri-commodities	▪ State of nature assessments are more likely to have been completed by regulated sectors e.g. extractives ▪ Format of state of nature (spatial layers or inventories) makes analysis difficult for actors with limited spatial expertise. ▪ Availability might vary if upstream supply chain data is considered.	▪ Environmental Impact Assessment (EIA)-regulated sectors will have generated more in-depth assessments ▪ Supply chain data, in particular associated with impact/dependency of agri-commodities, is rarely available ▪ Dependencies not yet routinely captured because they are a new and complicated concept	▪ No or limited quantitative reporting of outcomes from management responses across sectors ▪ Lack of independence as data is self-reported with limited transparency and therefore accountability

9 Available at: encore.naturalcapital.finance/en/map?view=hotspots
10 Available at: iucnredlist.org/resources/spatial-data-download
11 Available at: wri.org/aqueduct
12 Available at: waterriskfilter.org/
13 Available at: encore.naturalcapital.finance/en
14 Available at: coolfarmtool.org/

3. High-risk sector overviews

Introduction

This section presents overviews of 10 high-risk sectors:

1. Agriculture, forestry and fisheries
2. Energy (including oil, gas and renewables)
3. Mining
4. Transportation
5. Food and beverages
6. Apparel
7. Utilities
8. Chemicals
9. Manufacturing, including pharmaceuticals and healthcare
10. Construction

As outlined in the Proposed Technical Scope for TNFD (TNFD 2021), economic actors seeking to report on nature-related risks and opportunities will need to adopt a prioritised approach. Entities seeking to implement TNFD-aligned reporting can use the list of 10 high-risk sectors outlined here to support their prioritisation process. Further resources will be made available to support reporting entities in their implementation of the TNFD disclosure framework. For example, a report (Global Canopy and UNEP FI 2022) focused on soy in the consumer staples industry was recently released. Further pilots are expected to be released during the refinement of the TNFD disclosure framework. In addition, upcoming research from WWF, UNEP and UNDP[15] will focus on generating an improved understanding of the connection of environmental crises and gender equity, to support an integrated approach to nature-related risk management and disclosure which captures social and gender dimensions.

Dependencies and impacts will vary considerably *within* these broad sector groupings based on several factors. This includes the specific focus of economic activities within each sub-sector (e.g. crop production vs. aquaculture), the locations of economic activities, and their management practices (e.g. organic vs. conventional farming).

In each overview, we present the sector definition (based on definitions from the GICS classification categories[16]), the reason why this sector is a high-risk or priority sector, the

15 WWF GEF project "Establishing the Taskforce on Nature-related Financial Disclosures"—More information available at: wwfgef.org/gef/portfolios/establishing-the-taskforce-on-nature-related-financial-disclosures-tnfd/

16 The GICS classification is an MSCI product, last updated in 2018 (more information available at: msci.com/our-solutions/indexes/gics).

summary of the sector's direct impacts and dependencies of this sector and what potential sector-specific data could be required from companies. Examples of sector-specific data includes more details on the type of activity that is being undertaken, e.g. what type of crops is being cultivated for the agriculture sector and more details on the practices/process of the company: e.g. does the company hold sector-specific sustainability-linked certifications, or do they have specific-sector practices that have an effect on nature, e.g., the use of pesticides. Two key sources for this sector-specific data are the European Bank for Reconstruction and Development (EBRD)'s E&S risk management supporting tools and toolkits[17] and the International Finance Corporation (IFC)'s Environmental, Health, and Safety Guidelines (EHS) guidelines,[18] both freely available online.

More detailed information on impacts and dependencies of each sector can be found in the annexes: the definitions and categories of impacts (Annex 2) and dependencies (Annex 3). The reader will find further details on the impacts and dependencies materiality ratings of each sector in ENCORE.[19] Non-sector specific data requirements are outlined in section 1.2. and are not repeated in the high-risk sectors overviews.

17 More information available at: ebrd.com/who-we-are/our-values/environmental-emanual-toolkit.html

18 More information available at: ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

19 Full materiality ratings for all sectors can be found at: encore.naturalcapital.finance/en/data-and-methodology/methodology

3.1 Agriculture, forestry, and fisheries

Definition

All agricultural products producers, including crop growers, owners of plantations and companies that produce food and forestry products

Production processes identified

- Small- and large-scale irrigated & rainfed arable crops
- Small- and large-scale livestock (beef and dairy)
- Aquaculture, saltwater and freshwater wild-caught fish
- Small- and large-scale forestry

Potential sector-specific data requirements

Activity-related information

- Type of activity: what is the type of commodity produced? (e.g. growing perennial crops or livestock breeding.)
- Further refinement on the activity: e.g. exact commodities produced, or fish/wood harvested.

