Taskforce on Nature-related Financial Disclosures

Nature-related Risk and Opportunity Management and Disclosure Framework

Beta v0.4 Annex 4.6 Guidance on LEAP: Methods for assessing nature-related risks

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1. Context and objectives of this guidance

This document provides guidance on how to conduct three methods for risk assessment, including both qualitative and quantitative approaches. These methods can be used by both corporates and financial institutions in the context of applying the TNFD framework. The guidance has been informed by pilot testing. It complements the TNFD's guidance on scenario analysis and can be used in the context of the LEAP approach.

Nature-related risk assessments can help financial institutions and corporates inform their strategies and decision-making. For asset owners in particular, risk assessments feed into decisions about portfolio allocation, risk management and investment strategies, from due diligence to value creation and exit strategy. Risk assessments can also help corporates stress test their business strategies, identify options for risk mitigation and inform peer engagement to create industry-wide initiatives with positive impacts on nature. Understanding how to apply best practice risk assessment approaches effectively is essential for integrating nature into strategic thinking and decision making as well as risk management.

Box 1: Risk assessment for financial institutions and corporates

While the content of this paper has been piloted with asset owners, the approach is targeted at financial institutions in general. Implications for corporates have been pointed out where relevant.

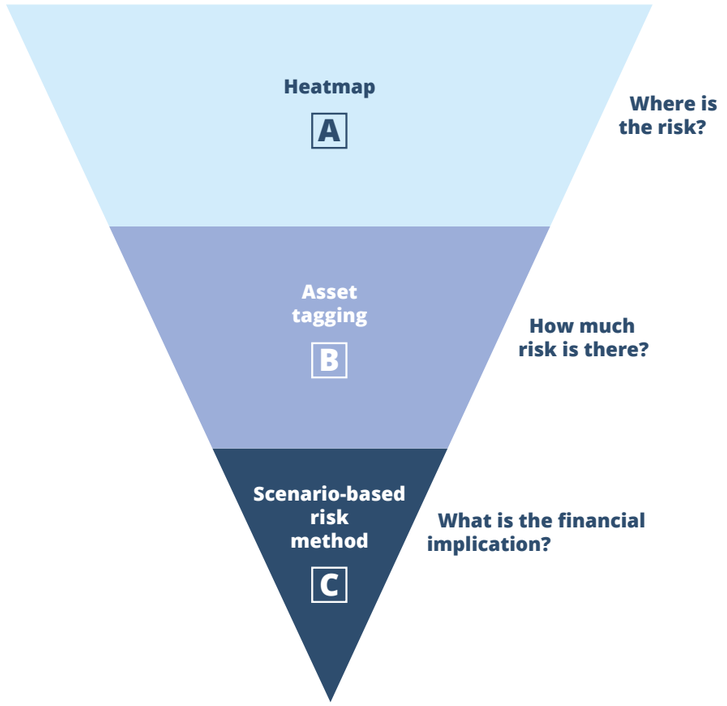
When looking at available public reports on risk assessment approaches, financial institutions tend to use risk assessment approaches to assess nature-related risk in a specific sector or company they have a financial exposure to. Corporates typically use them to understand exposure to nature-related dependencies, impacts and risks stemming from sectors of operation, products, services and locations.

Annex 4.6

2. Three example approaches to risk assessment

This section sets out practical guidance for implementing the three different risk assessment approaches shown in Figure 1. These methods build on each other and can be deployed in sequence when applying the LEAP approach iteratively.

Figure 1: Three risk methods for assessing nature-related risks



A. Heatmaps

i. Inputs, outputs and use cases

A heatmap qualitatively summarises potential or actual exposure to nature-related risk, revealing whether activities materially depend upon or impact nature. Organisations can use heatmaps to help identify sectors with multiple dependencies and impacts rated high or moderate.[1] An illustration of the outputs from the heatmap approach is shown in Figure 2, which shows an investor's portfolio exposure to a range of nature-related dependencies and impacts across several sectors.

1 Heatmaps may be a particularly useful risk assessment approach for asset classes where detailed data at the financial asset level is difficult or costly to obtain.

Figure 2: A heatmap helps identify sectors where exposure to nature-related risks has the potential to be most material (illustrative)

	Dependencies		Impacts						
			Land use	Water use	Pollution				Low – High
SASB Sectors	Soil quality	Water	Land use	Water use	Air pollution	Solid waste pollution	Soil pollution	Water pollution	AUM (% of total)
1 Agricultural Products & Tobacco	High	High	High	High	Low	Low	High	High	2%
2 Consumer Goods	Low	Low	Low	High	Moderate	Low	Moderate	Moderate	5%
3 Extractives & Minerals Processing	Low	Moderate	High	High	High	High	Moderate	High	14%
4 Financials	Low	Low	Low	Low	Low	Low	Low	Low	16%
5 Food & Beverage (ex. Agriculture & Tobacco)	Low	Moderate	Low	High	Low	Moderate	Low	Low	11%
6 Health Care	Low	High	Low	High	Low	Moderate	High	High	6%
7 Infrastructure (ex. Utilities & Generators)	Low	High	High	Low	Low	High	Low	Low	2%
8 Renewable Resources & Alternative Energy	Low	High	Low	High	Low	Low	High	High	3%
9 Resource Transformation	Low	Low	Low	High	Moderate	High	High	High	6%
10 Services	Low	Low	Low	Moderate	Low	Low	Moderate	High	12%
11 Technology & Communications	Low	Low	Low	Low	Low	Low	High	High	15%
12 Transportation	Low	Low	Moderate	High	Moderate	Moderate	High	High	5%
13 Utilities & Electricity Generators	High	High	High	High	High	High	High	High	3%

