A-Track

Integrating nature information into decision-making

An assessment of user needs

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1 Executive Summary

Nature data (raw unprocessed facts collected about the natural world with an emphasis on its living component) needs to be transformed into nature information (structured and interpreted indicators that support decision making) to maximize its applications across both public and private sectors. An understanding of the information needs of different users and applications is needed to address any gaps in the availability or accessibility of existing data.

For businesses, nature information underpins the 'assess' step of the Assess, Commit, Transform and Disclose (ACT-D) framework (Natural Capitals Coalition, 2024), and information needs are therefore rapidly evolving in response to emerging voluntary and mandatory assessment and disclosure frameworks. These frameworks guide through steps of locating interfaces with nature, prioritizing nature related issues and assessing impacts, dependencies risks and opportunities. Information collected and collated through assessment processes can support wide ranging internal decision making as well as external reporting and disclosure.

For financial institutions, nature information is needed to underpin high-level risk assessment and portfolio/projects management strategies. The granularity of information required varies from high-level screening of sectors and companies for ESG integration and thematic investing, to more in-depth information on the ground to support focused impact investment and stewardship strategies.

For the public sector, nature information supports policy design, implementation and evaluation across multiple themes, including biodiversity protection, macroeconomic decision making and public procurement, and nature information needs are evolving in relation to national and international frameworks including the adoption of the Kunming-Montreal Global Biodiversity Framework.

Common data and information needs can be identified when looking across business, finance, and the public sector (Figure 1), which is important to establish nature information pathways. Significant barriers exist however, for different users to apply nature data for decision making, including variability in data quality, accessibility and interpretability.

Natural Capital Accounting structures and principles present a mechanism for harmonizing data between sectors, and producing information that meets the shared needs. These accounting principles also have potential to address many cited barriers to access and uptake of data. This use of natural capital accounting will be explored through further work of the A-Track project.

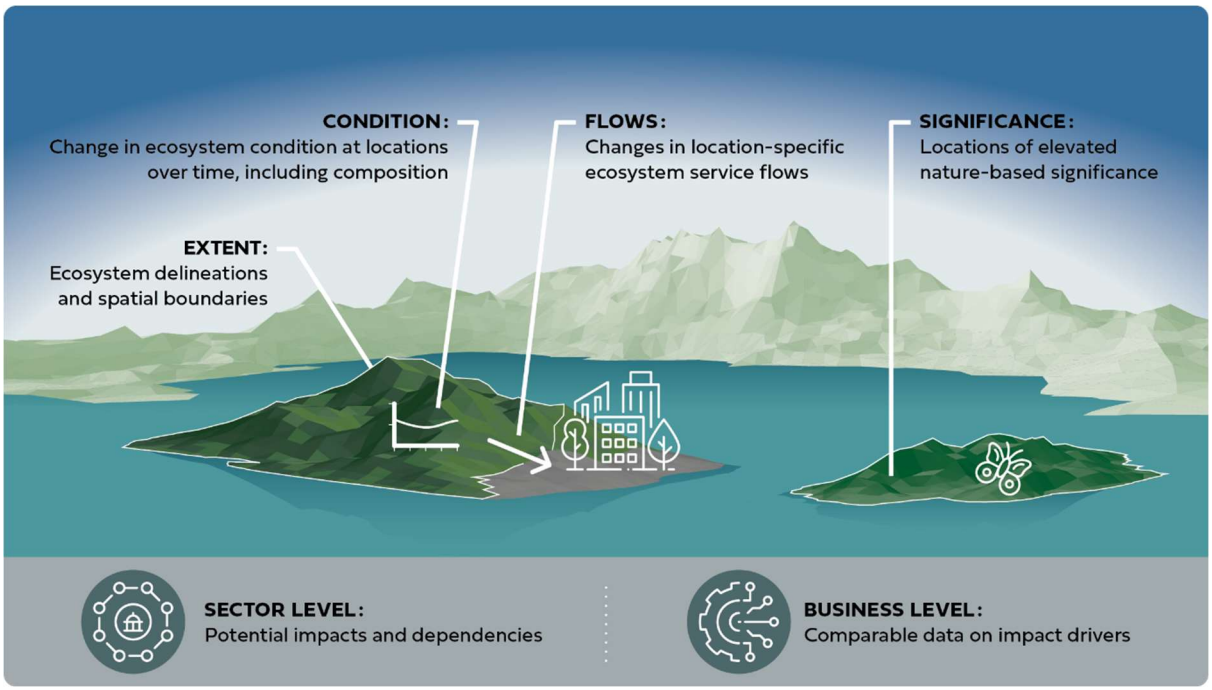


Figure 1. Common data needs identified across private and public sectors

2 Introduction

It is widely recognized that halting and reversing the ongoing global decline in nature requires transformation of economic systems, encompassing collective action across business, financial institutions, and governments. Data and information on nature is a requirement for all sectors to more effectively assess and act on nature-related risks and opportunities (Dasgupta, 2021), set credible targets, develop innovative business models and implement new and existing policies. Underpinning this system-wide transformation is a need for a more comprehensive data and information system, where nature related data, and insights from this data, flows from collection to application between business, finance, and governments. This information system could then better support robust and integrated decision making and the tracking of progress towards goals and targets. Accounting processes, where data is collected, organized, and aggregated in systematic and comparable accounts presents a potential mechanism to facilitate these flows of data from collection to application in decision making, which will be explored through the A-Track project.

A foundational step of this work is therefore to understand the core 'data and information needs' of business, finance, and governments in relation to nature. Both the private and public sector have been collecting and maintaining nature-related data to a degree before the, now rapid, emergence of new policies and initiatives on climate and nature. However, information needs of businesses are now evolving with the development of new voluntary corporate frameworks and standards, including the Taskforce on Nature-related Financial Disclosures (TNFD) and the Global Reporting Initiative (GRI) Standards, and regulations mandating corporate disclosure, such as the European Union Corporate Sustainability Reporting Directive (CSRD). These frameworks and standards are shaping the way institutions assess and manage their interactions with nature and where data needs are currently growing.

Similarly, within the finance sector, awareness of risks posed by the degradation of nature is rapidly increasing, and there is an ever-increasing demand for information that helps identify and manage these nature-related financial risks within portfolios. Data needs from governments are also rapidly evolving with the adoption of the Kunming-Montreal Global Biodiversity Framework, and the need to monitor implementation of National Biodiversity Strategies and Action Plans (NBSAPs). More regionalized and policies also drive information and data needs. For example, in the European Union context, the Habitat[1], Bird[1], and Marine Directives[1], requires Member States to report against targets on a regular basis. Lasty, the EU Nature Restoration Law will also require that a monitoring and reporting system is in place

[1] For the definition of these terms, please refer to the TNFD Glossary (https://tnfd.global/publication/glossary/)

following a standardized data collection method and exchanged with the European Environment Agency[2].

This assessment report aims to underpin the broader work on nature data and information within the A-Track project, including supporting selecting relevant applications for demonstration cases, and developing guidance for both private and public sector users. The assessment will combine desktop research of initiatives and standards, semi-structured interviews, and project survey results to establish data and information needs, find commonalities between sectors, and identify key barriers when accessing, using and sharing nature-related data. The report is structured in five core sections:

1. Data and information need for assessing business dependencies, impacts, risks, and opportunities;
2. Data and information need for integrating nature into financial sector decision-making;
3. Data and information needs for public sector decision-making;
4. Common data and information needs across business, finance, and public sector;
5. Key Barriers to access, use, and share nature information for decision making by the private sector and public sector.

This data and information needs assessment lays the background information for the next phase of this work, where demonstration cases will be developed on how accounting structures and principles can facilitate private sector actors applying public data to inform their nature-related assessments, and governments using private data to support decision making.

[2] See more at https://www.eea.europa.eu/en/datahub/eea-data-policy

3 Approach to defining 'data and information' needs

"*Data*" and "*information*" are not always the same. Two simple definitions below delineate these two concepts, which underpins this data needs assessment.

i. Nature data: Comprises raw, unprocessed facts that need context to become useful.
ii. Nature Information**:** Structured data on the set of characteristics that need to be observed, measured, and interpreted to make decisions about nature.

'*Nature Information Pathways* (NIP)' describe how primary nature-related primary data (data originally generated that has not been processed or changed) is structured, transformed, and applied for different decisions by different sectors. Nature Information Pathways help conceptualize the difference between 'data' and 'information'. A simplified summary of a Nature Information Pathway is presented in Figure 2. Further details outlining the broader nature information pathway concept applied in A-Track is the focus of A-Track activity 2.2 In this report we use this simplified framework to structure the assessment of user needs

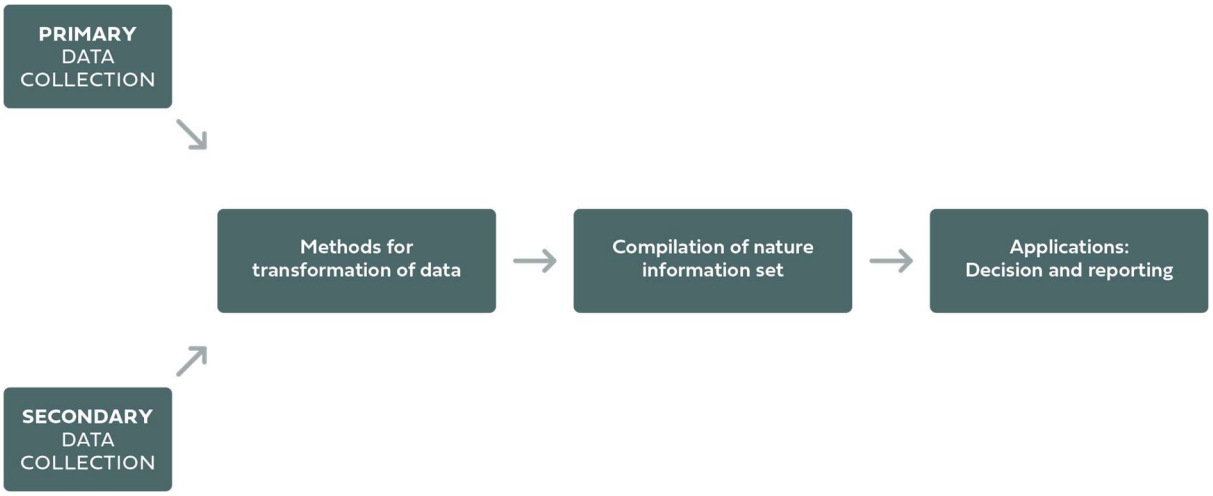


Figure 2. Simplified Nature Information Pathway

For different decision-making contexts, and starting with the application and working backwards along the information pathway, this user needs assessment considers where relevant:

1. **The Application -**describes a purpose of the data and information within a given decision making context.
2. **The 'Nature Information set' -**describes the information required to support this application. This includes indicators produced from bringing together multiple sources of structured and transformed nature data, as well as supplementary

information, including 'non-nature' data, required to provide context and support interpretation.

3. **The Primary and Secondary nature data** needed by a user to produce this nature information set (e.g., what is the nature data needed to be collected or sourced by a decision maker to create this information set (Box 1).
4. **Data underpinning methods for transformation of data:** what data underpins methods and models that transform data for specific applications.

Box 1: Primary and secondary data definitions

Primary data refers to raw data collected by a specific user to inform a specific application of that data by the user. For example, a government body wanting to assess the health status of a river may go out and collect water quality and invertebrate samples to inform that assessment.

Secondary data refers to data that is applied by a user for a decision that was not necessarily collected by that user or intended for that specific decision. It is often more transformed than raw data. For example, government samples of water quality and invertebrates may be used to create a spatial layer of the health status of different water basins. A property development business might then apply this spatial layer to inform its risk mitigation strategy. Here, the property company hasn't directly measured water quality and invertebrate communities itself but applied secondary public sector data.

3.1 Key concepts relevant for this assessment

The goal of this needs assessment is to describe the nature information required for different decision-making contexts across the public and private sectors, with associated suitable data characteristics required to produce these information sets. To standardize the understanding of the information and data characteristics, the sections below describe the key data concepts and data characteristics that underpin this report.

3.1.1 Type of nature data

For the context of this publication, *nature* will be considered according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) definition:

> *"In the context of IPBES, nature refers to the natural world with an emphasis on its living components. Within the context of western science, it includes categories such as biodiversity, ecosystems (both structure and functioning), evolution, the biosphere, humankind's shared evolutionary heritage, and biocultural diversity. Within the context of other knowledge systems, it includes categories such as Mother Earth and systems of life, and it is often viewed as inextricably linked to humans, not as a separate entity*."
>
> Taken verbatim from 2021 IPBES

Nature data can describe many different aspects relevant to decision making. A proposed structure for types of nature data is developed in A-Track activity 2.2, but four core distinctions are made here that are relevant for this assessment, and are used in this report under the following definitions:

i. Pressures/impact drivers: measurable inputs and outputs from activities that cause changes in the extent and condition of ecosystems (Natural Capital Coalition, 2016).
ii. Stocks/ state of nature: Refers to data describing biophysical aspects of the extent and condition of ecosystems. 'Impacts' in this context are therefore defined as a measurable change in the properties (extent and condition) of ecosystems (IPBES).
iii. Ecosystem service flows: Refers to data describing the flows of benefits being provided by ecosystems to people (IPBES).
iv. Responses/actions: Refers to data describing actions taken to address nature impacts and dependencies.

3.1.2 General data characteristics

Any source of nature data can be evaluated for its appropriate use for a given decision-making context. Six broad characteristics which are referred to within this assessment, outlined below. While many characteristics should apply to a dataset for its use in any application (relevance, accessibility), some broad data characteristics can be useful to articulate differences in data needs in different contexts (e.g. accuracy).

i. Relevance: how pertinent the data is to the purpose.
ii. Accuracy: Whether the data is correct and effectively describes real-world conditions.
iii. Verifiability: if the data can be traced and confirmed.
iv. Representativeness: how well the data represents the event or concept it describes.
v. Reproducibility: if the data can be consistently reproduced
vi. Accessibility: how easy it is to obtain and use the data.

3.1.3 Quantitative and Qualitative data

Quantitative data is, by definition, numeric variables or measures of values expressed in numbers. **Qualitative data, on the other hand, are categorical and can be represented by names, symbols or codes, among others.** For example, an institution might use quantitative data to express the extent of habitat areas under management (e.g., expressed in thousands of hectares). Qualitative data, in turn, can be used, for example, to describe the current state of a given species in the IUCN Red List (e.g., endangered).

Quantitative and qualitative data can be directly measured or inferred through models. Directly measured data involves collecting primary data. Modelled data refers to a value that was estimated through characterizing patterns in other primary data. For example, footprint indicators are mostly modelled data.

3.1.4 Static, responsive data and forward-looking

A key characteristic introduced in this assessment to describe metrics and datasets is whether they are 'static' providing a snapshot of information at one period, 'responsive' where data is collected over time to create a time-series dataset which can show changes and trends over time, or 'forward-looking' which requires forecast of how the data can behave in the future. While time-series data are required to understand impacts and performance, it depends on the granularity of what is being measured as to what a time-series will be able to detect. For example, a time-series of broad land use type conversions at a specific location may not be able to detect finer scale changes in land management such as reductions in fertilizer use, or management of on-site habitats.

3.1.5 Spatial scales

Nature-related data can be collected and applied at different scales. The appropriate spatial scale of data in turn depends on the decision-making context. For example, while on-site mitigation planning may require site-scale nature-related data, understanding whether a site has impacts on ecological connectivity may require nature-related data at wider landscape scales. This landscape scale is likely to be larger than the area on which a business collects any primary data on the state of nature. Similarly, aggregated reporting by governments on biodiversity targets may require data to be aggregated to country and regional scales.

4 Data and information need for assessing business dependencies, impacts, risks, and opportunities

Businesses are key actors in achieving global goals for nature. A first step for key decision-makers within the private sector to address nature-related issues is assessing their nature related dependencies, impacts, risks, and opportunities.[3] The assessment process involves several steps, each requiring the collection of various types of data, including spatial and non-spatial, primary and proxy data.

To facilitate the disclosure of companies on their nature-related issues, most reporting frameworks and standards also provide guidance on how to conduct such assessments. While the details of these frameworks differ, they largely converge on a similar structure. While many assessment frameworks and standards have been developed, this section of the user needs assessment focuses on steps that are common across three major reporting (and assessment) frameworks and standards as examples: the European Sustainability Reporting Standards (ESRS), the Global Reporting Initiative (GRI) Biodiversity standard, and the Taskforce on Nature-related Financial Disclosures (TNFD). We distinguish these assessment and disclosure standards from initiatives to standardize specific methods (e.g. Life Cycle assessments) such as the Product Environmental Footprint (PEF)[4].

Box 2: Introduction of different assessment (and disclosure) frameworks

European Sustainability Reporting Standards (ESRS)[5]

"In July 2023, the European Commission adopted the European Sustainability Reporting Standards (ESRS) for use by all companies subject to the EU Corporate Sustainability Reporting Directive (CSRD). The subjected companies will have to report environmental, social and governance sustainability related information according to the ESRS. Reporting will be mandatory for the first group of companies in financial year 2024. The ESRS

[3] For the definition of these terms, please refer to the TNFD Glossary (https://tnfd.global/publication/glossary/)

[4] For more information on these methods please refer to https://green-business.ec.europa.eu/environmental-footprint-methods_en

[5] For the full EU Regulation text please refer to https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302772

comprise the General requirements, General disclosures, as well as topical standards focusing on environmental, social, and governance related disclosures."