Practice-related information

- Existing certification: e.g. organic agriculture or FSC-certified forestry.
- Use of chemical inputs: e.g. fertilisers, pesticides, antibiotics.
- Use of Genetically Modified Organisms (GMOs).
- Intensity of the practice: e.g. livestock grazing outside or inside, number of animals/km^2.
- Compliance mechanisms: e.g. measures against illegal logging/fishing.

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
VH	VH	H	H	H

Impacts with very high materiality ratings concern ms (terrestrial, freshwater and marine) depending on the type of product, and water use. Further impacts with high materiality ratings relate to other resource use (fish), greenhouse gas (GHG) emissions, all types of pollutants, disturbances, and biological alterations (e.g. potential spread of disease through livestock, accidental release of fish species into water bodies, increased insect mortality due to pesticide use for non-target species, increased resistance to antibiotics).

Direct dependencies

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	VH	M	VH

Agricultural and forestry products is the sector most highly directly dependent on nature, with a very high dependency on three types of ecosystem services: 1) direct physical inputs such as water for crop irrigation or livestock, or fibres like wood for timber; 2) services that enable production such as pollination for agricultural products, nursery habitats for aquaculture and fishing; and 3) services that provide protection from natural hazards such as floods (e.g. from mangroves for aquaculture) and climate regulation).

3.2 Energy (including oil, gas and renewables)

Definition

All entities involved in the extraction, transport and conversion of fossil fuels (oil, gas, coal) into energy and producers of renewable energy.

Production processes identified

- Biomass, geothermal, solar, wind energy production
- Hydropower production
- Nuclear and thermal power stations
- Integrated oil & gas (oil & gas drilling, exploration surveys, refining, services, storage, transportation)

Potential sector-specific data requirements

Activity-related information

- Type of activity: what is the type(s) of energy produced/extracted (e.g. oil, gas, solar, etc.)?
- Further refinement on the activity: e.g. more details like floating offshore wind energy, shale gas, photovoltaic (PV) solar, large-scale vs. micro-scale hydro, etc.

Practice-related information

- Processes in place to monitor and abate threats to biodiversity at planning stage (e.g. wind turbines outside of bird migration routes) and throughout normal operations (e.g. fish ladder at hydropower dam).
- Processes in place to monitor safety and avoid threats that could also impact wider environment, in particular for oil & gas (e.g. fire, explosion, fuel leakage, etc.).
- Where the use of a location is temporary (e.g. drilling site), processes put in place to restore habitats on the site during decommissioning.

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
VH	VH	H	H	H

Impacts with very high materiality ratings concern ecosystem use in all realms (terrestrial, freshwater and marine) for some types of energies (e.g. all for oil & gas, freshwater for hydropower), and water use. Further impacts with high materiality ratings are linked to GHG emissions, all pollutants, disturbances and biological alterations (e.g. potential spread of invasive species).

Direct dependencies

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	VH	M	VH

The energy sector is highly dependent on nature, with a very high dependency on three categories of ecosystem services: 1) direct physical inputs such as organic matter for biomass energy production; 2) those that enable production such as water flow maintenance for hydropower or in cooling process for nuclear and thermal power; and 3) those that provide natural protection from disruption such as climate regulation for solar and wind power.

3.3 Mining

Definition

Companies of small and large scale, engaged in the diversified production or extraction of metals, consumable fuels (except for oil & gas) and minerals

Production processes identified

- Mining—Iron metal production
- Alumina refining—Steel production

Potential sector-specific data requirements

Activity-related information

- Type of activity: what are the types of resources being mined? (E.g. iron ore, lithium, etc.).
- Further refinement on the activity: what type of mining is practiced: e.g. surface or underground mining, open-cast or not, in-situ leaching, the extent of machinery used, whether some material processing is done too, whether infrastructure has been built on site (e.g., roads) etc.

Practice-related information

- Certification of the mine processes (e.g. ISO norms, Ceres, Global Reporting Initiative).
- Processes to handle waste generated while mining (mineral waste, wastewater, solvents etc.).
- Processes in place to monitor safety and avoid threats that could also impact wider environment (e.g. erosion and landslides, seismic activity, etc.).
- Processes put in place to mitigate impacts on biodiversity (e.g. noise) and to restore habitats on the mining/extraction site during decommissioning.

Impacts and dependencies overview

Direct impacts[20]

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
VH	VH	H	H	H

The highest impacts of the mining industry are its potential to severely degrade and fragment habitats (land/sea use change) and its large consumption of water, used at all stages of the mining process (e.g. cooling of drilling machinery, dust suppression, leaching solutions). Other types of impacts are climate change (GHG released through extraction), pollution (creation of waste), noise/seismic activity and invasive species.