Taken verbatim from 2024 UN Environment Programme Finance Initiative

Among the topical standards, ESRS E4 is particularly focused on biodiversity and ecosystems. The disclosure requirements cover different areas such as strategy, policy, and targets, with nature-related impacts, dependencies, risks, and opportunities as the main reporting themes in these areas. To facilitate disclosure, it also provides companies with Application Requirements to help them conduct assessments according to the disclosure requirements.

Global Reporting Initiative (GRI)[6]

"The Global Reporting Initiative (GRI) is an independent, international organization that helps businesses and other organizations in reporting impacts. The GRI Standards are a modular system of interconnected standards comprising: the GRI Universal Standards, the GRI Sector Standards, and the GRI Topic Standards. While the Universal Standards are applicable to all companies, the Sector Standards and the Topic Standards apply to companies in specific sectors and when the topics are material respectively."

Taken verbatim from 2024 UN Environment Programme Finance Initiative

Nature-related topic standards in GRI are mostly covered in GRI 101: Biodiversity 2024, together with GRI 305: Emissions and GRI 306: Waste.[7]

"The Biodiversity Standard, aligned with the goals and targets of the Kunming-Montreal Global Biodiversity Framework, helps organizations to better understand which decisions and business practices lead to biodiversity loss, where in their value chain impacts occur, and how they can be managed."

Taken verbatim from 2024 Global reporting Initiative

Guidance has been provided in the standard to help companies assess and report their biodiversity impacts based on the GRI requirement.

[6] https://www.globalreporting.org/

[7] https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/

Taskforce on Nature-related Financial Disclosures (TNFD)[8]

"Established in 2021, the Taskforce on Nature-related Financial Disclosures (TNFD) is a global, market-led initiative with the mission to develop and deliver a risk management and disclosure framework that can be used by organizations of all sizes in all jurisdictions to identify, assess, manage and disclose nature-related dependencies, impacts, risks and opportunities, and with the ultimate aim of supporting a shift in global financial flows away from nature-negative outcomes and toward nature-positive ones.

As a voluntary framework, TNFD seeks to provide recommendations and guidance of relevance to a wide range of market participants include financial institutions, corporates, and various types of business organizations.

In September 2023, TNFD has released Version 1.0 of the framework for market adoption(Recommendations of the Taskforce on Nature-related Financial Disclosures, 2023). This was accompanied by the Guidance on the Identification and Assessment of Nature-related Issues: the LEAP Approach.9 The LEAP Approach has provided companies a detailed methodology for the assessment of nature related issues."

Taken verbatim from 2024 UN Environment Programme Finance Initiative

4.1 Component 1: Prioritization of potentially material/most significant nature-related issues

A company can have multiple interfaces with nature based on its sector, value chain and geography. In order to effectively conduct detailed evaluation and assessment on the nature-related issues that have the highest potential to be material (seem to be most significant), it would be important to first filter and prioritize nature related issues that the company is facing. This step is covered by the Locate phase in the TNFD assessment guidance (LEAP approach), which helps companies to identify a company's potentially material sources of nature-related dependencies, impacts, risks and opportunities (Taskforce on Nature-related

[8] For further information on the TNFD please refer to https://tnfd.global/

[9] For further information on the Locate Phase of the TNFD LEAP approach please refer to https://tnfd.global/publication/additional-guidance-on-assessment-of-nature-related-issues-the-leap-approach/

Financial Disclosures, 2023).[10] Aligning with TNFD, ESRS recommends companies to assess the materiality of biodiversity and ecosystems by first localizing relevant sites regarding the company's interface with biodiversity and ecosystems in their direct operation and value chain (European Commission, 2023).[11] Similarly, when identifying the most significant (material) impacts on biodiversity, GRI recommends companies to first locate where impacts are most likely to be present and significant.[12]

The prioritization of potentially material/ most significant nature related issues can be conducted through 3 components: High-level dependencies and impacts screening, location identification, and determination of biodiversity importance/significance.

4.1.1 Category 1: High-level Dependency and Impact Screening

This component helps companies to screen sectors, value chains and direct operations associated with potentially moderate and high dependencies and impacts on nature to aid prioritization. Underpinning such high-level screening processes is a set of data on the relationship between different sectors, economic activities and their dependency and impacts. Tools such as ENCORE and SBTN materiality tool are available in the market to provide such analysis with their own underlying database.[13] [14]

Table 1. Nature information sets used for high-level dependency and impact screening

Function	Screening sectors, value chains and direct operations associated with potentially moderate and high dependencies and impacts on nature, to aid prioritization.
Nature information set	Qualitative indicators of potential nature-related impacts and dependencies related to the company's sector and value chain.

[10] TNFD LEAP Approach Guidance, p. 41-65.

[11] ESRS E4 Application Requirement 7, ESRS document p. 144.

[12] GRI 101: Biodiversity 2024, p. 16-22. (https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/)

[13] For more information, visit ENCORE (https://encorenature.org)

[14] For more information, visit SBTN Materiality Screening tool (https://sbtn.shinyapps.io/MaterialityScreeningTool/)

	Sectors and economic activities operated in and within value chain, turnover and spend data
Data underpinning methods	Quantitative, or qualitative sectoral level values of impact drivers / pressures on nature and dependencies on ecosystem services

4.1.2 Category 2: Location Identification

Companies should also locate the sites in the direct operation and value chains using spatial data. These spatial data can be used to source information related to the biomes and specific ecosystems that these sites interface with. Examples of tools available include the Integrated Biodiversity Assessment Tool (IBAT), Global Map of Ecoregions, and Global Forest Watch.[15] [16] [17]

Table 2. Nature information sets used for location identification

Function	To understand which ecosystems are present at the locations where the company operates or influences though supply chains
Nature information set	A list of locations for activities (direct operations and value chain), along with the biomes they fall in Spatial data (points, polygons) of sites/locations in the companies' direct operations and value chain and corresponding spatial data on biomes and ecosystems present

[15] For more information, visit Integrated Biodiversity Assessment Tool (IBAT) (https://www.ibat-alliance.org/)

[16] For more information, visit Global Map of Ecoregions (https://databasin.org/datasets/68635d7c77f1475f9b6c1d1dbe0a4c4c/)

[17] For more information, visit Global Forest Watch (https://www.globalforestwatch.org/)

Primary and secondary data	Secondary spatial data on biomes and ecosystem boundaries
Relevant data characteristics	Responsiveness: Static 'snapshot' data; Spatial scale: The spatial scale of the ecosystem typology applied likely depends on the position in the value chain. For example, supply chains may be located to biome level, whereas direct operational sites may be located to ecosystem functional type level.

4.1.3 Category 3: Sensitive location identification

To further identify ecologically/biodiversity-sensitive locations within and nearby companies' direct operation and value chain sites, they can use a set of criteria that defines such sensitive locations. TNFD itself has provided definition on sensitive locations.

Box 1.Sensitive Locations defined by TNFD

"According to TNFD, sensitive locations are defined as

1. *Areas important for biodiversity, including species;*
2. *Areas of high ecosystem integrity;*
3. *Areas experiencing rapid decline in ecosystem integrity;*
4. *Areas facing high physical water risks; and*
5. *Areas important for ecosystem service provision, including benefits to Indigenous Peoples, Local Communities, and stakeholders.*

Only one criterion needs to be met to constitute a sensitive location."

Taken verbatim from 2023 Taskforce on Nature on Nature-related Financial Disclosures

Table 3. Nature information sets used for sensitive location identification

Function	Identify locations that have high biodiversity importance or significance.
Nature information set	Summary values across key metrics that describe sensitivity for each location. Can be further aggregated into rankings to aid prioritization. Spatial data (points, polygons) on the companies' direct operations and value chain and their overlap with sensitive locations
Primary and secondary data needed	- Spatial data that covers the sensitive location criteria, which includes: o *"Areas of high ecosystem integrity;* o *Areas important for biodiversity, including endemic and threatened species;* o *Areas of rapid decline in ecosystem integrity;* o *Areas of high physical water risks;* o *Areas of importance for ecosystem service provision, including benefits to Indigenous Peoples, Local Communities and stakeholders."* The sensitive location criteria are taken verbatim from 2023 Taskforce on Nature on Nature-related Financial Disclosures
Relevant data characteristics	- Responsiveness: static 'snapshot' data layers; - Spatial scale: likely applied across the wider landscape to provide context (e.g., not just within site boundaries).

Consequently, different spatial data layers will be needed to analyze whether locations within/near the operation sites meet these criteria. With both the biodiversity/ecologically sensitive location and the location with high impacts and dependencies identified, companies can then prioritize sites satisfying both criteria and further evaluate impacts and dependencies at location in the next stage.

Table 4. Example data layers and metrics that can be applied to analyze sensitive area criteria

Sensitive area criteria	Example secondary data	Underlying data
Ecosystem Integrity	• Ecosystem Integrity Index (EII); • IUCN Red List of Ecosystems database.	Spatial distribution of anthropogenic land use and other pressures, including infrastructure
Biodiversity Importance	• World Database of Protected Areas (WDPA); • Key Biodiversity Areas (KBA).	Spatial data showing boundaries of Protected Areas and Key Biodiversity Areas
Ecosystem Service Delivery Importance	• Indigenous Peoples' and community-conserved territories and areas (ICCAs); • Critical Natural Asset layers.	Spatial data mapping Indigenous Peoples' and community-conserved territories and areas Ecosystem services data underpinning global models used to identify Critical Natural Assets
Water Physical Risk	• WRI Aqueduct Water Risk Atlas and Tools • WWF Water Risk Filter	Spatial data on water risk parameters

4.2 Component 2: Evaluation of Impacts and Dependencies

After locating and prioritizing the most sensitive locations, all assessment and frameworks require identifying and measuring the business' impacts and dependencies at location level

(UN Environment Programme Finance, 2024).[18] This component applies geo-specific information on impact drivers and changes in the state of nature in terms of ecosystem condition, species, and ecosystem services.

4.2.1 Evaluation of Impacts

Three components can be considered when evaluating impacts on nature: i) impact drivers, ii) changes to the stocks/state of nature (e.g.: extent and condition of ecosystems) and iii) changes in the flow of ecosystem services (UN Environment Programme Finance, 2024).[19] Measuring each of these components will require the use of different metrics and datasets specific to the business' activity.

Impacts can also be considered as either potential impacts, or realized impacts, which is an important distinction as they provide different information and require different underlying data. Potential impacts are ones that are either predicted, or inferred, based on the impact drivers and sensitivity of the location. Realized impacts refer to changes in the state of nature that have occurred, which can be observed and measured over time. Mitigation measures, and other external factors may mean realized impacts differ from potential impacts. A higher level of accuracy and precision of underlying data is required to move from potential impacts to measuring realized impacts.

Life Cycle Assessments are a category of methods for evaluating the potential impacts of products and services along their full value chain (from 'cradle to grave'). First an 'inventory' of pressures such as emissions and land use are produced for different stages of the value chain. Next, characterization *factors* are applied, which estimate a change in state based on the given level of impact driver. Ongoing developments in Life Cycle Assessment methods are increasing the coverage of biodiversity impacts within available characterization factors (Damiani, et al., 2023). Often, these characterization factors are applied in methods outside of strict 'Life Cycle' contexts and are used to estimate potential impacts without explicitly considering the full life cycle. These can be thought of as 'Life Cycle Approaches', as they have been derived from Life Cycle Assessment methods.

[18] Accountability for Nature report p. 30-34

[19] Accountability for Nature report p. 30-34

Table 5. Components to consider for impact on nature evaluation

	Potential Impacts	Realized Impacts
Purpose	Identify and assess potential impacts at each assessment location associated with their business activities	Measure and track realized impacts at priority locations associated with their business activities
Primary and secondary data needed	Impact drivers to estimate change in state of nature through characterization factors	Primary or secondary data on ecosystem extent and condition at location over time
Relevant data characteristics	Impact driver data at company level provides a more granular and accurate estimation of potential impacts than sector average impact driver data	Responsive data over time, able to detect changes resulting from mitigation measures

Component 1: Impact drivers

The five IPBES direct drivers of biodiversity loss and ecosystem change are included by all frameworks and standards for the measurement of business impact drivers (UN Environment Programme Finance, 2024). While multiple metrics can be used to measure the company's contribution to each individual impact driver category, guidance such as the LEAP approach has provided a list of metrics under each impact driver to guide companies on what to assess (Taskforce on Nature-related Financial Disclosures, 2023).[20] Consequently, different data will be needed for the measurement of each impact driver.

[20] TNFD LEAP Approach Guidance p. 157-184

Table 6. Different types of impact drivers and examples of primary and secondary data needs for measurement (Taskforce on Nature-related Financial Disclosures, 2023) [21]

Drivers of Nature change	Impact driver category	Primary and secondary data needs
"Land/ freshwater/ ocean-use change"	*"Land/ freshwater/ ocean-use change"*	*"Extent of land/ freshwater/ocean ecosystem use change (km^2) by:* • *Type of ecosystem* • *Type of business activity"*
"Climate Change"	*"GHG emissions"*	*"ISSB reporting on GHG emissions"*
"Resource-use/Replenishment"	*"Water-use"*	*"Total volume of water withdrawal and consumption (m^3)*
	"Other resource use"	*"Quantity of wild species (tonnes and/or number of individual specimens, by species) extracted from natural habitats for commercial purposes."*
"Pollution/pollution removal"	*"Non-GHG air pollution"*	*"Non-GHG air pollutants (tonnes) by type:* *i. Particulate matter (PM2.5 and/or PM10);* • *Nitrogen oxides (NO_2, NO and NO_3);* *ii. Volatile organic compounds (VOC or NMVOC);* *iii. Sulphur oxides (SO_2, SO, SO_3, SOX);* • *Ammonia (NH_3)."*

[21] Adapted from TNFD LEAP Table 22

Drivers of Nature change	Impact driver category	Primary and secondary data needs
	"Water Pollution"	*"Volume of water discharged (m^3), split into:* • *Total;* • *Freshwater;* • *Other."*
	"Soil Pollution"	*"Number of soil-related detrimental impact incidents experienced by organisation by location."*
	"Waste"	*"Weight of hazardous and non-hazardous waste (tonnes) disposed of, split into:* *iv. Waste incinerated (with and without energy recovery);* • *Waste sent to landfill;* • *and Other disposal methods."*
	"Disturbances"	• *"Percentage of light fixtures that fully cut-off or fully shielded or below 60W;* • *Outdoor lighting (lumen/ha)."*
"Invasive species and other"	*"Biological Alterations"*	*"Proportion of high-risk activities operated under appropriate measures to prevent unintentional introduction of IAS, or low-risk designed activities."*
Impact driver category and primary and secondary data needs examples are taken verbatim from 2023 TNFD		

Changes to the State of Nature

A full assessment of either potential or realized impacts requires an assessment of change in the state of nature resulting from business activities (e.g., change in ecosystem extent and condition, and change in species populations), with differing levels of accuracy and precision. The approach to assessing impact on the state of nature will vary depending on the decision-making context. Two broad categories of methods for assessing the change in the state of nature are illustrated in Figure 3 and detailed below in table 7.