Direct dependencies[21]

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
H	H	N/A	H

The mining sector is dependent on nature, with a high dependency on three categories of ecosystem services: 1) direct physical inputs, especially water e.g., for machinery cooling, dust suppression); 2) those that enable production such as water flow maintenance for leaching solutions; and 3) those that provide natural protection from disruption such as natural erosion control provided by vegetation, protecting the mine infrastructure.

20 While this assessment is not forward-looking, readers should note that the mining industry is expected to grow in line with increasing demand for commodities needed in the energy transition. This will likely result in changes in the scale of the mining industry's potential impacts on nature.

21 Highest materiality dependencies for mining are on the following ecosystem services: climate regulation, surface and ground water, water flow maintenance

3.4 Transportation

Definition

Companies providing air, marine and land transportation services for passengers and goods, as well as associated services (airports, ports)

Production processes identified

- distribution [including road and air transportation]
- marine transportation
- railway transportation
- marine ports and airport services

Potential sector-specific data requirements

Activity-related information

- Type of activity: what is the type of transportation considered (e.g. air, rail, road, marine)?
- Further refinement on the activity: e.g. type of vehicles, fuel on which the vehicle is running (e.g. electric vs fossil fuel car), average distance travelled per year, etc.

Practice-related information

- If potentially harmful/toxic substances are transported, processes in place to avoid leaching in the environment.
- For vehicles powered using fossil fuels, processes in place to limit the release of air pollutants (greenhouse gases and non-greenhouse gases) in the atmosphere (e.g. filtering system).
- Processes in place to mitigate the impact of vehicles and transportation infrastructure to biodiversity (e.g. ensure connectivity with wildlife crossings etc.).

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
H	H	H	H	H

The transportation industry has a high materiality rating for all direct impact categories: land/sea use change, e.g. ports increasing the erosion of marine and coastal ecosystems, water use, e.g., airports require large volumes of water, climate change, e.g. most vehicles types are GHG emitters, pollution, e.g., transport of potentially harmful substances, and invasive species/other, e.g. light and noise pollution and can contribute to the spread of invasive species.

Direct dependencies[22]

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
H	M	N/A	VH

The transportation sector is dependent on nature, with a very high or high dependency on two categories of ecosystem services: 1) those that provide natural protection from disruption such as climate regulation to protect transportation infrastructure like railroads or highways from extreme weather events; 2) direct physical inputs, in particular dependency on water, e.g. in airports for aircrafts or in ports where water levels need to be maintained or for cleaning purposes.

22 Highest materiality dependencies for transportation are on the following ecosystem services: climate regulation, flood and storm protection, mass stabilisation and erosion control, surface and ground water

3.5 Food and beverage

Definition

All companies producing beverages including brewers, distillers and vintners, and soft drinks producers, as well as packaged foods and meat, but excluding companies directly producing agricultural products

Production processes identified

- Alcoholic fermentation and distilling
- Processed food and drink production

Potential sector-specific data requirements

Activity-related information

- Type of activity: what type of food and/or drink is the company producing (e.g. soft drinks, beer, processed meat)?
- Further refinement on the activity: e.g. what processes are used to produce the food and drinks; which steps of (meat) processing are completed in-house?

Practice-related information

- Processes to handle the waste created in the production steps (e.g. using food waste to produce animal feed or fertiliser, what is done with unavoidable waste).
- Procedures to minimise water use (e.g. filtering and reusing wastewater).
- Policies to increase traceability/sustainability of sourced ingredients (including certifications).

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
N/A	H	H	H	N/A

The highest impacts of the food and beverage sector are: 1) its water use, which occurs in large quantities in all steps of the production of processed food and beverages, including fermentation and distilling; and 2) its emissions of greenhouse gases and other pollutants (e.g. ammonia in the meat industry, packaging waste for both food and beverages, solid residues from distilling processes).

Direct dependencies

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	M	L	M

The highest dependency of the food and beverage sector is on water, due to its large consumption at all steps of the production of processed food and drinks (including cleaning throughout each step). The sector is also dependent on water quality and water flow maintenance, genetic materials (e.g. specific strains of yeast for fermentation), and protection of infrastructure from floods and storms.

3.6 Apparel

Definition

All companies manufacturing textiles and clothing-related goods, including jewellery and footwear.

Production processes identified

- Footwear production
- Jewellery production
- Natural fibre production
- Synthetic fibre production

Potential sector-specific data requirements

Activity-related information

- Type of activity: what is the main type of commodity produced (e.g. clothing, jewellery, footwear, or a mix)?
- Further refinement on the activity: e.g. what type of raw materials are used (e.g. animal or plant fibres, synthetic fibres, metals, minerals) and main processes applied to transform/refine those raw materials.

Practice-related information

- Use of chemical and of products that are potentially toxic/harmful to the environment, and processes to dispose of this waste (including wastewater).
- Processes to increase traceability/sustainability of sourced ingredients (including certification).
- Processes used to reduce water consumption during manufacturing steps.

Impacts and dependencies overview

Direct impacts[23]

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
H	VH	H	H	ND

The highest impact of the apparel sector is its water use, which occurs in large quantities in textile manufacturing (especially for natural fibres). Next are emissions of GHG and other pollutants (e.g. production waste such as unused fibres, solvents, colourants, oils etc.) and land use for natural fibre production (e.g. hemp, cotton, especially when intensive agriculture is practiced.).

Direct dependencies

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	M	L	M

The highest dependency of apparel is direct physical input, especially water needed in high quantities for processes such as textiles manufacturing (e.g., cleaning and processing of natural fibres; use in chemical reactions to produce synthetic fibres). It also depends on the provision of animal and plant fibres, natural dyes, and other materials such as metals and minerals.

23 Highest materiality impacts for the apparel industry are the following: water use, terrestrial ecosystem use, greenhouse gases emissions, non-greenhouse gases air pollutants, solid waste.

3.7 Utilities

Definition

All activities of companies engaging in the distribution/transport of electricity, gas and water to the end consumer, as well water treatment systems and environmental facilities.

Production processes identified

- Electric/nuclear power transmission and distribution
- Environmental and facilities services
- Gas distribution and retail
- Water services (e.g. wastewater, treatment and distribution)

Potential sector-specific data requirements

Activity-related information

- Type of activity: what activity in the utilities sector is the company involved in (e.g. water, gas, electricity-related or environmental services)?
- Further refinement on the activity: this could include type of infrastructure used for distribution network (e.g. for electricity—underground or surface power lines), type of services provided (e.g. for water—distribution, treatment, storage).

Practice-related information

- Processes used to minimise disruption to ecosystems that host the infrastructure (e.g. to minimise fragmentation of habitats).
- For water services and environmental facilities, processes to minimise the release of waste (including wastewater) in the environment (e.g. the current maximum frequency and acceptable conditions of wastewater release in local fresh or seawater systems).

Impacts and dependencies overview

Direct impacts				
Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
H	H	H	M	N/A

The highest impacts of the utilities sector are the changes to land use that they can cause (e.g. water treatment services can significantly change freshwater ecosystems like rivers; gas and power distribution networks fragment landscapes), the use of water (e.g. for water services), and the emissions of greenhouse gases (e.g. methane leaks from pipelines).

Direct dependencies			
Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	VH	M	VH

The utilities sector is highly dependent on nature, with a very high dependency on water and water flow maintenance (especially for water services). The sector also has a very high dependency on natural flood and storm protection to shield distribution networks (especially for electricity distribution). Similarly, the sector has a medium dependency on erosion control to protected critical infrastructure (e.g. critical infrastructure).

3.8 Chemicals

Definition

All producers of commodity, diversified, fertilizers & agricultural and specialty chemicals and industrial gases

Production processes identified

- catalytic cracking, fractional distillation & crystallisation
- cryogenic air separation—gas adsorption
- incomplete combustion—membrane technology
- natural gas combustion—polymerisation
- recovery and separation of carbon dioxide
- solids processing—synthetic fertilizer production—vulcanisation

Potential sector-specific data requirements

Activity-related information

- Type of activity: what are the main production processes in use (e.g. cracking, distillation)?
- Further refinement on the activity such as exact types of chemicals produced and their classification (e.g. perfluorinated chemicals such as PFAS and PFOS).

Practice-related information

- For the main chemicals handled, especially if they are released in the environment, the classes and categories of the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals[24] (e.g. acute aquatic toxicity of Category 2—environmental hazard).
- Processes in place to handle chemical waste (solid, liquid and gaseous waste): percentage of waste treated/recycled vs waste released in the environment and potential waste monitoring).
- Production of chemicals not yet regulated by environmental agencies.

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
H	VH	H	H	ND

The highest impacts of the utilities sector are the changes to land use that they can cause (e.g. water treatment services can significantly change freshwater ecosystems like rivers; gas and power distribution networks fragment landscapes), the use of water (e.g. for water services), and the emissions of greenhouse gases (e.g. methane leaks from pipelines).