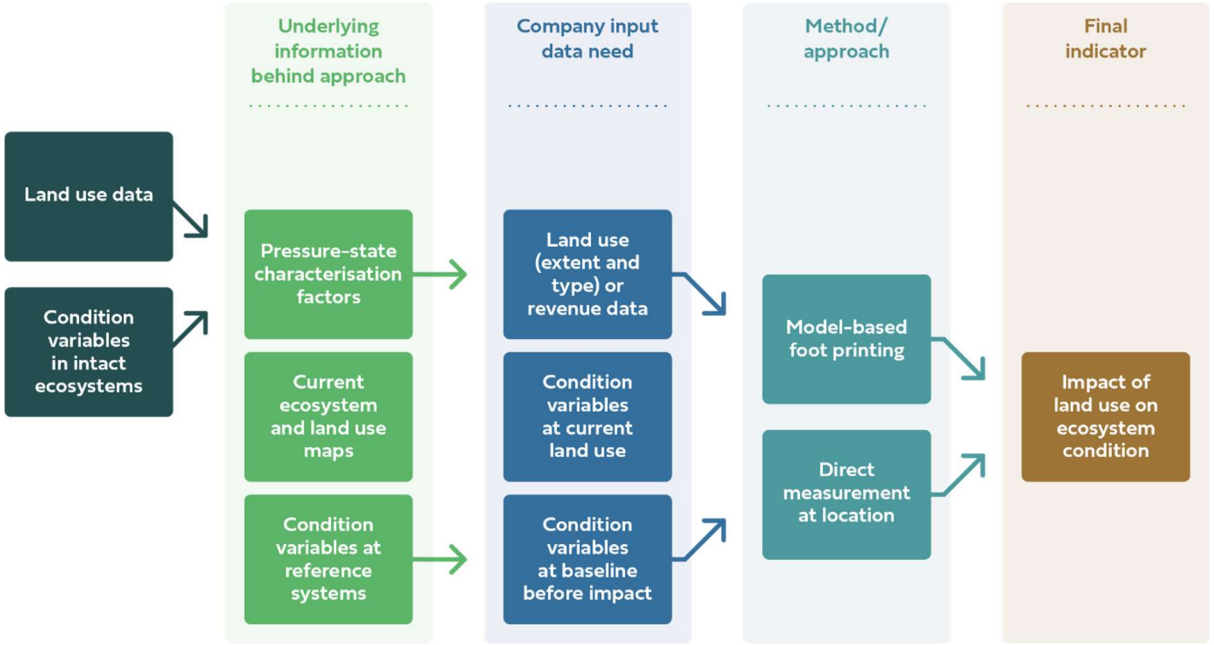


Figure 3. Two broad categories of approaches to assessing change in state of nature

Table 7. Data needs for approaches to assess change in the state of nature

Approach to assessing change in state of nature	Potential or realized impacts	Description	Data needed as input by company	Data needed to underpin approach
Life-cycle approaches including model-based foot printing	Potential	Estimates change in the state of nature against a pristine reference condition caused by impact drivers	Primary or sector average data on impact drivers (known as the 'inventory' within Life Cycle Assessment). Can be estimated from spend data.	- *Geospatial Data on state of nature within pristine reference conditions;* - *Data on relationship between pressure and change in state to produce characterisation factors.*
Measuring change in state of nature at locations against a baseline	Realized	Direct measurement to track changes in specific ecosystem assets and species at a given location in relation to business activities. Measurements may be based on primary data or taken from secondary data if they have the correct spatial granularity and responsiveness.	- *Responsive data on state of nature at location* - *Data on state of nature at baseline chosen*	Geospatial data on state of nature within reference conditions

While the different frameworks vary in their specificities on state of nature methods and metrics, all frameworks and standards recognize that measuring changes in the state of nature includes covering species and ecosystems (UN Environment Programme Finance, 2024). Further detail on the concepts of ecosystem extent and condition, the foundational concepts to describe stocks of nature within the UN-SEEA, is provided in Activity 2.2.

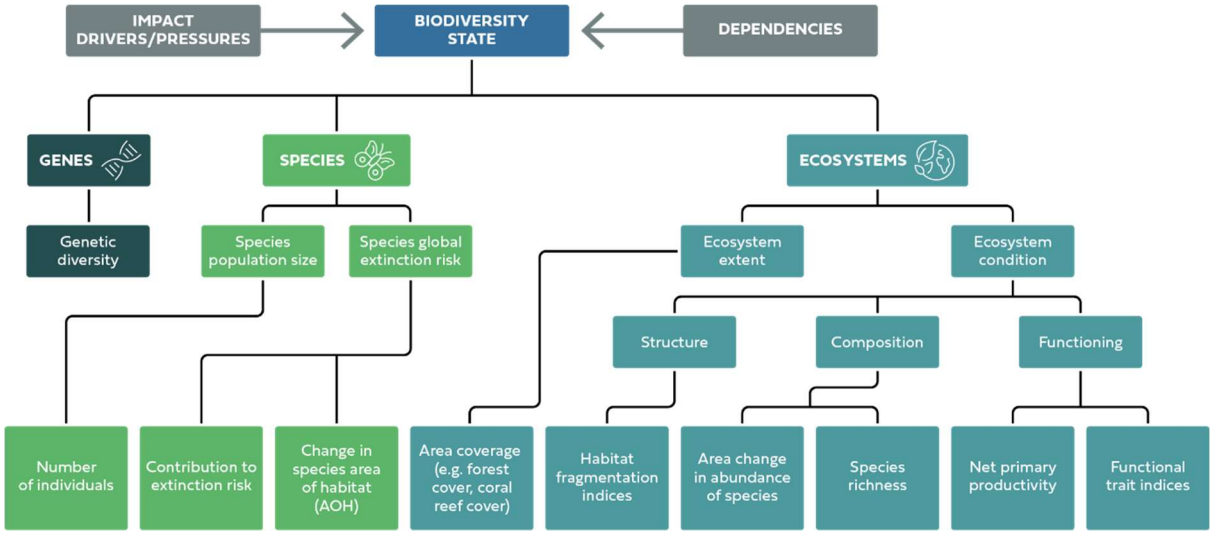


Figure 4. Components of biodiversity and example measurement indicators from Align recommendations (UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe, 2022)

Ecosystem condition

Frameworks and standards share similar definition on the term ecosystem condition. While TNFD follows SEEA EA in defining it as the quality of an ecosystem measured by its abiotic and biotic characteristics, GRI similarly defines it as the quality of an ecosystem measured by its living and non-living characteristics against a reference condition (Taskforce on Nature-related Financial Disclosures, 2024) (Global Reporting Initiative, 2024).[22] [23]

TNFD, GRI, and ESRS all advise that assessing ecosystem condition involves evaluating its composition, function, and structure (Taskforce on Nature-related Financial Disclosures,

[22] TNFD Glossary p. 21

[23] GRI 101: Biodiversity 2024 p. 29

2023) (Global Reporting Initiative, 2024) (European Commission, 2023).[24] Additionally, both GRI and TNFD also incorporate the measurement of physical and chemical state characteristics (e.g., soil structure and nutrient levels) and landscape characteristics (e.g. connectivity) (Taskforce on Nature-related Financial Disclosures, 2023) (Global Reporting Initiative, 2024) [25] [26]. The table below brings examples of metrics for the different types of conditions and its data needs.

Table 8. Primary and secondary data needs for ecosystem extent and condition measurement (UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe, 2022) [27]

Component	Primary and secondary data needs	Example
"Ecosystem extent"	*"Measures of area coverage of a particular ecosystem without necessarily considering the quality of the area being assessed."*	*"Forest Cover"*
"Ecosystem Condition – Structure"	*"Measures of aggregate properties of ecosystems, irrespective of specific species composition, such as vegetation height and balance of different levels of food webs. At landscape level, structure also includes levels of fragmentation and connectivity (i.e. how linked one piece of habitat is to another)."*	*"Fragmentation Indices"*
"Ecosystem Condition – Composition"	*"Measures of composition covering multiple species (rather than the number of a individuals within a single species) within an ecosystem."*	- *"Mean Species Abundance (MSA)*

[24] TNFD LEAP Approach Guidance p. 185-221, GRI 101: Biodiversity 2024 p. 29, ESRS p. 265

[25] TNFD LEAP Approach Guidance p. 187, GRI 101: Biodiversity 2024 p. 29

[26] TNFD considers connectivity is measured as part of the structure

[27] Table adapted from Align Recommendations for a standard on corporate biodiversity measurement and valuation Table 3

		- *Potentially Disappeared Fraction (PDF)"*
"Ecosystem Condition – Functioning"	*"Measures of processes (or function) that the ecosystem completes or reflects the ability to undertake these processes (e.g. through using functional traits as a proxy)"*	*"Net Primary Productivity (NPP)"*
Taken verbatim from 2022 UNEP-WCMC, Capitals Coalition, Arcadis, ICF, and WCMC Europe		

Ecosystem condition metrics, and how they are measured, vary in two core ways:

i. Scale of specificity to ecosystem types: While some metrics measure 'generic' condition variables that are applicable across different ecosystem types (e.g., species richness), others measure variables specific to individual ecosystems (e.g., canopy height, coral cover).
ii. Directness of measurement: While some metrics are measured directly, others are inferred based on the pressure data (measured indirectly).

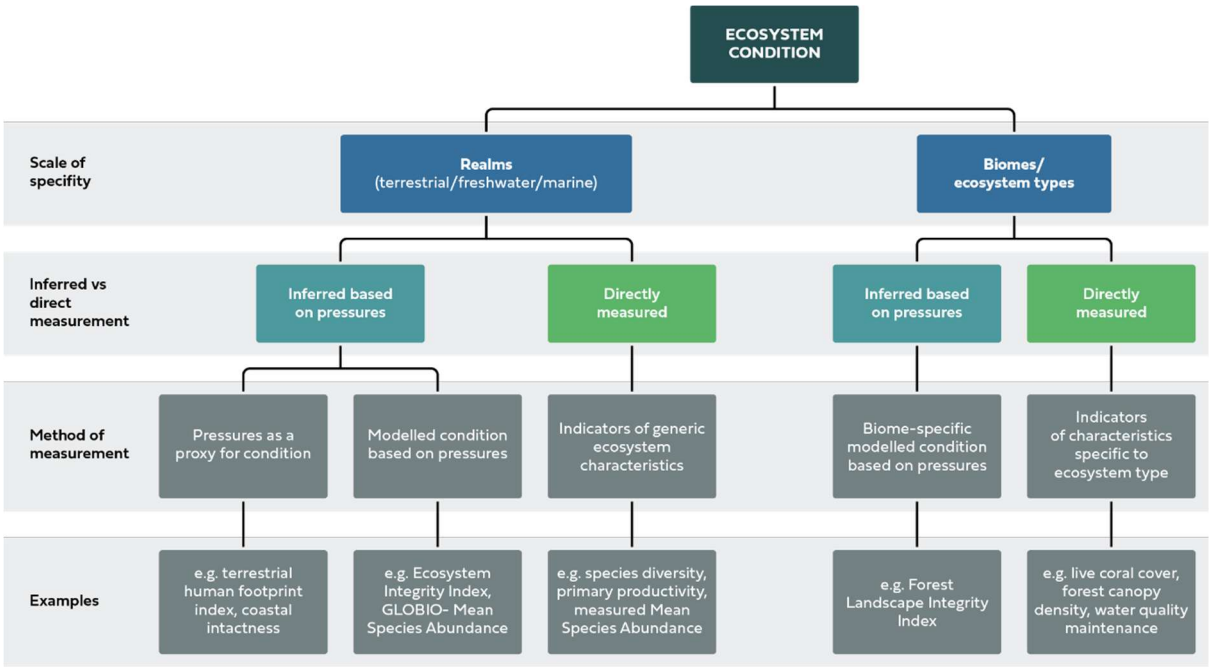


Figure 5. Components of ecosystem condition and example measurement indicators from Align primer on ecosystem condition (UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe, 2023)

Species

Included in all three frameworks and standards, the assessment of impacts on species involves assessing impacts on population size and global extinction risk (UN Environment Programme Finance, 2024) [28] (Table 9). According to GRI, population size measures the number of individuals of a species within an area (Global Reporting Initiative, 2024).[29] It can be measured by the number of mature individuals or the number of breeding pairs. Measurement methodology such as in situ direct population counts can be used when collecting these primary biodiversity state data.

Often, directly measuring impacts on population size is not feasible. Where habitat loss is a main pressure, species area of habitat can be used as a proxy for impacts on species populations. Metrics assessing current and potential changes in species extinction risk combine information on

i. Threat status of a species, including information on its range size and threat, and how an organization's activities may affect the threat status;
ii. Changes in the available species habitat, which is used as a proxy in understanding the impact on local or global extinction risk[30].

Table 9. Primary and secondary data needs for impacts on species (UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe, 2022) [31]

Component	Primary and secondary data needs	Example
"Species Population size"	*"Metrics that measure changes in the number of individuals of a species within a specific area."*	*"Number of Breeding pairs"*

[28] Accountability for Nature report p. 32-34

[29] GRI 101: Biodiversity 2024 p. 30

[30] According to GRI, and ESRS E4, "changes in the relevant habitat for a threatened species as a proxy for the undertaking's impact on the local population's extinction risk."

[31] Table adapted from Align Recommendations for a standard on corporate biodiversity measurement and valuation Table 3

"Species Global Extinction risk"	*"Metrics that measure the threat status of species and how activities/ pressures may affect the threat status."*	*"Change in local species threats"*
	"Metrics that measure change in the available habitat for a species as a proxy for impact on local or global extinction risk."	*"Change in species Area of Habitat (AoH)"*
Taken verbatim from 2022 UNEP-WCMC, Capitals Coalition, Arcadis, ICF, and WCMC Europe		

4.2.2 Changes in the flow of ecosystem services

All three frameworks and standards include the measurement of the changes in the flow of ecosystem services as part of impact measurement (UN Environment Programme Finance, 2024).[32] Changes in ecosystem services can be caused by the changes in the underlying stocks of nature which in turn impact the flow of benefits to beneficiaries. Ecosystem services can be divided into 3 major categories (Taskforce on Nature-related Financial Disclosures, 2023) (Global Reporting Initiative, 2024) [33] (regulating and maintenance, provisioning and cultural) and numerous sub-categories.[34]

[32] Accountability for Nature report p. 30-34

[33] Under the definition of TNFD LEAP Approach Guidance p. 82, GRI 101: Biodiversity 2024 p. 31

[34] For sub-categories, please reference to the ecosystem service categorization based on SEEA-EA

Table 10. Examples of nature information sets for different ecosystem service categories (Taskforce on Nature-related Financial Disclosures, 2023) [35]

Ecosystem Service Category	Ecosystem Service	Nature Information set	Example Primary and secondary data need
Regulating and maintenance services	*"Water Flow Regulation"*	*"Amount of water flow regulated"*	*"Capacity of reservoirs or alternative forms of storage (cubic metres) otherwise needed to provide same service."*
		"Amount of secure water supply"	*"Altered level of number of people/ businesses/acres with secure water supply."*
	"Flood mitigation"	*"Altered flood risk level"*	*"Change in flood damage costs"*
		"Tonnes of greenhouse gas (GHG) retained"	*"Amount of carbon absorbed by vegetation."*
	"Global climate regulation"	*"Altered wildfire risk level"*	*"Altered level in the number of wildfires and/or in the area damaged by wildfires in km^2 (e.g. reduction in the number of wildfires)."*
	"Local (micro and meso) climate regulation"	*"Number of people affected due to climate-related hazards."*	*"Number of households with air temperature reduced by more than 5°C on hot days."*

[35] adapted from TNFD LEAP Approach Table 24

Ecosystem Service Category	Ecosystem Service	Nature Information set	Example Primary and secondary data need
	"Air filtration"	*"Weight or volume of pollutant filtered/ remediated."*	*"Tonnes of pollutants absorbed by type of pollutant (e.g. PM10; PM2.5)."*
	"Soil and sediment retention"	*"Soil retained."*	*"Tonnes of soil retained."*
	"Solid waste remediation"	*"Weight or volume of waste remediated."*	*"Tonnes of solid waste remediated."*
	"Water purification"	*"Area of habitat providing services."*	*"Hectares of habitat providing water filtration."*
	"Pollination"	*"Area of habitat pollinated."*	*"Area of crops pollinated, by type of crop."*
	"Nursery population and habitat maintenance"	*"Biomass stocks dependent upon nursery and habitat services."*	*"Size of biomass stocks dependent upon nursery and habitat services."*
Provisioning Services	*"Biomass provisioning"*	*"Weight or volume of provisioned assets."*	*"Gross tonnes of wood (timber) biomass harvested."*
	"Water supply"	*"Weight or volume of water supply."*	*"Cubic metres of water, by type and quality."*
Cultural Services	*"Recreation-related Services"*	*"Visits for cultural purposes."*	*"Number and length (hours) of visits."*

Ecosystem Service Category	Ecosystem Service	Nature Information set	Example Primary and secondary data need
	"Visual amenity services"	*"Number of properties with visual amenity services."*	*"Number of properties with views of natural landscapes/located near green/ blue areas."*
	"Education, scientific, and research services"	*"Number of visits for educational, scientific and research purposes."*	*"Number of visits for educational, scientific and research purposes."*
	"Spiritual, artistic and symbiotic services"	*"Number of visits for spiritual, artistic and symbiotic purposes."*	*"Number of visits for spiritual, artistic and symbiotic purposes."*
Taken verbatim from 2023 Task Force for Nature-related Financial Disclosures			

4.2.3 Evaluation of business dependencies

An assessment of business dependencies differs from assessing impacts. Understanding of dependencies on nature requires gaining an understanding of the reliance on ecosystem services, abiotic flows and the flows of services to beneficiaries, and the underlying stocks of nature.

Both ESRS E4 and TNFD requires the assessment and disclosure of nature-related dependencies (UN Environment Programme Finance, 2024).[36] Dependencies assessment consists of measuring

i. Drivers of change;
ii. (changes in) the state of nature that the ecosystem services depend upon;
iii. (changes in the flow of) ecosystem services (UN Environment Programme Finance, 2024).[37]

Table 11. Measuring an energy company's dependency on coastal hazard protection [EXAMPLE]

Function	Nature information set	Example Primary and secondary data
Assessing reliance on ecosystem services	Type, number and location of assets benefiting from hazard protection ecosystem services provided by mangrove forests.	- Coastal habitat maps - Locations (points/polygons) of company assets
Understanding external drivers of change influencing ecosystem services depended on	Average expansion rates of the aquaculture sector	- Economic data on outputs of aquaculture as a sector

[36] Accountability for Nature report p. 35-38

[37] Accountability for Nature report p. 35-38

		- Spatial data showing distribution of aquaculture sites

Table 12. Measuring an apparel company's dependency on water supply through its upstream value chain [EXAMPLE]

Function	Nature Information Set	Example primary and secondary data
Assessing reliance on ecosystem services	Volume of water required for the volume of cotton sourced	Primary data on water use or volumes of cotton sourced (to estimate water use through Input-output models)
Understanding external drivers of change influencing ecosystem services depended on	Locations of operations falling within identified climate change hotspots	Climate change hotspot layer

4.3 Structuring information on impacts and dependencies through Corporate Natural Capital Accounting (cNCA)

While 'ad-hoc' measurements of impacts and dependencies can support stand-alone assessments and compliance with reporting standards, more systematic collection, structuring and organization of data on impacts and dependencies would support more in-depth integration into business decision making.