Direct dependencies[25]

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
H	M	L	M

The chemicals sector is highly dependent on water, and water flow maintenance, with water being used at various stages of the production processes (e.g. cooling, washing, steam cracking). Other dependencies include protection from disruption for infrastructures (e.g. erosion control, climate regulation) and mitigation of impacts (e.g. filtration of chemical waste by ecosystems).

24 See UN website for more information: unece.org/reports-32.

25 Highest materiality dependencies for chemicals are on the following ecosystem services: surface and ground water.

3.9 Manufacturing, including pharmaceuticals and healthcare

Definition

All manufacturers of physical commodities and goods, including pharmaceuticals and healthcare, but excluding food and beverages, chemicals and apparel (see other sectors)

Production processes identified

- Commercial printing
- Electronics and hardware production
- Glass making
- Houseware and specialities production
- Metal processing
- Forest and wood-based products
- Health care equipment production
- Life science, pharma and biotech manufacture and tools and services
- Manufacture of machinery, parts and equipment
- Manufacture of semiconductor equipment
- Paper packaging production
- Production of paper products
- Production of leisure or personal products
- Provision of health care
- Managed health care
- Semiconductor equipment production
- Tyre and rubber production

Potential sector-specific data requirements

Activity-related information

- Type of activity: what is the main type of good being produced (e.g. ceramic dishes)?
- Further refinement on the activity: such as information on the main industrial processes used in the production of those goods (e.g. glassmaking, organic synthesis, etc.).

Practice-related information

- Processes to reduce water consumption during the steps of the manufacturing process.
- Processes to handle and minimise the waste produced during the manufacturing steps (e.g. filtering potential air pollutants produced).
- Procedures to increase traceability/sustainability of sourced raw materials, especially when rare or directly harvested in nature (e.g. pharmaceutical components), including certification.

Impacts and dependencies overview

Direct impacts				
Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
N/A	VH	H	H	M

The highest impact of the manufacturing sector is linked to its water use (very high materiality rating), especially for industrial processes such as glassmaking, houseware, or paper production. This is followed by the sector's potential for greenhouse gas emissions (e.g. due to the use of machinery), and emissions of an array of pollutants and waste linked to manufacturing processes (e.g. non-product outputs such as glass, metal, plastic).

Direct dependencies			
Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	M	L	M

The main dependency of the manufacturing sector is on ecosystem services providing direct physical inputs, in particular water (used in many manufacturing processes; e.g. for cooling and cleaning) and materials such as minerals or metals. Other dependencies include those on ecosystem services such as water flow maintenance and flood and storm protection.

3.10 Construction

Definition

All companies engaging in the manufacture of building components and the construction and maintenance of residential and non-residential infrastructure (including civil engineering and contractors).

Production processes identified

- Construction
- Construction materials production
- Infrastructure builds
- Infrastructure maintenance contracts

Potential sector-specific data requirements

Activity-related information

- Type of activity: what activity in the construction sector is the company practicing (e.g. production of construction materials, building construction or civil engineering)?
- Further refinement on the activity: e.g. type of building/infrastructure under construction, type of site (greenfield vs. brownfield), materials and processes used in the construction works, the sustainability of those materials and their sourcing, extent of landscape modifications.

Practice-related information

- Processes in place to dispose of construction-related waste in a way that does not affect the environment, including waste created at the end of life of built infrastructure.
- Processes in place to screen the areas selected for development/construction work for potential impacts on species (e.g. IUCN Red List, Key Biodiversity Areas, etc.) and processes in place to mitigate potential negative impacts (e.g. avoidance of key zones, measures supporting landscape connectivity).

Impacts and dependencies overview

Direct impacts

Land/sea use change	Resource exploitation	Climate change	Pollution	Invasive species/other
VH	H	H	H	M

The highest impacts of the utilities sector are the changes to land use that they can cause (e.g. water treatment services can significantly change freshwater ecosystems like rivers; gas and power distribution networks fragment landscapes), the use of water (e.g. for water services), and the emissions of greenhouse gases (e.g. methane leaks from pipelines).

Direct dependencies

Direct physical input	Enabling production	Mitigating direct impacts	Protecting from disruption
VH	M	M	H

The highest dependency of the construction sector is its dependency on water (very high materiality rating), which is essential as a direct physical input to several processes in construction works. This is followed by high dependence on ecosystem services providing the sector with natural protection from disruption, such as flood and storm protection and climate regulation.

Annexes

Annex 1: Existing research

This Annex provides a summary of the main sources used for the identification of high priority sectors in this report.

<table>
<tr><th>Source</th><th>Short description</th><th>Main limitations</th></tr>
<tr><td rowspan="2">UN Environment Programme, UNEP Finance Initiative and Global Canopy (2020)</td><td colspan="2">Identified a set of priority sectors for biodiversity-related target setting. Aimed to 1) enable a better understanding of the business sectors at risk from the loss of biodiversity; and 2) lay out an initial approach to enable financial institutions to set evidence-based biodiversity targets in line with international policy developments.

List of priority sectors identified based on qualitative information contained in the ENCORE knowledge base for both dependencies and impacts. Refined by the financial flows to each sector (with sectors receiving higher financial sectors flagged as higher priority).

The resulting list of priority sectors is as follows:</td><td rowspan="2">Coverage of dependencies and impacts

The analysis only covered direct dependencies and impacts. As such it did not consider indirect or cumulative dependencies and impacts. These should also be considered carefully by organisations in their decision-making.

Global scope of analysis

The analysis adopted a global view, meaning it was not tailored to individual national socio-economic or environmental conditions. Additionally, the analysis did not consider sectoral overlap with or proximity to sensitive biodiversity features.</td></tr>
<tr><td>▪ Agricultural Products
▪ Apparel, Accessories & Luxury Goods
▪ Brewers
▪ Distribution
▪ Electric Utilities
▪ Independent Power Producers & Energy Traders</td><td>▪ Mining
▪ Oil & Gas Exploration & Production
▪ Oil & Gas Storage & Transportation</td></tr>
</table>

<table>
<tr>
<td>WEF (2020)</td>
<td colspan="2">Laid out the business case for why companies and the economy should be concerned by the current crisis engulfing nature.

Focused on risks emerging from dependencies of businesses on nature and outlined a list of sectors at highest risk. Used a combination of qualitative ENCORE dependencies data and quantitative data from Multi-Regional Input-Output models. Found that $44 trillion of economic value generation (over 50% of global Gross Domestic Product) is moderately or highly dependent on nature and its services.

The resulting list of priority sectors is as follows:

▪ Forestry
▪ Agriculture
▪ Fishery and aquaculture
▪ Food, beverages and tobacco
▪ Heat utilities

▪ Construction
▪ Electricity
▪ Water utilities
▪ Supply chain and transport
▪ Chemical and materials industry</td>
<td>Aggregation of materiality ratings

To combine ENCORE dependency data with quantitative economic data from Input-Output models, dependency materiality ratings were aggregated. This loses some degree of granularity in the dependencies ratings for different sectors.

Use of modelled economic data

Linked to the above point, while Multi-Regional Input-Output models help understand flows of finance or materials between sectors and countries, each model comes with its own trade-off between sectoral granularity and geographic granularity. Additionally, the methodology states Gross Value Added (GVA) was used to determine nature dependency at sector level. Given that products increase in value as they near the consumer end of value chains, this means that primary sectors, where most nature-related risks occur, can be perceived as lower having lower economic value. In it unclear if or how this was accounted for in the methodology.</td>
</tr>
</table>

<table>
<tr><td rowspan="2">Trucost (2013)</td><td colspan="2">Estimated in financial terms the risk from unpriced natural capital inputs to production across a broad range of sectors and regions. Assessed primary production sectors and a selection of primary processing sectors.
Focused on impacts (externalities) from land use, water consumption, GHG emissions, air pollution, land and water pollution, and waste.
The resulting list of priority sectors is as follows (aggregated here from multiple sub-lists for simplicity; includes greatest overall impact and sectors with at least 50% of impacts in their supply chain):</td><td rowspan="2">Global scope of analysis
The report provides a global view of impacts per sector at a regional level. It therefore does not capture intra-national trends, differences in technologies, or differences in business practices.
Use of modelled economic data
The report relied on modelled data from an environmentally extended input-output model. This could be strengthened by using primary data for impacts (externalities).</td></tr>
<tr><td>▪ Coal power generation
▪ Cattle ranching and farming
▪ Iron and steel mills
▪ Farming (wheat and rice)</td><td>▪ Soybean and other oilseed processing
▪ Animal processing (incl. poultry)
▪ Wet corn milling
▪ Beet sugar manufacturing</td></tr>
<tr><td rowspan="2">SASB (2018)</td><td colspan="2">SASB focus on how sustainability affects enterprise value creation and identify which are the most financially material issues for different industries. SASB cover different risks and opportunities per industry based on overarching Environmental, Social and Governance criteria.
The resulting list of sectors is as follows (based on nature-related criteria used by SASB):</td><td rowspan="2">Coverage of nature-related topics
Under the Environment dimension SASB cover GHG emissions, air quality, energy management, water & wastewater management, waste & hazardous materials management, ecological impacts. It is unclear if or how these cover aspects such as use of natural resources (e.g. biomass) and other forms of pollution such as noise or light pollution.
Lack of sector prioritisation
While SASB Standards are detailed and specific to each sector, there is not list of priority sectors provided based on environmental criteria. Within sectors, it is unclear whether sustainability disclosure topics are scored or compared in any way.</td></tr>
<tr><td>▪ Agricultural products
▪ Alcoholic beverages
▪ Transportation
▪ Renewable resources and alternative energy</td><td>▪ Extractives and minerals processing
▪ Forestry
▪ Food and beverage
▪ Chemicals</td></tr>
</table>