To facilitate this integration, approaches that apply Natural Capital Accounting principles at the corporate level are emerging (called corporate Natural Capital Accounting- cNCA approaches).

cNCA is centered around creating a register of ecosystems and species impacted and depended on (natural capital assets), and systematically keeping records of their biophysical condition (stocks). From these structured measurements, a wide range of 'nature information sets' can be built through applying valuation methods that relate changes in the stocks to business financial accounting. This may be through understanding the market value of changes to ecosystem services resulting from changes in the stocks, or calculating the costs required to maintain or restore the stocks to target levels.

The data needs for corporate Natural Capital Accounting are not additional to the needs of measuring impacts and dependencies. However, consensus is emerging on key principles on robust approaches (Capitals Coalition, 2022). This includes a focus on spatially explicit, directly measured data (rather than relying only on 'top-down measurements from Life Cycle Approaches), and applying strict ecological equivalency (one asset type cannot be substituted for another).

As well as increasing the transparency and comparability of information disclosed on impacts and dependencies, cNCA approaches can support produce a wider range of nature information sets that are aligned with financial accounting, including the assessment of risks and opportunities, outlined in the following section.

4.4 Assessment of risks and opportunities

Both ESRS and TNFD requiring companies to assess and disclose their nature-related risks and opportunities. The TNFD LEAP approach has provided a detailed assessment guidance, which the ESRS also suggests companies to refer to (Taskforce on Nature-related Financial Disclosures, 2023) (European Commission, 2023).[38] [39] It should be noted however that this guidance from the TNFD does not necessarily reflect the breadth of how risks are quantified in practice across business and finance.

[38] TNFD LEAP Approach Guidance p. 100-137

[39] ESRS Application Requirement 6, ESRS document p. 144

Box 3: Risk assessment methods under TNFD and the LEAP approach (Taskforce on Nature-related Financial Disclosures, 2023) [40]

• Heat Mapping – Focusing on the "Where is the risk" question, a heat mapping exercise helps companies to qualitatively summarise potential or actual exposure to nature-related risk and opportunities, revealing whether activities and/or assets potentially have a material dependence on impact on nature. Financial institutions can use heatmaps to help identify sectors with multiple and significant dependencies and impacts. Example tools that perform this assessment are ENCORE and the SBTN materialiy screening tool. With data being provided within the heat mapping tool (e.g. ENCORE database in ENCORE), The analysis result would have a low granularity, providing portfolios an overall qualitative rating (i.e. Very Low, Low, Medium, High, Very High) at the sector level.

• Asset Tagging – Focusing on the "How much risk is there" question, asset tagging deepens the heatmap method by using data specific to financial or corporate assets to determine the exposure to dependencies and impacts. Compared to using a heatmap approach, the asset tagging method offers the potential to move from a sector-level analysis to a focus on individual physical or financial assets, thereby providing a more granular and specific understanding of risk. Additionally, it allows for the use of more quantitative data at the process, product, geography, and physical asset levels, which improves the understanding of the magnitude of risk. The data need for asset tagging can fall into two categories, which are i) Sector, process, product, or location data, detailing a corporate's operations; and ii) Nature exposure and risk data, which links the later data to nature-related dependencies, impacts or risks qualitatively or quantitively. The level of granularity of the of the analysis will depend on the level of data available.

• Scenario based risk method – Focusing on "What is the financial implication" question, a scenario-based risk method builds upon the heatmapping and asset tagging methods. It translates exposure to nature-related risks into financial implications for financial institutions. To conduct a scenario-based risk assessment, additional inputs are required. economic and financial information such as price of different assets, and modelled nature data related to porfolio dependencies and impacts on nature.

Nature related risks (Table 13) and opportunities (Table 14) can be assessed through compiling a nature information set that consists of exposure and magnitude metrics. While

[40] Adapted from TNFD LEAP Approach p. 244-246

exposure metrics are based on measurements of nature-related dependencies and impacts, magnitude metrics are used to assess the financial implications to the organization of nature-related risks and opportunities. Therefore, while exposure metrics will require similar data that are used in the evaluation of impacts and dependencies, magnitude metrics may involve financial data that may be obtained through scenario analysis (Box 3).

Table 13. Different types of nature related risks and their example Nature Information set (Taskforce on Nature-related Financial Disclosures, 2023) [41]

Type	Risk	Example	Example Nature Information set
Acute Risk	Changes in the extent and condition of ecosystems the organisation is dependent on or impacted by, resulting in changes to the flow of ecosystem services.	Degradation of freshwater lake due to pollutants released by the organisation and other stakeholders	Change in condition of freshwater ecosystems Data on reduction in revenue/ costs associated with an interruption of operations/ supply chain
Chronic Risk	Changes in the state of ecosystems (condition and/or extent) and species (population size, extinction risk) the organisation is dependent on or impacted by, resulting in changes to the flow of ecosystem services.	Reduction in crop yield due to change in abundance of pollinators	Changes to crop yield (ecosystem service) Financial data on Increased costs of natural inputs/reduced supply of ecosystem services
Liability	Fines/penalties due to nature-negative outcomes	Degradation of freshwater habitat due to pollutants released by the organisation that exceeds legislative limits.	Quantity and concentration of pollutants (impact driver) Financial losses due to delays in operations/permit denials
Policy	Changes to legislation/ regulations aimed at achieving	New protected area in close proximity to area of operations.	Change in state of ecosystem (ecosystem condition)

[41] Adapted from TNFD LEAP Approach Guidance Table 16 p.131-135

Type	Risk	Example	Example Nature Information set
	nature-positive outcomes/ reducing nature-negative outcomes		Financial data on compliance costs
Technology	Requirements to transition to more efficient, resilient and less environmentally damaging technologies.	Failure of nature-friendly technological innovation	Sector Average or company specific Impact Driver data Company financial data on Increased research and development expenditure of new and alternative technologies
Market	Shifting customer/ investor values or preferences to products and/or services that are nature-positive/ have lower impacts on nature.	Increased cost of plant-based inputs the organisation uses in the production process	Amount of input used in the production process (ecosystem service) Costs related to substituting existing products/services
Reputation	Changes in sentiment towards the organisation/ brand due to impacts on nature	Company is responsible for an oil spill	Total number of recorded oil spills (impact driver) Reduction in revenue due to lower demand for products and services

Table 14. Different types of nature related opportunities and their example data need (Taskforce on Nature-related Financial Disclosures, 2023) [42]

Sustainability performance opportunity	Business performance Opportunity	Example	Example Nature Information set
Sustainable use of natural resources: Transition to processes/circularity mechanisms that reduce risks related to business dependencies on nature, including within the value chain: reduced pollution and waste	Transmission mechanisms: • *Resource efficiency* • *Markets*	An organisation adopts internal processes that reduce the levels of pollutants emitted to freshwater	Indicators of water quality in area (ecosystem condition) Company financial data on reduced operational and compliance costs
Ecosystem protection, restoration and regeneration: **Direct restoration, conservation or protection of ecosystems or habitats**	Transmission mechanisms: • *Reputational Capital* • *Markets*	An organisation invests in the restoration of an area of degraded mangrove with the purpose to increase resilience of infrastructure	Area of degraded land restored (impact driver), improvement in ecosystem condition (ecosystem condition) Company financial data on Increase in revenue due to improved reputation, increased market valuation through resilience planning

[42] Adapted from TNFD LEAP Approach Guidance Table 17 p.136

4.5 Data and information need for disclosure

In the assessment stage, data and information needs are based on the specificity of the metrics used. While frameworks and standards have provided a list of recommended metrics for companies to apply in assessing their nature related issues (and management response), they offer them the flexibility in the choice of metrics (UN Environment Programme Finance, 2024).[43]

However, when then disclosing information on nature, companies are often required to disclose specific (sets of) metrics that are used in the assessment stage. For TNFD, disclosure metrics are a sub-group of assessment metrics rather than a mutually exclusive group. Companies are required to disclose the Core disclosure metrics, which are metrics to be included in all disclosures following the TNFD disclosure recommendations on a comply or explain basis. Core metrics are split into 'core global metrics' which all organizations should disclose, regardless of sector, and 'core sector metrics' which are specific to the sectors that organizations operate in. In the 2023 publication, the TNFD's recommended core disclosure metrics are organized around 14 core global indicators relating to:

i. Dependencies and impacts on nature, and
ii. Nature-related risks and opportunities to the organization (Taskforce on Nature-related Financial Disclosures, 2023).[44]

Companies can also choose to include additional metrics in their disclosures, based on their specific industry, location and/or regulatory requirements to provide more specific information and strengthen disclosures. The list of additional metrics is illustrative rather than exhaustive.

For ESRS, Companies reporting against E4 on biodiversity and ecosystems are required to disclose two metrics:

i. the number, and
ii. **the area size (in hectares) of sites owned, leased, or managed in or near biodiversity-sensitive areas that the company negatively affects** (European Commission, 2023)**.**[45]

For other nature-related issues, ESRS E4 gives companies the flexibility to choose their own metrics but provides specific recommendations regarding the elements these metrics should

[43] Accountability for Nature report p. 44-48

[44] TNFD Disclosure recommendations p. 61-67, 81-99

[45] ESRS document p.139

cover. For example, if companies directly contribute to the impact drivers of land-use change, freshwater-use change, and/or sea-use change, they are encouraged to report on metrics measuring changes in ecosystem structural connectivity and changes to the spatial configuration of the landscape (European Commission, 2023). [46]

The GRI biodiversity standard requires disclosure of several metrics if the given nature-related issues are material for the reporting company. For instance, if the company identifies it contributes to exploitation of natural resources, examples of the required metrics include the volume of water withdrawal and consumption in megaliters or type and quantity of wild species used and their species extinction risk in locations (Global Reporting Initiative, 2024).[47] For other aspects of the company's impacts on nature, GRI Standards leave companies the flexibility to choose the metrics but outline what the metrics should cover or provide some recommendations for metrics. For example, for measurement of ecosystem condition, the GRI Biodiversity Standard recommends reporting condition-adjusted hectares (Global Reporting Initiative, 2024).[48] Annex 1 summarizes the metrics and potential data needs for the three main disclosure framework.

Standards developed for corporate natural capital accounting (cNCA) also provide guidance on how to disclose information compiled in corporate natural capital accounts in a way that is aligned with reporting on financial accounting. For example, the British Standards Institute standard on corporate Natural Capital Accounting (BS 8632:2021) guides on developing two accounting outputs:

- A natural capital balance sheet (showing the organization's dependency on the natural capital assets)
- A natural capital income statement (showing the positive and negative impacts of the organization).

[46] ESRS document p.140

[47] GRI 101: Biodiversity 2024 p. 23

[48] GRI 101: Biodiversity 2024 p. 29

5 Data and information need for integrating nature into financial sector investment decision-making

Whereas businesses primarily impact and depend on nature through direct and value chain operations, financial institutions have minimal direct impact. Instead, financial institutions' nature-related impacts and dependencies largely stem from their investment decisions (Taskforce on Nature-related Financial Disclosures, 2024) **– through lending, investment or advisory portfolios.** Currently, the financial institutions that incorporate nature into decision making predominantly approach nature-related topics through a risk management lens, making first a high-level assessment on exposures to nature-related risks, before then applying nature specifications to different investment strategies. The type of strategy, and the granularity of nature information integrated into decision making depends on their data expertise level, impact intended, and return objectives (Figure 6).

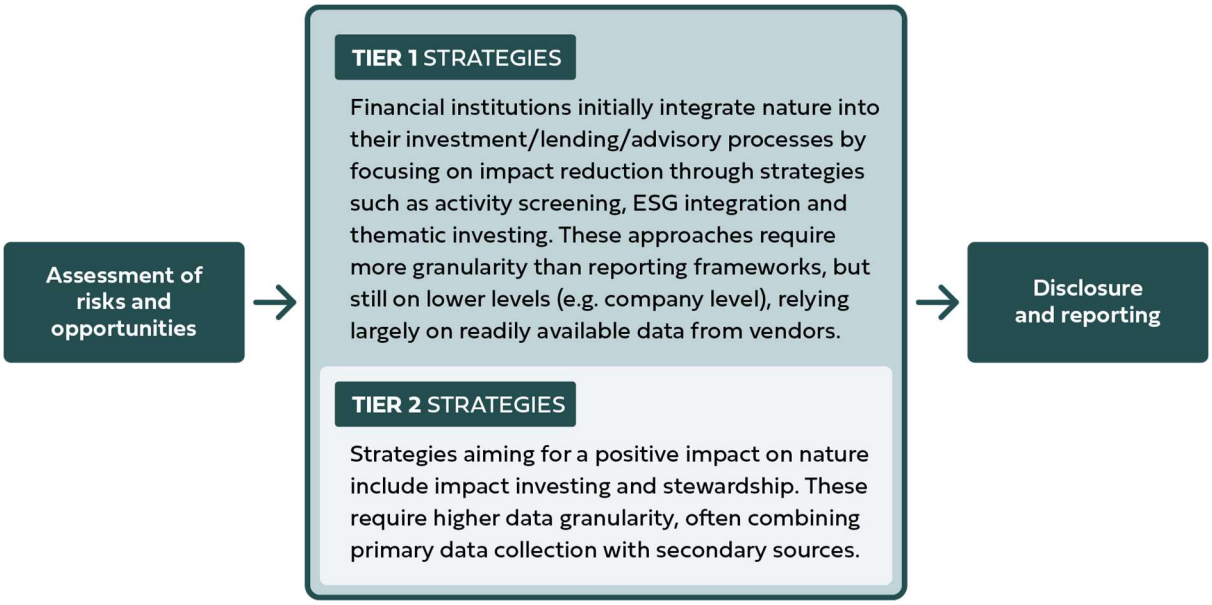


Figure 6. While the different frameworks vary in their specificities on state of nature methods and metrics, all frameworks and standards recognize that measuring changes in the state of nature includes covering species and ecosystems (UN Environment Programme

A common entry point to applying nature-related data into investment decision-making is through a high-level assessment of risks and opportunities. Tools such as heatmaps and sectoral exposure analysis help institutions estimate the materiality of nature-related risks in their portfolios. These assessments prioritize risk analysis over identifying opportunities and

generally require minimal expertise in nature data or metrics. Sector-level information is often sufficient for initial evaluations. The findings from these risk assessments can then inform subsequent strategies, such as engaging with companies in key sectors, applying sector-based screening criteria, shaping ESG integration, or identifying trends for thematic investments.

The incorporation of actions to mitigate risks and achieve positive nature outcomes are then separated in two clusters according to the data needs and type of impact intended. Tier 1 strategies, also known as "initial strategies," can build on the high-level risk assessments conducted. These strategies focus on reducing the negative impacts of investments while maintaining competitive market returns and rely on low data granularity, typically at the company level. They include activities such as screening, ESG integration, and thematic investing, with nature data integration often occurring post-risk assessment. The ambition of these strategies is primarily to mitigate negative impacts, which can lead to scalable solutions. For instance, screening to exclude harmful practices like deforestation, using readily available data, may have broader impacts than high-ambition but smaller-scale efforts like localized restoration projects. Although Tier 1 strategies may require slightly more detailed data than risk assessments, the data can remain relatively low in granularity and responsiveness.

Tier 2 strategies, on the other hand, focus on achieving positive impacts and require higher granularity of data targeted to action on a local level. Impact investing, a key approach within this tier, not only aims to avoid and minimize negative impacts but also to generate positive social and environmental outcomes. Typically applied at local scales, it requires detailed monitoring and evaluation, increasing the need for granular and responsive data. Similarly, stewardship, although lacking specific evidence for nature-related outcomes, is a strategy for achieving real-world impact in broader ESG goals and is popular within responsible investing. Data requirements for stewardship vary, but greater data granularity enhances the robustness of the strategy and enhances credibility.

Two key components for incorporation of nature-related data in sustainable finance strategies are identifying the nexus between climate change and nature and building internal capacity. Since its release in 2017, thousands of financial institutions have supported and disclosed under the Taskforce for Climate-related Financial Disclosures (TCFD) guidelines (Task Force on Climate-related Financial Disclosures, 2022). Efforts to disclose on climate-related risks and opportunities and integrate the topic into decision-making, should be viewed as part of nature-related strategies – not additional to them. In terms of data, the Finance for Biodiversity Foundation suggests that financial institutions start the integration by prioritizing sectors with a high impact on nature and climate, rankings (e.g. CDP Climate Change and CDP Forests tools, Coller FAIRR Protein Producer Index, Forest 500 scores and rankings), and joining initiatives like Nature Action 100 (NA100) and Climate Action 100+ (CA100+) (Finance for Biodiversity, 2023). Once initial integration steps are taken, locate points of climate-nature nexus, map the existing internal data efforts that could feed into nature topics (e.g., water usage, land use, etc.), and build capacity in remote sensing data, and natural capital accounting principles is essential to standardize and integrate the data into processes and decision-making.