<table>
<tr>
<td>Allianz Global Corporate & Specialty (2018)</td>
<td>Provided an overview of natural capital risk and levels of mitigation based on analysis of 2,500 companies in 12 sectors. Focused on risks (related to both dependencies and impacts) and classified sectors into three ‘zones’ accordingly: 1) Danger zone; 2) Middle zone; 3) Safe haven.
The Danger zone represents sectors where risks are generally greater than mitigation. The Middle zone, where risks tend to match mitigation. The Safe haven represents sectors that do not seem to face high risks and/or that typically have reasonable safeguards in place.
The resulting list of priority sectors is as follows:
▪ Oil and gas
▪ Mining
▪ Food and beverage
▪ Transportation
▪ Automotive
▪ Chemical
▪ Clothing
▪ Construction
▪ Manufacturing
▪ Pharmaceuticals
▪ Utilities</td>
<td>Use of proxy data
The quantitative aspect of the methodology used proxies for risks and mitigation measures relating to aspects of natural capital. This could be strengthened by using primary data.
Coverage of nature-related topics
While the coverage of nature-related topics is relatively broad, it is unclear if or how the methodology covered trends in these risks in the marine and freshwater realms.</td>
</tr>
<tr>
<td>Organisation for Economic Co-operation and Development (OECD) (2018)</td>
<td>OECD guidance aims to support multinational enterprises with implementing its recommendations for due diligence. The guidance focuses on risks associated with negative impacts that different economic activities can have on people, the environment and society.
The guidance was compiled through a multi-stakeholder process involving representatives from OECD and non-OECD countries, as well as businesses, industry bodies and civil society groups.
The OECD developed sector-specific guidance for the following sectors:
▪ Agriculture
▪ Garment and footwear
▪ Minerals
▪ Extractives
▪ Financials</td>
<td>Lack of sector prioritisation
While OECD Due Diligence guidance is detailed and includes information specific to individual sectors, by nature the guidance offers no prioritisation or comparison of sectors based on environmental criteria.</td>
</tr>
</table>

Annex 2: Detailed list of direct impacts[26]

Nature-related issue area	Impact driver	Definition
Land/Water/ Sea Use Change	Terrestrial ecosystem use	Examples include area of agriculture by type, area of forest plantation by type, area of open cast mine by type, etc.
	Freshwater ecosystem use	Examples include area of wetland, ponds, lakes, streams, rivers or peatland necessary to provide ecosystem services such as water purification, fish spawning, areas of infrastructure necessary to use rivers and lakes such as bridges, dams, and flood barriers, etc.
	Marine ecosystem use	Examples include area of aquaculture by type, area of seabed mining by type, etc.
Resource exploitation	Water use	Examples include volume of groundwater consumed, volume of surface water consumed, etc.
	Other resource use	Examples include volume of mineral extracted, volume of wild-caught fish by species, number of wild-caught mammals by species, etc.
Climate Change	GHG emissions	Examples include volume of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_{20}), Sulphur hexafluoride (SF_6), Hydrofluorocarbons, (HFCs) and perfluorocarbons (PFCs), etc.

26 Definitions of impact drivers are drawn from ENCORE, while the classification of nature-related issue areas is the one defined by the *Science-based Targets for Nature Initial Guidance for Business* (SBTN 2020), inspired by the five main drivers of nature loss, as presented by IPBES (2019).

Pollution	Non-GHG air pollutants	Examples include volume of fine particulate matter (PM2.5) and coarse particulate matter (PM10), Volatile Organic Compounds (VOCs), mono-nitrogen oxides (NO and NO2, commonly referred to as NOx), Sulphur dioxide (SO2), Carbon monoxide (CO), etc.
	Water pollutants	Examples include volume discharged to receiving water body of nutrients (e.g., nitrates and phosphates) or other substances (e.g., heavy metals and chemicals).
	Soil pollutants	Examples include volume of waste matter discharged and retained in soil over a given period.
	Solid waste	Examples include volume of waste by classification (i.e., nonhazardous, hazardous, and radioactive), by specific material constituents (e.g., lead, plastic), or by disposal method (e.g., landfill, incineration, recycling, specialist processing).
Invasives and Other	Disturbances	Examples include decibels and duration of noise, lumens and duration of light, at site of impact.
	Biological alterations/ interferences	Examples include number of non-native and invasive animals or plants released by species, area of agriculture with genetically modified organisms or reduced genetic diversity, number of animals at risk of catching cattle-transmitted disease by species, etc.