Financial institutions typically rely on highly transformed data products supplied by third parties, rather than collecting or collating primary and secondary nature data. This data may then be adapted for specific uses or directly integrated into the broader nature information set. Primary data collection is generally limited to impact investing (for quantitative and qualitative impact monitoring) and stewardship strategies (qualitative data on engagement with invested companies or projects). Figure 8 below illustrates how nature information pathways differ between Tier 1 and Tier 2 strategies.

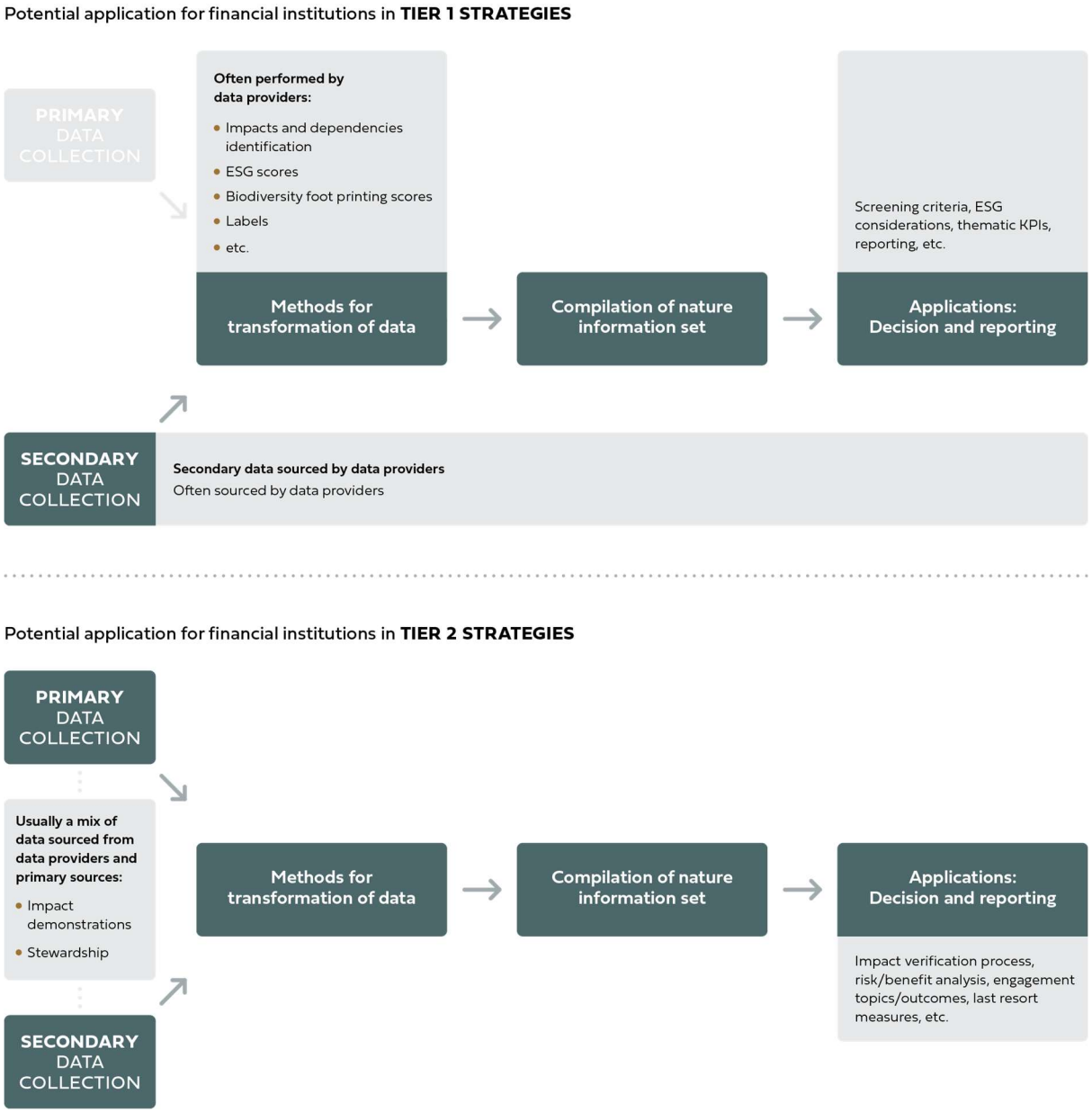


Figure 7. Nature information pathway diagram (Figure 2) adapted for the financial institutions

Data characteristics were identified through a desktop review including publications by Principles of Responsible Investment (PRI), Align, TNFD and Partnership for Biodiversity Accounting Financials (PBAF), supplemented with information from unstructured interviews.

5.1 Tier 1 Strategies: ESG integration, screening criteria, thematic investing

Tier 1 strategy information needs are mainly ready-to-use indicators, indexes, or labels provided by data vendors or certification agencies, particularly for ESG integration, screening criteria, and thematic investing strategies. Data providers mostly collate secondary data and transform the data to feed into the nature information set of financial institutions. It is important to note that financial institutions are most likely to access highly transformed data instead of primary or secondary nature data when applying nature-related data into tier 1 strategies.

ESG integration strategy serves as an entry point for incorporating nature and biodiversity considerations, alongside social and governance factors, into investment decisions. This strategy does not limit the investable universe but integrates ESG metrics into the decision-making process, often alongside screening criteria.

Screening criteria are divided into: (i) negative screening, where portfolio managers exclude companies based on specific characteristics or a materiality threshold, and (ii) positive screening, or best-in-class, which filters companies in based on certain standards. Another way to implement exclusion criteria is setting a materiality threshold to avoid investing in companies if a significant portion of their activities or revenues come from excluded activities. Alternatively, it may involve excluding the lowest-ranked companies according to a specific sector or index criterion (European Securities and Markets Authority, 2023). Positive screening (or best-in-class screening criteria) apply the opposite exclusion criteria, filtering companies in based on meeting certain criteria. The strategy also allows for prioritization or weighting of capital allocation based upon the criteria.

While highly transformed indicators provide general guidance on broad screening criteria (e.g., exclusion of companies operating in specific sector) or ESG considerations (e.g., assessment of environment scores). impacts and dependencies on nature are inherently highly location and context specific. Financial institutions aiming to be more accurate with their ESG and screening strategy evaluation can make use of more spatially resolved secondary data such a deforestation database, or range data from the IUCN Red List of Threatened Species when the location of assets or activities is known. The integration of nature related information into Tier 1 strategies needs to be continuous (European Securities and Markets Authority, 2023), but a lack of data responsiveness is not a barrier for decision-making.

Thematic investing focuses on the identification of trends and selects sectors, companies, and assets that are relevant for this trend (e.g., circular economy) (Principles for Responsible Investment, 2023)**. To identify such trends, financial institutions need a deeper sector analysis, focusing on a macro trend and selecting assets that contribute to it.** This strategy also relies on highly transformed data provided by data vendors, such as activity indexes and biodiversity footprint that provide insights into operational trends. Key performance indicators (KPIs) are vital for tracking environmental performance in thematic investing and vary based on the trend; for example, climate change-related thematic strategies may integrate Forest Carbon Flux data with emissions indicators. Emerging conservation and restoration strategies benefit from more location-specific indicators extracted from secondary data sources like the Biodiversity Intactness Index, Mean Species Abundance, and Ecosystem Integrity Index.

Heat-mapping tools such as ENCORE can be helpful in applying Tier 1 strategies. However, financial institutions may need more spatially resolved indicators for their analysis of impacts and dependencies. Metrics provided by private data vendors like Iceberg Data Lab[49], EthiFinance[50], and SEED Biocomplexity[51] offer scores for different level of analysis (e.g., ecosystem, genetic or species) at the asset level. For geolocation-specific data, tools like IBAT[52] and Earth Blox[53] provide location-specific data layers and metrics.

The table below summarizes the characteristics of data needed for ESG integration, screening criteria and thematic investing[54].

[49] For more information, visit https://www.icebergdatalab.com/

[50] For more information, visit https://www.ethifinance.com/

[51] For more information, visit https://www.seed-index.com/

[52] For more information, visit https://www.ibat-alliance.org/

[53] For more information, visit https://www.earthblox.io/

[54] For further guidance on databases and metrics, consult: Assessment of Biodiversity Measurement and Approaches for Business and Financial institutions (Lammerant, 2021), Descriptive report of the Biodiversity Databases (Kieling, et al., 2023), and Global metrics for terrestrial biodiversity (Burgess, et al., 2024)

Table 15. Tier 1 Investment strategies and its data needs

	ESG Integration	Screening Strategies	Thematic Investing
Function	Integrate nature aspects into the ESG factors analysed in each investment process	Define criteria that determines which investments are or are not part of the investable universe of a portfolio.	Build an investment portfolio that is expected to benefit from specific biodiversity long-term trends

Nature Information Set	- *Indicators to reduce impact/manage nature-related risks:*
	  ○ *Labels and certification*
	  ○ *Aggregated indexes (e.g., ESG or footprint indexes)*
		- *Indicators to reduce impact/manage nature-related risks and to implement positive or negative criteria:*
		  ○ *Labels and certification*
		  ○ *Aggregated indexes (e.g., ESG or footprint indexes)*
		  ○ *Spatial data (points, polygons) of sites/locations in the companies' direct operations and value chain*
			- *Indicators to reduce impact/manage-related risks and monitor macro trends:*
			  ○ *Labels and certification*
			  ○ *Aggregated indexes*
			  ○ *Spatial data (points, polygons) on the companies' locations/sites in the direct operations and value chain*

Relevant data characteristics	Aggregated indexes should be responsive to high-level company actions on nature, to be able to reflect changes in company performance on nature. Whilst data at Sectoral level granularity can be used, data at the level of individual business entities provide more robust information.	- *Aggregated indexes should be responsive to high-level company actions on nature, to be able to reflect changes in company performance on nature.Whilst data at Sectoral level granularity can be used, data at the level of individual business entities provide more robust information* For spatial data layers, country or subnational granularity can be applied.	Spatial data layers for screening locations can be static. Aggregated indexes need to be responsive over time, in order to track the trend that characterize the thematic investing. Whilst data at Sectoral level granularity can be used, data at the level of individual business entities provide more robust information. Geospecific data of business entity's sites are needed for deeper trend analysis.

5.2 Tier 2 Strategies: impact investing and stewardship

In the nature-related context, impact investing involves financing specific projects that improve the state of nature and maintain or enhance flows of ecosystem services, while seeking financial returns (Principles for Responsible Investment, 2023)**, often with concessionary rates**[55]**.** This strategy can be implemented through debt instruments (e.g., sustainable development bonds, green bonds, sustainable lending) or blended finance. Although currently limited in number, these instruments are gaining popularity for financing nature conservation and restoration (Cooper & Trémolet, 2019). Nonetheless, impact investing projects have limited scalability, and their impact is limited to small geographic areas.

Stewardship, by contrast, is seen as the most effective way to achieve environmental goals on a larger scale. In the climate space, engaged companies often show reduced carbon emissions and lower environmental risks (Hoepner, et al., 2024). This strategy involves engaging with potential and current investees, deploying voting rights to achieve predetermined goals, and taking last-resort measures in case of non-compliance.

Both Tier 2 strategies require more granular data from both primary and secondary sources than Tier 1 strategies. Beyond quantitative data, qualitative data coming from surveys – especially on the mapping of impacts of an economic activity on local communities – and corporate sustainability reports play a key role in providing the context for KPI formulation, transition plans, and targets tracking.

For impact investing, initiatives like IRIS+ and the IFC Biodiversity Finance offer established metrics linking to climate change mitigation and adaptation, the Global Biodiversity Framework, and TNFD (International Finance Corporation, 2023)**.** Impact investors must assess the contribution of an action against a baseline (Impact Frontiers, n.d.), often requiring precise methods such as eDNA, bioacoustics, remote sensing, and ecosystem condition surveys. Given the limited accessibility of such data, financial institutions may also rely on modeled data. Tools like Pivotal support impact investors by providing insights through peer-reviewed, mixed-method data collection (World Economic Forum, 2024).

For stewardship, both KPIs and qualitative data are essential. Investors must monitor company communications and reports to track progress, attend assemblies, review public communications, and meet with management. Forward-looking data helps assess alignment of current plans with long-term nature-related goals. Due to high amounts of data and analysis needed, combined with the relevance of shareholders, engagement coalitions like Climate

[55] According to the Rockefeller Philanthropy Advisors, concessionary return is the return on an investment that sacrifices some financial gain to achieve a social benefit.

Action 100+ and Nature Action 100 are key for establishing metrics, leading review process, and co-leading direct engagement (Cambridge Associates, 2023).

Box 4: From screening to engagement – The IK Partners case

Evidence from desktop research and interviews reveals that when nature data is integrated into the investment decision-making process, it typically occurs at three main entry points: i) pre-screening, ii) risk management, and iii) engagement. During the pre-screening phase, scores and footprint indexes are reviewed. If a risk is identified, further due diligence is conducted in collaboration with the invested company. Follow-up is then carried out to monitor the risk mitigation measures implemented.

IK Partners ("IK") , a leading European mid-market private equity firm, has worked with consultants and built an internal team to strengthen the integration of ESG considerations into their decision-making processes.

As part of its nature risk assessment, IK uses a location-based approach to screen all potential portfolio companies for activities in both protected areas and proximity to areas with threatened species. The initial assessment relies on indicators from the Altitude tool by AXA Climate . Material risks identified during this stage later inform the due diligence process and how IK engages with the company during ownership. In addition, during the holding period, invested companies are asked to complete an annual survey, where qualitative primary data is collected. Quantitative key performance indicators primarily focus on emissions in scopes 1,2 and 3, while more nature-specific performance indicators are still being developed. This development is guided by IK's preparation to disclose in alignment with the TNFD, as an Early Adopter.

IK's approach demonstrates how financial institutions can begin integrating nature into their existing decision-making processes without requiring extensive data collection in place.

The table below summarizes the data characteristics needed for Tier 2 strategies

Table 16. Tier 2 Investment strategies and its data needs

	Impact Investing	Stewardship
Function	Identify projects or companies that contribute to nature restoration and conservation while achieving financial return.	Informed deployment of investor rights and influence to act upon environmental goals that are in line with their interest or on behalf of their beneficiary.
Nature Information Set	- *A set of nature-related indicators to monitor and demonstrate positive impact of projects or invested companies' activities*	- *Indicators on impacts and dependencies assessment on the sectoral or company level* - *Invested company nature-related ambition, target, and transition pathways*
Primary and secondary data needed	- *Change in species and/or ecosystem extent and condition (depending on the impact intended) obtained through 'on-the-ground' data collection* - *Spatial data (points, polygons) on the companies'/project locations/sites in the direct operations and value chain* - *Economic valuation of ecosystem services provided*	- *Qualitative or quantitative data on invested company/project pressures to assess impacts and dependencies on species and/or ecosystem extent and condition* - *Spatial data (points, polygons) on the companies'/project locations/sites in the direct operations and value chain*
Relevant data characteristics	Data on State-of Nature over time is required to most robustly evidence outcomes of investment, and should be responsive to the actions implemented. Forward-looking data can enhance the reliability of the impact investment thesis. Spatial data for impact investing needs to follow a more granular approach that other strategies, and be at the project site level.	At minimum level the data on business actions needs to be responsive understand if business comply with agreements made during engagement. Forward-looking data can help on ensuring sustainability commitments will remain a priority in the future. Any data collated on impacts and dependencies for engagement purposes needs to be on business entity level.

6 Data and information needs for integrating nature into public sector decision-making

Nature data allows countries to consider the impacts and dependencies of their economies on nature. Nature is key to consider when formulating public sector policy decisions (Dasgupta, 2021). Nature data is vital for more than just environmental branches of government especially given the interconnections between outcomes across a range of issues, for example biodiversity, food, water, health and climate change which are currently poorly recognized (IPBES, 2024) and as such can and should be used across different government departments including those which cover economic development and the production of national statistics. In economic or statistical departments, nature data can be used alongside economic data to measure comprehensive wealth by incorporating natural capital, and likewise used widely in policy development processes.

Nature information can be integrated into different steps of the policy cycle (Figure 8). This includes policy design, implementation, monitoring, and review. The use and collection of nature data in the policy process is cyclical. For example, increased data collection might be an outcome of the implementation of a nature-related policy which can then be used for monitoring and evaluation of other existing policies, or to implement further new policies (**Error! Reference source not found.**).

Natural capital accounting enables nature and economic data to be combined and organized in a coherent way to derive monitoring and reporting indicators and assist policymakers in decision-making. This section of the assessment will focus on the information needs for different decision-making contexts and explore the pathways as to how natural capital accounting can facilitate data flows into these decisions. The UN-SEEA and its two major conceptual and methodological frameworks published by the UN Statistical Services for natural capital accounting provide a unifying framework for country-level natural capital accounting. The frameworks were designed to be consistent with the System of National Accounts (SNA), a measurement framework for economic activity (United Nations, 2014). The UN-SEEA can also be customized to suit the varying policy needs of stakeholders and integrates environmental and economic information in both physical and monetary terms. These frameworks include the System of Environmental Economic Accounting Central Framework (SEEA-CF), the System of Environmental Economic Accounting Agriculture, Forestry and Fisheries (SEEA-AFF), and the SEEA-Ecosystem Accounting (SEEA-EA) (United nations, 2021) (Box 5).

Figure 8. The policy cycle

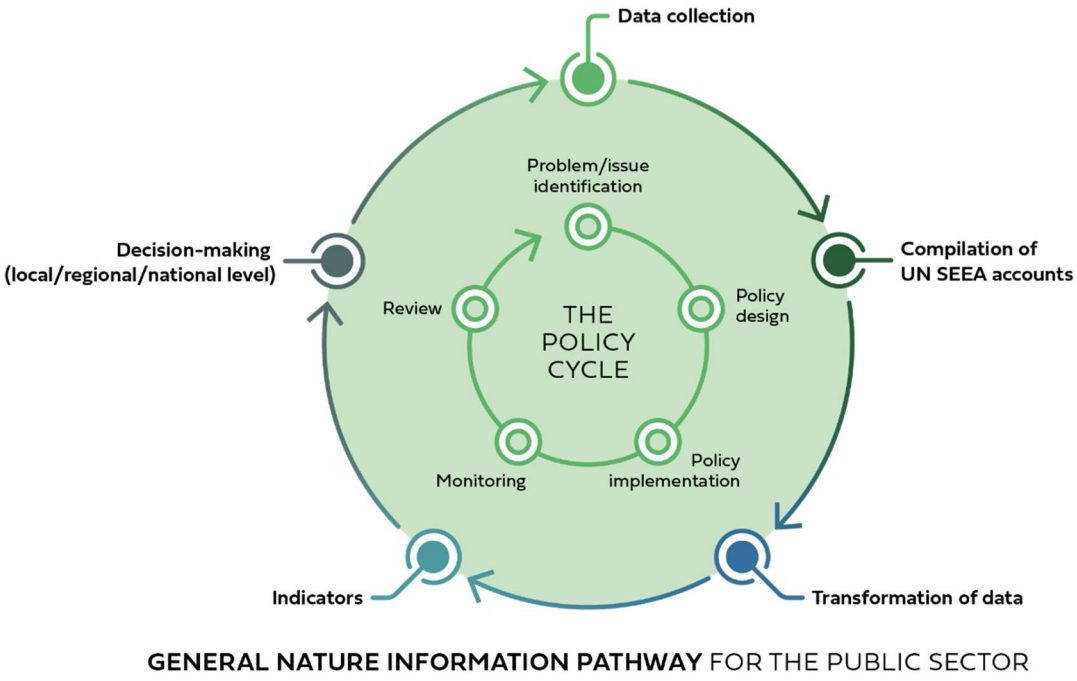


Figure 9. General nature information pathway for the public sector

Box 5: Introduction to different SEEA frameworks and methodologies

SEEA-Central Framework

The SEEA-CF is the international statistical standard for natural capital accounting. The SEEA-SF defines and assesses the "interactions between the economy and environment", including stocks and changes in stocks of environmental assets. **(United Nations, 2014)**

The framework includes methodologies for the measurement of all natural resources, cultivated biological resources and land within a country of reference. This includes individual natural resources (i.e., fish and timber) as well as ecosystems, although the methodology for the latter is described more in the SEEA-EA. The SEEA-CF does not include marine ecosystems and atmospheric system within its scope of environmental assets because their stocks are too large to be useful for analytical purposes **(United Nations, 2014)**.

SEEA-Ecosystem Accounting

The SEEA-EA complements the methodological and conceptual framework of the SEEA-CF and expands on the definition of a natural capital asset to include ecosystems. The SEEA-EA

considers the extent, condition and resulting services/benefits of ecosystems as assets in a spatially based statistical framework. Ecosystems are defined as non-overlapping assets which provide services and benefits to society **(United nations, 2021)**. Assets are classified by different ecosystem types, such as forests or wetlands. The framework does not include an explicit "ecosystem diversity" or "biodiversity" account **(King, 2020).**

The SEEA-EA also applies the accounting principles of the SNA, including exchange values. While this technique can be applied more easily with assets that have a market price, ecosystem valuation is often difficult and always underestimated. Monetary values derived from ecosystems are not fully reflective of the benefits they contribute to society.

The first seven chapters of the SEEA-EA – which focus on the biophysical measurement of ecosystems and their services – have been adopted as an international statistical standard.

6.1 Public sector nature data needs for the creation of new policy

Nature data can be mobilized via natural capital accounts for the creation of new policies (e.g., used in the identification and implementation stages of the policy cycle). While there is limited evidence of accounts being used to inform specific national public policies, there is potential for nature information sets to inform future decision-making and prompt policy action

For example, a leading example of nature data structured into accounts, being used to develop, and implement national policy is in Guatemala. Increasing fuelwood demand in the country has resulted in deforestation and forest habitat degradation (Banerjee, et al., 2019). A nature information set that linked deforestation, fuelwood and energy trends supported the government to develop a new strategy for the sustainable production of natural resources, including fuelwood and soils (Banerjee, et al., 2019).

Nature information can inform policy across a variety of decision-making contexts, including sectoral policy and macroeconomic policy/incentive decision-making. The data and information needs will vary depending on these contexts. Sections 5.1.1 and 5.1.2 will examine several examples of these nature information sets for both policy types.

6.1.1 Sectoral policies

Sectoral policies, or regional policies, are those that can be targeted at a specific or policy area, for example, conservation. Conservation specific policies are those that are eco-centric, aiming to protect a certain species or ecosystem area. These policies might have less integration of economic information and rely more on ecosystem extent, condition, and species accounts. However, the integration of economic data earlier on in the policy formulation process

could enable the implementation of more conservation policies. These policies might consider how ecosystem services provided by ecologically sensitive or important species and ecosystems, are currently used, and hence help to understand for example who might win, and who might lose from any change in how an area is managed, but also to identify whether there are additional beneficiaries who might be willing to contribute to covering the costs of conservation. In this sense, over time natural capital accounts can build up a picture of how ecosystem assets and their benefits are changing and potentially help to identify what is driving depletion or degradation and hence where policy responses might be most effective.

Governments need to determine the current state of natural assets in their country as well as potential future flows to make evidence-based decisions for conservation. This type of decision involves better understanding of the natural environment through working with environmental ministries, statistical departments and often external researcher bodies. An example of this decision type includes setting protection mechanisms for ecosystems, such as setting up a marine protected area (Table 17).

Table 17. Data needs for marine protected area (an illustrative example of a sectoral policy)

Function	Identify the state and future trends of natural capital stocks/assets (individual resources or ecosystems) in biophysical and monetary terms for a country's seagrass meadow ecosystems both with and without protection.
Nature Information set	Quantitative indicators of the state of natural resource and ecosystem stocks and flows in a country, expressed in biophysical and monetary values. For example: • Net present value of the ecosystem asset type • Ecosystem Condition Score (ECS) • Total Ecosystem Capability (TEC)
Primary and secondary data needed	• Ecosystem extent and condition metrics (Land cover and use, register of ecosystem assets) • Net present value (monetary) and biophysical value of seagrass meadow assets over time • Biophysical and monetary values of ecosystem services for a country's seagrass meadows
Relevant data characteristics	Granular geospatial data at the scale of specific ecosystem types required.

6.1.2 Macroeconomic policy

Macroeconomic policies aim to manage national or global economic performance and can be informed by the relationship between different types of capital, including natural. These can be decision related to interest rates, competitiveness, productivity, or in relation to economic stress testing or the "fiscal triangle". The triangle includes tax, borrowing and spending mechanisms which need to be balanced in order for government spending to be financially sustainable (Figure 10). Traditionally, macroeconomic decisions have not included natural capital analysis. However, comprehensive or inclusive wealth, which include natural, social and human capital in addition to produced or man-made capital assets in wealth calculations, has become more mainstream in macroeconomic decision-making in recent years (Agarwala & Zenghelis, 2020). Integrating nature-related and socioeconomic data into a system of accounts, such as the SEEA, can further help to incorporate other types of capital into macroeconomic decisions.

Because the SEEA is designed within the overall SNA, information about the environment can be organized in the same way as a country's macroeconomic data for analysis. Data and indicators from accounts can be integrated into pre-existent macroeconomic models to demonstrate the effects of a new policy or environmental regulation on competitiveness, as well as predictions of economic growth. Natural capital accounts can also help expose a country's future risk, such as the physical (costs of replacing depleted natural capital) and financial (biodiversity loss impacts the financial sector or undermines investor confidence) risk (Agarwala & Zenghelis, 2020).

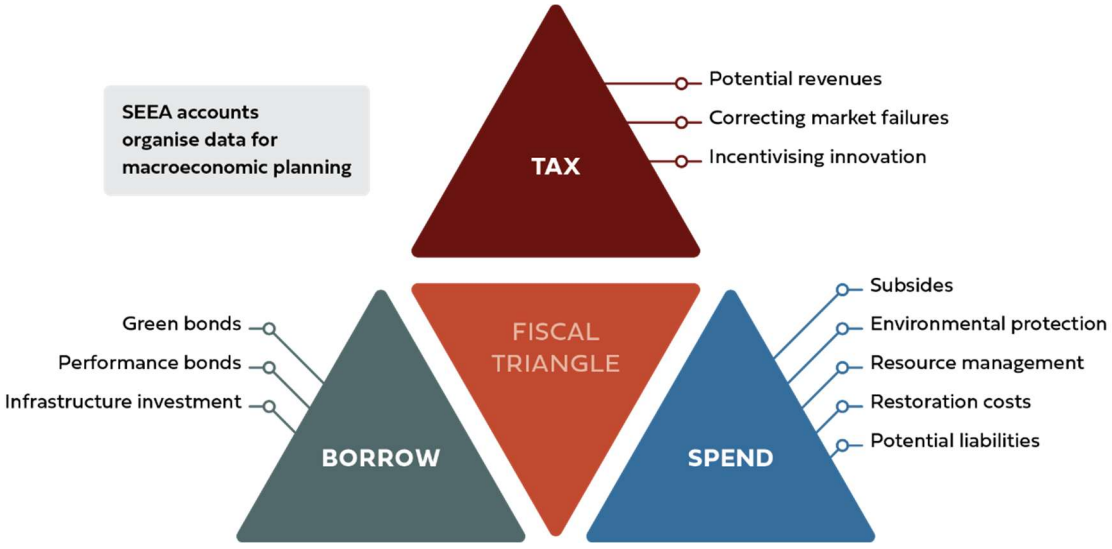


Figure 10. The fiscal triangle (Agarwala & Zenghelis, 2020)

Governments need to determine how economic activities impact and depend upon nature to make evidence-based economic decisions. **Economic data also helps to understand and contextualize the flows and benefits that nature provides to society.** National economic statistics are available from national statistical offices and can present information related to productivity and resource efficiency of environmental and ecosystem assets in a country. An example of this decision type includes decisions around implementing a tax on an environmentally-degrading activity, such as pollution (Table 18). Decisions on tax regulation can be well-informed by biodiversity data, as policymakers can use information on environment assets and flows to determine the relevant tax rate to use in order to minimize an environmentally harmful activity, internalizing a negative externality in a market.

Table 18. Data needs for the creation of a national environmental tax on pollution (an illustrative example of a macroeconomic policy)

Function	Identify the biophysical and monetary value of the impact on ecosystem services per unit of pollution to determine a national environmental tax, as well as the impact of the tax on larger macroeconomic policy
Nature Information set	Quantitative indicators to determine the changes in ecosystem services flowing from natural assets and pollution/residuals flowing from economic assets, expressed in biophysical and monetary values. Quantitative indicators to determine the impact of the tax on the economy or society should also be considered. For example: - Gross Ecosystem Product (GEP) (the economic value of all ecosystem services generated) - Biophysical values of pollution from economic sectors - GEP as a percentage of GDP - Environmental tax revenue as a proportion of gross domestic product (GDP) - Ratio of distribution of income to distribution of an environmental tax burden
Primary and secondary data needed	- Extent and condition values (Land cover and use, register of ecosystem assets) - Biophysical and monetary values of ecosystem services from a country's ecosystem or natural assets - Consumption values of natural assets per sector - Imports and export values of natural assets per sector
Relevant data characteristics	Most economic data will be at a national or sectoral rather than local scale, so spatial datasets are not always an option. However, for household income and consumption values, local and regional spatial data will be useful.

6.2 Nature information needs for monitoring and evaluation of existing policy

As well as policy design, nature data also supports monitoring and evaluation of policy implementation, through informing how biodiversity and ecosystems have changed over time. Monitoring data and indicators pre and post policy implementation can inform decision-makers whether a policy has been effective in managing resource use or biodiversity conservation, restoration, etc. Table 19 and Table 20 provide examples of nature information sets that can be useful to inform questions on the evaluation of current policies. These nature information sets largely mimic those used in new policy creation, however they are utilized for a different purpose.

With the adoption of the Kunming-Montreal Global Biodiversity Framework, and its associated monitoring framework in development, national biodiversity indicators are required to track progress against national commitments. **Aggregated biodiversity indicators on changes in species abundance and the spatial extent of ecosystems have been developed over the past few years to improve nature conservation outcomes** (Czúcz, et al., 2012). The Convention on Biological Diversity (CBD) and European Union currently finance projects for the development of these policy-relevant biodiversity indicators (Czúcz, et al., 2012). Natural capital accounts play a critical role in the development of these indicators from nature data by providing disaggregated spatial data on ecosystem extent and condition, with economic variables and monetary flows of ecosystem services provided by ecosystem assets. Given the localized nature of biodiversity issues, production of biodiversity indicators from spatial accounts can also offer a more regional lens to policy creation.

To compare and extract meaningful evidence from nature information sets and indicators, policymakers should apply common tools for standardization. To verify and compare trends across different datasets, policymakers can choose sub-indicators with similar directional trends to complement the main indicator. Increases in the main indicator will imply improvement in all chosen variables. For example, La Notte, et al. (2020) computed the relative value of raw crops and processed crops in monetary terms to derive their composite indicator of a country's agricultural sector's contribution to GDP. Indicators should use a common unit for reporting, e.g., British Pounds, and always use relative values to avoid correlating the size of a country or industry with the impact or effect they have (La Notte, et al., 2020). In ecosystem accounting, biodiversity indicators could be organized by ecosystem type, revealing trends in biodiversity, its relevant ecosystem services, and how these vary with changes in ecosystem extent and condition (King, 2020).

Consistent monitoring also enables decision-makers to be responsive to changes in environmental and economic trends, as well as report against global commitments such as the UN Sustainable Development Goals (SDGs) and Kunming-Montreal Global Biodiversity

Framework (Vardon, et al., 2022). While evidence of integration of natural capital accounting into new policy is sparse, monitoring has become more widespread on the global stage (Ruijs, et al., 2018). Sweden uses their monetary accounts to monitor environmental expenditures and subsidies (Ruijs, et al., 2018). Mexico uses indicators from accounts to monitor changes in biodiversity and ecosystem services (Schipper, et al., 2017). The Netherlands monitors interdependencies between ecosystems and economic activities (Schipper, et al., 2017). Each of these use cases indicates different types of data trend monitoring, but all can be effective in promoting the findings from natural capital accounts to inform future policy.

Table 19. Data needs for monitoring how a country is aligning with global commitments and goals under the Global Biodiversity Framework Target 3

Function	Identify the change and trends in a country's natural assets and flows in biophysical and monetary terms to monitor progress against Target 3 of the Global Biodiversity Framework[56]
Nature Information set	Quantitative indicators to map trends in environmental and biodiversity variables and how they change over time. For example: - Land-use intensity - Total Ecosystem Capability (TEC) - Gross Ecosystem Product (GEP) (the economic value of all ecosystem services generated) - Biodiversity status and budgetary expenditures (e.g., cost of conservation management of wasteland ecosystem assets)
Primary and secondary data needed	- Extent and condition values (Land cover and use, register of ecosystem assets) - Biophysical and monetary values of ecosystem services from a country's ecosystem or natural assets

[56] Target 3 of the Global Biodiversity Framework is "Conserve 30% of Land, Waters and Seas". For further information on the 2030 targets refer to https://www.cbd.int/gbf/targets

Relevant data characteristics	○ Responsive time series data spanning over longer time horizons is integral for these types of nature information sets, requiring data from pre-policy and post-policy implementation.

Table 20. Data needs to evaluate changes in species abundance in a region after the establishment of a rare species conservation policy

Function	Identify the current and baseline state of species abundance in biophysical terms to determine the effectiveness of a species conservation policy.
Nature Information set	- Population estimates for focal species - Distribution of focal species - Threat assessment for focal species
Primary and secondary data needed	○ Changes in the number of individual species within a specific area (e.g., number of breeding pairs) ○ The threat status of species (e.g., change in local species threats) ○ Change in the available habitat for a species (e.g., Change in species Area of Habitat (AoH)) ○ Ecosystem extent or condition values (Land cover and use, register of ecosystem assets)
Relevant data characteristics	Responsive time series data spanning over longer time horizons is integral for these types of nature information sets, requiring data from pre-policy and post-policy implementation.