Annex 3: Detailed list of direct dependencies

Cate-gory	Ecosystem service	Definition
Direct Physical Input	Animal-based energy	Physical labour is provided by domesticated or commercial species, including oxen, horses, donkeys, goats and elephants. These can be grouped as draught animals, pack animals and mounts.
	Fibres and other materials	Fibres and other materials from plants, algae and animals are directly used or processed for a variety of purposes. This includes wood, timber, and fibres which are not further processed, as well as material for production, such as cellulose, cotton, and dyes, and plant, animal and algal material for fodder and fertiliser use.
	Genetic materials	Genetic material is understood to be deoxyribonucleic acid (DNA) and all biota including plants, animals and algae.
	Ground water	Groundwater is water stored underground in aquifers made of permeable rocks, soil and sand. The water that contributes to groundwater sources originates from rainfall, snow melts and water flow from natural freshwater resources.
	Surface water	Surface water is provided through freshwater resources from collected precipitation and water flow from natural sources.

Enables Production Process	Maintain nursery habitats	Nurseries are habitats that make a significantly high contribution to the reproduction of individuals from a particular species, where juveniles occur at higher densities, avoid predation more successfully, or grow faster than in other habitats.
	Pollination	Pollination services are provided by three main mechanisms: animals, water and wind. The majority of plants depend to some extent on animals that act as vectors, or pollinators, to perform the transfer of pollen.
	Soil quality	Soil quality is provided through weathering processes, which maintain bio-geochemical conditions of soils including fertility and soil structure, and decomposition and fixing processes, which enables nitrogen fixing, nitrification and mineralisation of dead organic material.
	Ventilation	Ventilation provided by natural or planted vegetation is vital for good indoor air quality and without it there are long term health implications for building occupants due to the build-up of volatile organic compounds (VOCs), airborne bacteria and moulds.
	Water flow maintenance	The hydrological cycle, also called water cycle or hydrologic cycle, is the system that enables circulation of water through the Earth's atmosphere, land, and oceans. The hydrological cycle is responsible for recharge of groundwater sources (i.e. aquifers) and maintenance of surface water flows.
	Water quality	Water quality is provided by maintaining the chemical condition of freshwaters, including rivers, streams, lakes, and ground water sources, and salt waters to ensure favourable living conditions for biota.
Mitigates Direct Impacts	Bio-remediation	Bio-remediation is a natural process whereby living organisms such as micro-organisms, plants, algae, and some animals degrade, reduce, and/or detoxify contaminants.
	Dilution by atmosphere and ecosystems	Water, both fresh and saline, and the atmosphere can dilute the gases, fluids and solid waste produced by human activity.
	Filtration	Filtering, sequestering, storing, and accumulating pollutants is carried out by a range of organisms including, algae, animals, micro-organisms and vascular and non-vascular plants.
	Mediation of sensory impacts	Vegetation is the main (natural) barrier used to reduce noise and light pollution, limiting the impact it can have on human health and the environment.

Protection from Disruption	Buffering and attenuation of mass flows	Buffering and attenuation of mass flows allows the transport and storage of sediment by rivers, lakes and seas.
	Climate regulation	Global climate regulation is provided by nature through the long-term storage of carbon dioxide in soils, vegetable biomass, and the oceans. At a regional level, the climate is regulated by ocean currents and winds while, at local and micro-levels, vegetation can modify temperatures, humidity, and wind speeds.
	Disease control	Ecosystems play important roles in regulation of diseases for human populations as well as for wild and domesticated flora and fauna.
	Flood and storm protection	Flood and storm protection is provided by the sheltering, buffering and attenuating effects of natural and planted vegetation.
	Mass stabilisation and erosion control	Mass stabilisation and erosion control is delivered through vegetation cover protected and stabilising terrestrial, coastal and marine ecosystems, coastal wetlands and dunes. Vegetation on slopes also prevents avalanches and landslides, and mangroves, sea grass and macroalgae provide erosion protection of coasts and sediments.
	Pest control	Pest control and invasive alien species management is provided through direct introduction and maintenance of populations of the predators of the pest or the invasive species, landscaping areas to encourage habitats for pest reduction, and the manufacture of a family of natural biocides based on natural toxins to pests.

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