6.3 Insights on compiling and structuring data into national natural capital accounts

As the uptake of the UN SEEA frameworks increases, examples of demonstrated application of natural capital accounting to policy decision making are becoming more available. From these, insights on how data and information needs vary for different contexts and different spatial scales can be gained, including barriers and data gaps. Table 21. Includes examples of how countries have used accounts to answer policy questions. Box 6 and 7 detail specific examples of applications across Ireland and South Africa.

Table 21. Different public sector decision types with the relevant nature information sets and examples for new policies

Decision Type	Description	Policy Question	Relevant Accounts	Examples and applications of natural capital accounts
Protection mechanisms	Policies that target the specific protection or restoration of an ecosystem or species	- How do you maximize the area of ecosystem protected and minimize the cost to government and industry? - How effective is the management and protection levels of an ecosystem?	- Ecosystem extent and condition Accounts	- *Guatemala:* accounts were used to create new forestry policy that prioritizes the protection and restoration of forest ecosystems (Banerjee, et al., 2019) - *Philippines*: mangrove accounts are used to establish the benefits of mangroves for coastal zone protection (Rujis & Vardon, 2018) - *Uganda*: ecosystem accounts used to establish the extent of ecosystem degradation and increase appreciation of biodiversity as an asset amongst decision makers (Rujis & Vardon, 2018) - *EU:* ecosystem condition and extent accounts can be used to support policies such as the EU Birds and Habitats Directives and the EU Restoration Law (Damiani, et al., 2023)
Macroeconomic	Decisions on growth, productivity, competitiveness and the fiscal triangle (taxation, spending and borrowing)	- What tax level can be applied to dissuade activities harmful to biodiversity? - How do you address market failures and incentivize innovation?	- Monetary Accounts - Environmental activity/expenditure Accounts - Ecosystem Extent and Condition accounts	- *United Kingdom:* natural capital accounts showed a decline in the value of fossil fuels and an increase in the share of electricity generated by renewables with potential application of the accounts to clarify the potential for tax revenues / fiscal policy to correct market failures and incentivize innovation (Guerry, et al., 2015)

Decision Type	Description	Policy Question	Relevant Accounts	Examples and applications of natural capital accounts
				- *Peru*: accounts used to assess the economy-wide effects of ecosystem degradation (Rujis & Vardon, 2018) - *Colombia*: accounts used to inform the rates of water use tariffs (Rujis & Vardon, 2018)

Box 6: Ireland's differing data needs for different natural capital projects

Landscape and catchment level with secondary data – INCASE[57]

The Irish Natural Capital Accounting for Sustainable Environments (INCASE) project was the first NCA project in Ireland and piloted four river catchment level UN-SEEA ecosystem extent and condition accounts. Key national datasets used for the account compilation include CORINE landcover, Copernicus Land Monitoring Service Data and Natura 2000. These datasets were supplemented with local catchment surveys **(Stout, et al., 2023)**.

Site level with primary data – Nature+ Energy Project

The Nature+ Energy project in Ireland compiles biodiversity condition and extent accounts for onshore wind farms to help create biodiversity action plans for individual farms. The project used site level ecosystem accounting with primary data collection at each of the wind farms (i.e., through field surveys and habitat mapping).

National accounting - ForES Accounting for Forest Ecosystem Services

Developed to determine the link between forestry management decisions and the provision of ecosystem services in Irish forest ecosystems. The project is developing extent, condition and ecosystem service site-level accounts for 25 sites in Ireland, each between 30 and 2000 ha in size. Data mostly comes from publicly available data sets on land use and the Irish forestry commission (Department of Agriculture, Food and Marine and Coillte).

Overarching data challenges

One of the main gaps in projects is due to the lack of time series data. Ad hoc reporting from different stakeholders means data is collected from different time periods making it difficult to link different data types with one another (e.g., species and land cover). Each of the projects also recognized matching global ecosystem types with ecosystems in the region as a challenge when compiling ecosystem accounts.

Spatial granularity and data availability also posed an issue. For example, onshore wind energy farms are required to collect data pre- and post-construction of wind farms, but data is often not spatially explicit or is inaccessible due to confidential company reporting. Similarly, because data is typically collected by a third-party it is difficult to translate data into the appropriate natural capital accounting 'language.'

[57] For more information, visit https://www.incaseproject.com/

The INCASE project recommended that going forward a detailed ecosystem map for Ireland should be compiled in order to facilitate further ecosystem account production in the country, as well as the creation of a centralized national data platform.

Box 7: Data-rich natural capital accounting in South Africa – SANBI use case

The South African National Biodiversity Institute (SANBI), an agency in the environment ministry, works in partnership with Statistics South Africa to compile natural capital accounts in South Africa. National ecosystem accounts compiled to date include:

- National River Ecosystem Accounts
- Land and Ecosystem Accounting
- Land and Terrestrial Ecosystem Accounts
- Accounts for Protected Areas
- Accounts for Strategic Water Source Areas

South Africa is a unique case of NCA compilation given the country's wealth of pre-existing **data** available through the National Biodiversity Assessment (NBA) and other national databases. The NBA includes spatial assessments of ecosystems and species in terrestrial, freshwater and marine ecosystems. Headline indicators for the NBA include Ecosystem Threat Status, Ecosystem Protection Level, Species Threat Status and Species Protection Level **(South African National Biodiversity Institute and Statistics, 2021)**. South Africa has a national ecosystem classification system that is used to identify detailed national ecosystem types, which are cross-referenced to the IUCN Global Ecosystem Typology, allowing for harmonized global reporting and comparison with other countries.

Spatial data layers from the NBA require some further processing to fit the format required for natural capital accounts, including temporal and spatial scales. The South African case also acts as an example of data-sharing and collaboration within the public sector, as different managers of data and stakeholders were consulted throughout the compilation process. SANBI's co-production of accounts with the national statistical office and other stakeholders promoted institutional trust.

The accounts and the data and indicators they provide have been used in public sector decision-making, for example in highlighting declines in the ecological condition of rivers and addressing the impacts of land use in areas in the country that are critical for water provision.

7 Common data and information needs across business, finance, and public sector

Although data needs vary by sector and decision-making requirements, identifying common factors across private and public sectors can support streamlining information flow.

Understand the nature information set needed for different applications is the first step for the integration of nature-related data into decision-making. Common data needs can be seen when looking across business, financial institutions and governments, which can support more focused data collection and transformation to support multiple users.

Here, this assessment identifies broad nature information needs that are common across sectors, including: (i) sector-level data on impacts and dependencies, (ii) locations of significant nature-related risks, (iii) ecosystem delineation, (iv) company-level impact-driver data, (v) changes in ecosystem conditions, and (vi) changes in ecosystem service flows.

Once the information sets are defined, the underlying data required to produce them can be scoped, and gaps in available data identified. Common between business, financial, and public sector decision-making is the need to move towards more spatially granular, and responsive data as decision making moves from high-level assessments of potential impacts, dependencies, risks, and opportunities, to tracking realized outcomes of decisions on the ground, and understanding place-dependent risks and opportunities. The current landscape of data is often characterized by ad-hoc, disjointed datasets, and there is often a need for more consistent, responsive data to show changes over time .

Table 22 shows six types of nature information identified as a common need between business, finance and public sector decision making. These examples will be taken forward to pilot a nature information pathway that aims to boost the information flow between the sectors.

Table 22. Common nature information need identified across private and public sectors

Common nature information need identified	Example application for assessing business dependencies, impacts, risks and opportunities	Example application for finance sector strategies	Example application for public sector policy
Static sector level information on potential impacts and dependencies	Screening of potential material impacts and dependencies	- *Screening activities* - *ESG Integration* - *Reporting Frameworks*	- *Determining productivity levels of the economy / resource efficiency indicators per sector*
Lists of locations of elevated nature-related risks based on sensitivity and significance	Prioritizing locations for detailed assessments	- *Screening activities* - *ESG Integration* - *Reporting Frameworks* - *Thematic Investing* - *Impact Investing* - *Stewardship*	Support to developing spatial plans for new Protected Areas
Ecosystem delineations and spatial boundaries	Locating interface of operations and value chain with nature	- *Impact Investing* - *Stewardship*	- *Planning actions to meet ecosystem restoration commitments*
Comparable data on impact drivers	Measuring potential impacts on nature	- *Thematic Investing* - *Impact Investing* - *Stewardship*	- *Monitoring the impact of a policy designed to reduce impact drivers from key sectors*
Change in ecosystem condition at locations over time	Measuring realized impacts on ecosystems	- *Thematic Investing* - *Impact Investing* - *Stewardship*	- *Monitoring the impact of a policy designed to restore degraded ecosystem condition*
Changes in location specific ecosystem service flows	Assessing dependency-related risks	- *Impact Investing* - *Stewardship*	- *Monitoring the impacts of a policy designed to enhance flow of ecosystem services*

8 Key Barriers to access, use, and share nature information for decision making by the private sector and public sector

Data is collected and stored in different ways in private and public sectors. The Kunming-Montreal Global Diversity Framework Target 21 focuses on ensuring that biodiversity data, information and knowledge is available and accessible to guide biodiversity action – and both private and public sector has a role to play in achieving this target. The private sector can benefit from sharing their biodiversity data by adopting international best practices in data management and achieving greater operational efficiency (UNEP-WCMC, 2023). In turn, the public sector, generally the owners of large masses of biodiversity data, can benefit from the data sharing process by encouraging better integration of biodiversity considerations into private sector decision-making, using further data to address their national biodiversity priorities, and enlarging their own datasets by receiving data from other stakeholders (NEA and UNEP-WCMC, 2024).

As mentioned in the previous section, the aim of identifying data needs in each sector is also to bring to light challenges accessing this data as well as the barriers to sharing it. For instance, the report 'Data use in natural capital assessments Assessing challenges and identifying solutions' (Natural Capital Coalition, 2019) identify four core barriers to the use of natural capital data by the private sector:

i) **Accessibility**: factors affecting access include limitations and disincentives placed on the sharing of data, costs or licensing restrictions, incompatibility of datasets, and 'dark' data that have not been digitized, uploaded, or otherwise made available.
ii) **Infrastructure**: Weak governance through poor or inconsistent data management, a lack of systems or strategies, and a lack of policies or standards may negatively impact data quality and use.
iii) **Quality**: data gaps, either in terms of relevant and applicable spatial and temporal scales, subject matter, or within datasets, result in incomplete assessments.
iv) **Capacity**: lack of capacity regarding the use of data in natural capital assessments

The figure below illustrates a summary of the main stakeholder groups relevant to nature data and the main barriers private sector face when dealing with it.

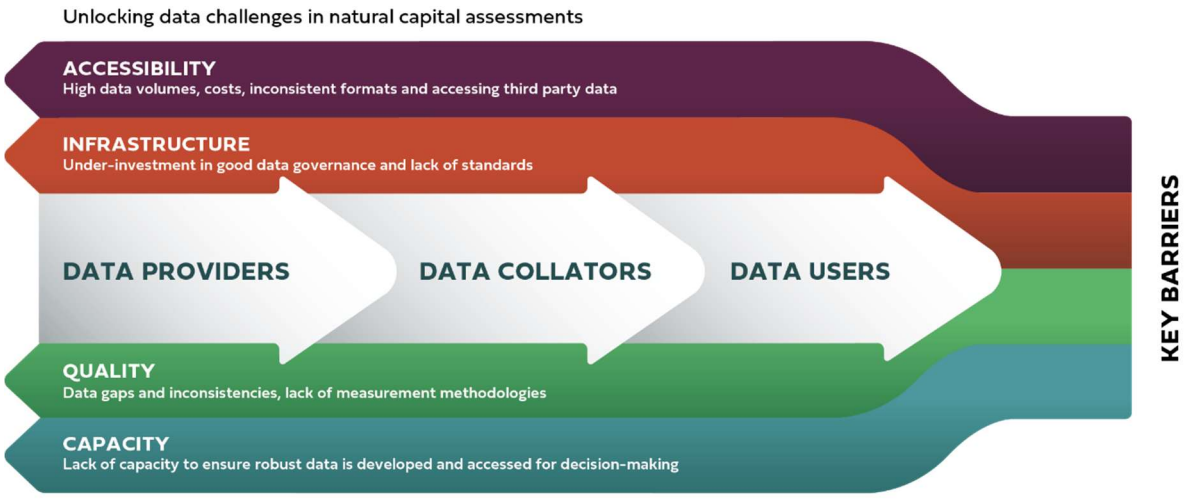


Figure 11. Main stakeholder groups involved in nature data collection and creation with the key barriers to data access (Natural Capital Coalition, 2019)

In May 2024, the A-Track project conducted a survey to establish user needs for the project, which contained three data-related questions to the wider private sector audience. The survey had 84 respondents and the majority work either in sustainability or senior management roles. To map the level of nature-data usage and perceptions across business, three specific questions were raised in the survey.

i. What categories of data are you using for nature-related issues (DIROs) within your direct operations and/or priority parts of your value chain?
ii. Has your company estimated the biodiversity footprints of your operations and value chains?
iii. Has your company built or is currently building Natural Capital Accounts?

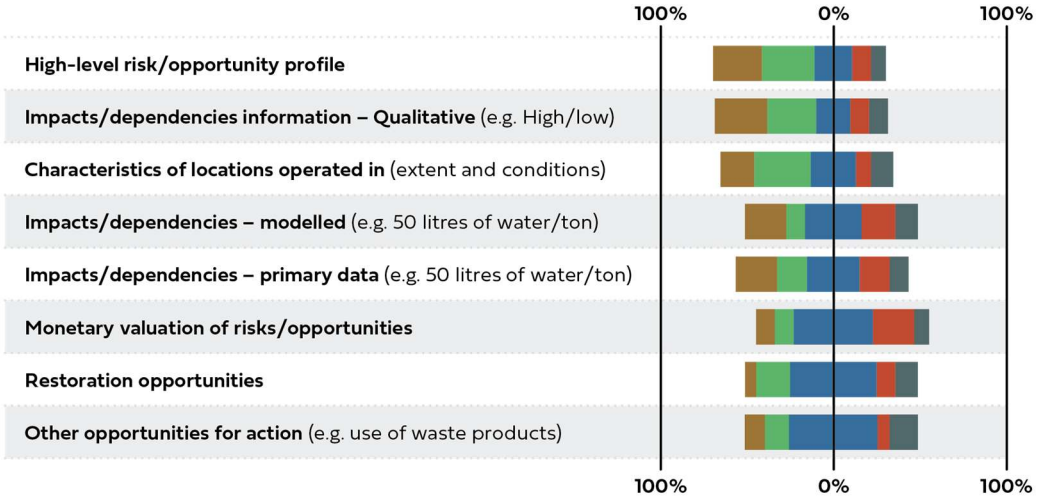
The result of the survey suggests that many companies surveyed use qualitative information on nature for screening purposes only. Fewer use more granular information for measuring impacts and dependencies, and fewer apply information for more advanced purposes such as understanding monetary values or assessing restoration activities. Moreover, many of the companies surveyed intend to assess their biodiversity footprint in the near-future and are interested in applying corporate natural capital accounting. This suggests demand for nature-related information is growing.

Some specific information needs highlighted by sustainability functions included biome-specific information on impacts and dependencies and improved understanding of pressure-state relationships. It is also important to highlight that data and information barriers are embedded in wider barriers for uptake of nature information, including lack of perceived materiality, prioritization of climate over nature and lack of understanding of nature-related risk. The two figures below detail the survey answers.

The survey results show that data and data accessibility is only one piece of the puzzle, with biggest challenge seems to emerge from how nature is understood, perceived, and budgeted for within companies.

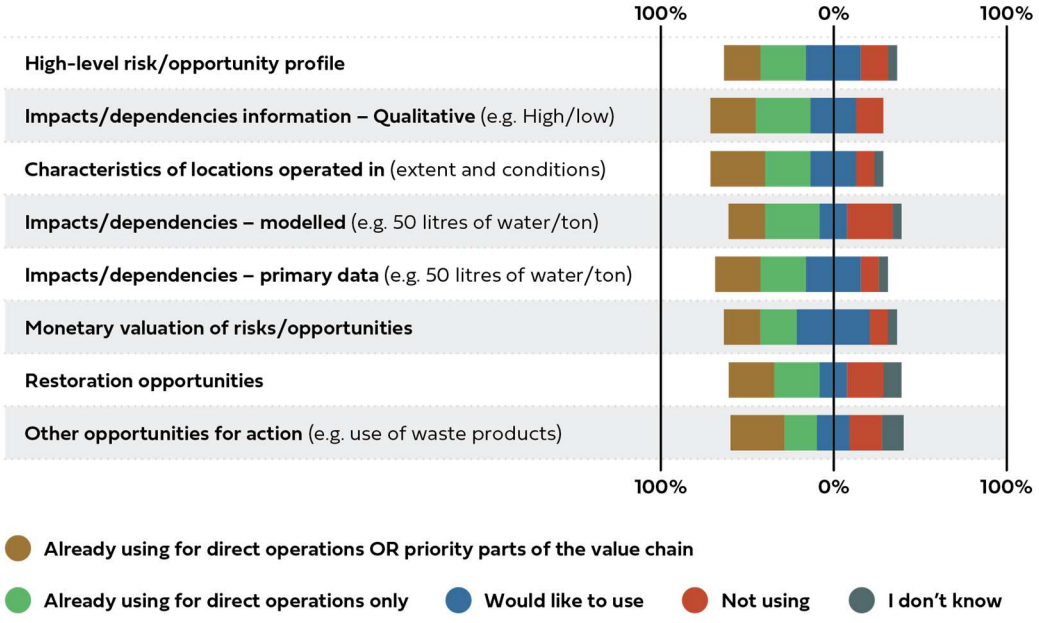
What categories of data are you using for nature-related issues (DIROs) within your direct operations and/or priority parts of your value chain?

Answers from C-suite, board, directors



What categories of data are you using for nature-related issues (DIROs) within your direct operations and/or priority parts of your value chain?

Answers from sustainability experts



Has your company estimated the biodiversity footprints of your operations and value chains?

Has your company built or is currently building Natural Capital accounts?

Even when the data accessibility barriers are overcome, sharing the data produced comes with a set of new barriers to the private sector. The Proteus Partnership[58] – an initiative to help companies to place data in the context of business decisions, and to place decisions in the context of global momentum to address the biodiversity crisis and achieve a nature-positive energy transition – developed a step-by-step guidance for businesses to share their data through the Global Biodiversity Information Facility (GBIF) (UNEP-WCMC, 2023). There are other initiatives promoting data sharing, like Zenodo[59] on the European level, national, regional, museum and archeology initiatives, and specific thematic ones like the European Vegetation

[58] For more information, visit https://www.proteuspartners.org/

[59] For more information, visit https://www.openaire.eu/zenodo-guide

Archive[60]. Nonetheless, GBIF has been a leading platform unifying data from different sources and different sectors of the economy. The table below was prepared by the Proteus Partnership initiative specifically for their members - but its findings can be broadly applied throughout the private sector - and summarizes the main barriers for the private sector to share their data found by the initiative and suggests steps to overcome them.

Table 23. Lessons from the Global Biodiversity Information Facility initiative on overcoming barriers to private sector data sharing

Private sector barrier	**Response**
Sensitive biodiversity information	Follow guidance provided by GBIF on identifying sensitive species and obscuring location data(Chapman, no date).
Sensitive commercial information	Delay and/or avoid publication of data that compromises commercial sensitivities.
Accusation of greenwashing	Ensure communications around data sharing are accurate and nuanced, with consistency on why data is/isn't shared.
Uncertainty around data quality and formatting	Follow GBIF guidance on types of data that are suitable to share and formatting requirements[61,62]

[60] For more information, visit https://euroveg.org/eva-database/doi

[61] For more information, visit https://www.gbif.org/dataset-classes

[62] For more information, visit https://www.gbif.org/standards

Private sector barrier	Response
Aligning consultant work with GBIF requirements	Where possible, instruct consultants to collect data aligned with GBIF requirements from the outset of projects
Financial costs of data sharing	Publication is free, and staff time requirements are small[63] with potential data management co-benefits
Lack of national capacity to accept data	Companies have options to work with different GBIF Nodes, and a helpdesk coordinated by the GBIF Secretariat can support where needed
Reputational risks if biodiversity is damaged	Greater transparency will reward high performance, benefitting leading companies
Companies can use GBIF without contributing data	GBIF is not depleted by use, and companies that share data can gain operational benefits
Lack of precedent	Around 60 companies have shared data to GBIF already, and further data sharing offers low-cost leadership opportunities

Similarly, the public sector also faces barriers to access, use, and sharing of their data. The challenges will change for different government branches and their level of maturity on

[63] For more information, visit https://www.gbif.org/data4nature

biodiversity monitoring, but an overarching point is usually the data gaps. Data gaps can mean a lack of continuous time series, lack of standardization in data collection, or different principles when storing data across the different levels of government. Data-sharing also brings other barriers, like lack of funding for data management or governance concerns such as staff turnover, policy discontinuity and lack of legal structures. Just like in the private sector, public sector can benefit from improving nature-information flows by reducing costs with collection and management of data while increasing scientific equity and providing access to data for low- and medium-income countries (NEA and UNEP-WCMC, 2024). The following table summarizes barriers that the public sector faces when collecting, accessing, and sharing data together with potential ways to overcome these barriers. The findings and details of the information can be found in the report from UNEP-WCMC and the Norwegian Environment Agency on *Sharing Biodiversity Data* (NEA and UNEP-WCMC, 2024).

Table 24. Lessons from the Norwegian Environment Agency on overcoming barriers to public sector data sharing (NEA and UNEP-WCMC, 2024)

Public sector barrier	**Response**
Technical gaps: lack of technical capacity for managing biodiversity data with a spatial component (e.g., GIS capacity) or limited expertise to harmonize and standardize data collection and curation	Narrowing technical gaps: build capacity across different teams identifying potential assets in each team and the different technical capabilities they have.
Funding gaps: insufficient funding can compromise data collection activities, as they usually require paid staff, remote field work or access to expensive technologies.	Bridging the funding gaps: Early integration of budgets and fundraising for biodiversity information management in projects is important as it will help mitigate funding challenges and promote free data sharing among institutions and users. Collaboration between organisations will also promote sustainable financing and reduce duplication of efforts.

Lack of data availability, quality, and usability: nature data is often scattered among multiple databases restraining data accessibility and visibility. Lack of interoperability and standardization of data collection and curation processes compromises data quality.	Enhancing data availability, quality, and usability: improving the usage of technology for collection of data (e.g. satellite data) to be shared can significantly build up the quantity and quality of the biodiversity information available. Standardizing data formats (e.g., Darwin code) and creating user-friendly interfaces increases data usability. Promoting existing global biodiversity data network infrastructures like GBIF will also contribute to better data availability, quality and usability.
Governance concerns: some government agencies experience a high rotation of staff and it can compromise data sharing processes that were initiated or maintained by former staff. Lack of formal data-sharing structures also make it difficult to establish procedures for managing data within different levels of government.	Addressing governance concerns: Developing and implementing data sharing strategies backed by legislation is core to ensure continuity in data management. Implementing international standards and protocols for data management, storage and sharing within governments and organizations addresses concerns on political changes, as the data sharing challenges posed by instability will be more smoothly dealt with.

9 Conclusion: next steps for exploring solutions to common data needs and identified barriers

Through a decision-centered approach the user needs assessment here brought together the different data and information needs from private and public sector that can facilitate the integration of nature into strategies. Different applications within the private and public sector will differ in their needs for nature-data in terms of granularity, responsiveness, etc. Understanding the required nature information set can help identify data that can fit different purposes in different levels of the economy, with the aim of accelerating the uptake of data and information into decision making.

For business, assessing impacts, dependencies, risks, and opportunities is the key driver of their need for nature information. Frameworks like TNFD, GRI and CSRD provide guidance on the steps needed to evolve the analysis of impacts, dependencies, risks, and opportunities. As assessed by this report, a first step of assessing impacts will often require qualitative, spatial, and static data. As companies evolve their process, data needs become more granular and the need for primary data collection increases.

Financial institutions' impacts and dependencies on nature are mostly linked to their investment portfolios rather than their operations. Therefore, mapping different sustainable finance strategies and understanding the data needs for incorporating nature-related issues on these strategies is crucial. For strategies like ESG integration, screening activities, and thematic investing, financial institutions can use static transformed data such as indices, foot printing scores, and sustainability labels to assess risks and opportunities. For impact investing and stewardship, spatial data and responsive primary data collection (both quantitative and qualitative) together with secondary data sources is needed. The need for spatial localized data is needed across the strategies, but the granularity and responsiveness will change depending on the level of ambition on nature targets and the need to robustly measure outcomes.

In the public sector, nature information may be collected in several branches of the administration, and the key challenge is to harmonize and use this data in both new and existing policy cycles. In this sense, organizing nature data in a common structure is key for the public sector. The System of Environmental Economic Accounting offers a framework for the compilation of natural capital stocks and flows that also connect to the existing System of National Accounts, promoting the integration of environmental and economic output decisions. In terms of data, new conservation, macroeconomic and public procurement policies can benefit from responsive field assessment and economic data not only on the direct projects or economic outputs but also on the value chain. Monitoring and evaluation processes will then rely on specific transformed data (indicators) to continuously measure extent and condition of impacted or conserved areas.

Common between business, financial, and public sector decision-making is the need to move towards more spatially granular, and responsive data. This supports the move from high-level assessments of potential impacts, dependencies, risks, and opportunities, to tracking realized outcomes of decisions on the ground, and understanding location-dependent risks and opportunities. Understanding the commonalities of data needs is a first step to improve nature information flows between private and public sector. Nonetheless, barriers to data sharing, access and use are still challenges. To address these, standardized data organization, harmonization of concepts between private and public sector and capacity building are the main areas for development if nature-information is to be integrated in the core of decision-making.

Applying accounting principles to data collection and organization can support standardizing nature data and facilitate sharing across sectors. In the private sector, emerging corporate natural capital accounting (cNCA) approaches translate different complex topics into one single language, understandable by a wide range of stakeholders – according to a Value Balancing Alliance (VBA), Capitals Coalition, and WBCSD study[64]. The same study shows that cNCA also helped to streamline nature into key decision-making like prioritization of supplier and materials for product design, consolidation of the total value of product developments and innovations including environmental and/or social aspect, and projection of P&L accounting for the expected internalized externalities. Alternatively, in the public sector, the UN System of Environmental Economic Accounting (UN-SEEA) can also contribute to the inclusion of nature data into decision-making in South Africa, where accounts and the data and indicators they provide have been used in public sector decision-making, for example in highlighting declines in the ecological condition of rivers and addressing the impacts of land use in areas in the country that are critical for water provision.

The next step of this work is therefore to explore how accounting principles and structures can support nature information pathways that inform private, finance and public sector decision making. Key concepts of assessment and accounting will be harmonized to develop a common data structure. The common data needs identified in this assessment will be used to form demonstration cases on how public sector information, compiled using accounting principles and structures, can be used for business and finance sector applications. As a last phase of the project, a set of policy recommendations will be outlined to boost such information pathways based on the lessons learned in the previous phases of the project.

[64] For more information, visit https://capitalscoalition.org/wp-content/uploads/2021/04/Transparent-benchmarking-final.pdf

Table 25. Barriers to access and use nature-data and the potential role of accounting principles on overcoming these barriers

Data barrier	Potential role of accounting approaches
Accessibility	Accounting structures can help ensure data is collected and structured in consistent and interpretable formats Accounting systems such as SEEA provide specific guidance on accessible sources of relevant data
Infrastructure	Accounting structures can provide standards and the structure of underlying data systems that support data collection and collation
Quality	Public sector natural capital accounts can support filling data gaps in private sector nature-related decision making. Private sector data can supplement public sector accounts. Using metrics, concepts and data from standardised accounting systems and structures strengthens confidence in the quality and relevance of outputs
Capacity	Accounting approaches have the potential to bridge expertise in sustainability, finance and data within organizations to increase internal capacity around nature data.

9 Annex 1

Table 26. Data needs for disclosure metrics across TNFD, ESRS E4 and GRI

	TNFD Core disclosure indicator/metrics	ESRS E4 Biodiversity and ecosystem services	GRI 101 Biodiversity
Location Prioritization	- *Total spatial footprint (km square)*	- *Number and area size (in hectares) of sites owned, leased or managed in or near biodiversity-sensitive areas*	- *Report the location and size in hectares of its sites with the most significant impacts on biodiversity*
Impacts and Dependencies	- *Extent of land/ freshwater/ ocean-use change* - *Pollutants released to soil split by type* - *Wastewater discharged* - *Waste generation and disposal* - *Plastic pollution* - *Non-GHG air pollutants* - *Water withdrawal and consumption from areas of water scarcity* - *Quantity of high-risk natural commodities sourced from land/ocean/ freshwater*	**If the company contributes to the impact drivers of land /freshwater/ sea use change,** it shall report relevant metrics that measure: - *The conversion over time (e.g. 1 or 5 years) of land cover;* - *Changes over time (e.g. 1 or 5 years) in the management of the ecosystem;* - *Changes in the spatial configuration of the landscape;* - *Changes in ecosystem structural connectivity; and* - *The functional connectivity* **If the company identifies material impacts with regards to land-use change, or impacts on the extent and condition of ecosystems,** it may disclose: - *Their land-use based on a Life Cycle Assessment*	GRI Standards include several required indicators/metrics to capture the company's contribution to direct drivers of biodiversity loss, changes to the state of biodiversity, and ecosystem services. **Direct drivers of biodiversity loss**: For each site reported with most significant impacts where its activities lead or could lead to - *Land and sea use change, report:* *i. the size in hectares of natural ecosystem converted since a cut-off or reference date, the cut-off date or reference date, and the type of ecosystem before and after conversion;*

	TNFD Core disclosure indicator/metrics	ESRS E4 Biodiversity and ecosystem services	GRI 101 Biodiversity
		If the company directly contributes to the accidental or voluntary introduction of invasive alien species, it may disclose: - *The metrics to manage pathways of introduction and spread of invasive alien species and the risks posed by invasive alien species* **If the company identifies material impacts related to the state of species, the undertaking may report metrics it considers relevant**. The undertaking may: - *Refer to relevant disclosure requirements in ESRS E1, ESRS E2, ESRS E3, and ESRS E5;* - *Consider population size, range within specific ecosystems as well as extinction risk;* - *Disclose metrics that measure changes in the number of individuals of a species within a specific area;* - *Disclose metrics on species at extinction risk that measure:* *i. The threat status of species and how activities/pressures may affect the threat status; or*	*ii. the size in hectares of land and sea converted from one intensively used or modified ecosystem to another during the reporting period, and the type of ecosystem before and after conversion;* - *Exploitation of natural resources, report:* *i. for each wild species harvested, the quantity, the type, and extinction risk;* *ii. water withdrawal and water consumption in megalitres* - *Pollution, report:* *i. the quantity and the type of each pollutant generated;* - *The introduction of invasive alien species, describe:* *i. how invasive alien species are or may be introduced;* - *For each product and service in its supply chain reported with the most significant impacts on biodiversity, companies should report:* *i. the information required by above, with a breakdown by country or jurisdiction*

	TNFD Core disclosure indicator/metrics	ESRS E4 Biodiversity and ecosystem services	GRI 101 Biodiversity
		ii. Changes in the relevant habitat for a threatened species as a proxy for the undertaking's impact on the local population's extinction risk. **If the company identifies material impacts related to ecosystems**, it may disclose: - *With regard to ecosystems extent, metrics that measure area coverage of a particular ecosystem without necessarily considering the quality of the area being assessed, such as habitat cover.* - *With regard to ecosystems condition:* *i. Metrics that measure the quality of ecosystems relative to a pre-determined reference state;* *ii. Metrics that measure multiple species within an ecosystem rather than the number of individuals within a single species within an ecosystem; or* *iii. Metrics that reflect structural components of condition such as habitat connectivity*	**Changes to the state of biodiversity** - *For each site reported with the most significant impacts, report the following information on affected or potentially affected ecosystems:* o *the ecosystem type for the base year;* o *the ecosystem size in hectares for the base year;* o *the ecosystem condition for the base year and the current reporting period*
Risks and opportunities	- *Value of assets, liabilities, revenue and expenses that are assessed as*		

	TNFD Core disclosure indicator/metrics	ESRS E4 Biodiversity and ecosystem services	GRI 101 Biodiversity
	vulnerable to nature-related transition risks. - *Value of assets, liabilities, revenue and expenses that are assessed as vulnerable to nature-related physical risks.* - *Description and value of significant fines/penalties received/litigation action in the year due to negative nature-related impacts.* - *Opportunity Amount of capital expenditure, financing or investment deployed towards nature-related opportunities, by type of opportunity, with reference to a government or regulator green investment taxonomy or third-party industry or NGO taxonomy, where relevant.* - *Increase and proportion of revenue from products and services producing demonstrable positive impacts on nature with a description of impacts.*		
Response and management			- *Report the goals and targets to halt and reverse biodiversity loss, whether they are informed by scientific consensus, the base year, and the indicators used to evaluate progress.*

	TNFD Core disclosure indicator/metrics	ESRS E4 Biodiversity and ecosystem services	GRI 101 Biodiversity

			- *Report for each site with the most significant impacts on biodiversity:*
			  o *the size in hectares of the area under restoration or rehabilitation;*
			  o *the size in hectares of the area restored or rehabilitated;*

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A-Track is a four-year, €11 million project that will accelerate action for nature by business, financial institutions and government.

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Partners have led the development or implementation of guidelines and standards for measurement of nature impacts and dependencies for improved decision-making, including: biodiversity footprinting, natural capital assessment and accounting, and business models and finance that contribute to nature positive outcomes.

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