AUM: Assets under management

In this illustrative example:

- Utilities and electricity generators sector ranks high across all dependencies and impacts.
- Agricultural products and tobacco sector ranks high across most dependencies and impacts.
- Most sectors rank high or moderate for water use, soil pollution and water pollution impacts.

Heatmaps can help organisations identify areas of their portfolio or operations that have high concentrations of higher-risk dependencies and impacts and therefore may need further analysis. For example:

- The extractives and minerals processing sector has relatively high financial exposure and ranks high or moderate across most dependencies and impacts.
- The technology and communications sector ranks high on two impacts and has a high share of financial exposure, representing 15% of assets under management in the portfolio.

A review of published reports (see Table 2 at the end of the document) **sheds light on the advantages and drawbacks of the heatmap approach.**

- **Advantages:**
  - Data sources that can be used to build a heatmap are readily available and quite straightforward to use.
  - Financial sector reports often use the publicly available ENCORE tool or the WWF Biodiversity Risk Filter to assign a qualitative rating to each sector for each nature-related category, similar to the SBTN Materiality Matrix.
  - Organisations can adjust qualitative ratings derived from a data source, based on the report preparer's relevant factors. For example, Moody's adjusts the qualitative risk rating assigned to specific categories of risk based on the track record of specific sectors when it comes to risk mitigation.
  - Organisations can incorporate value chain considerations in a heatmap-type assessment instead of focusing exclusively on direct dependencies and impacts. For example WEF makes use of an input-output table.
- **Drawbacks:**
  - The qualitative rating assigned to each category is often agnostic to financial exposure or to the individual companies that make up the portfolio. This reflects potential rather than actual dependencies, impacts or risks for financial institutions.
  - A basic heatmap generally does not consider dependencies and impacts that arise across the value chain of a given sector or subsector.
  - It is more difficult to account for opportunities as this involves forward-looking assessments of nature-related pools of value and revenue potential. No reports reviewed to date consider nature-related opportunities in the context of a heatmap.
  - Published heatmaps are not forward-looking, but usually focused on the present or the short-term future and do not typically involve scenario analysis.
  - Heatmaps represent an aggregated view that does not provide nuances below the sector or subsector level and data sources typically used to produce heatmaps, such as ENCORE, do not yet provide data about unconventional sectors and subsectors.

For these reasons, organisations may choose to supplement a heatmap approach with an asset tagging or scenario-based risk assessment approach.

The heatmap approach outlined in this example involves mapping an organisation's financial exposure and assets under management to ENCORE sub-industries, with their corresponding ENCORE impact and dependency ratings, using sector and industry classification system correspondence tables and then producing relevant metrics. While the ENCORE tool is currently widely used by the market, other data sources are available.[2]

2 As referenced in TNFD guidance, some examples of other data sources include: SBTN's Sector Materiality Tool, SASB's Materiality Finder, and GRI's Sector Standards.

Annex 4.6

ii. Considerations for report preparers

Choosing the relevant level of aggregation

Global, sector-level heatmaps enable rapid screening and comparison across sectors, but disaggregation may be required to generate actionable insights:

- A sector is often comprised of multiple sub-sectors that can vary greatly in their nature-related dependencies and impacts. For example, the SASB classification system "food & beverage" sector includes agricultural products, food retail and restaurants. For this reason, report preparers may wish to use sub-sector classifications to generate more specific insights, as depicted in Figure 2.

Incorporating location-specific information

Although the archetypal heatmap is produced at the global level, it is possible to produce a heatmap for a specific region, geography, biome or ecosystem:

- This could involve applying expert judgement to adjust global-level qualitative risk ratings derived from ENCORE or other data sources, potentially accompanied by additional research related to geography-specific dependencies and impacts.
- An investor's suggestion was to generate multiple heatmaps for different geographies, especially if portfolio holdings are concentrated in specific regions.

Incorporating value chain impacts

The main shortcoming of a basic heatmap is the lack of consideration for the dependencies and impacts that arise across the value chain of a given sector or subsector.

- Risk ratings derived exclusively from the ENCORE tool only account for a sector's direct dependencies and impacts on nature, without considering dependencies and impacts that arise upstream or downstream. This affects the food and beverage sector, for example, which may not be seen as particularly high risk on the heatmap, partly because its links to the upstream agricultural sector are not accounted for in the rating scores that it is assigned.
- ENCORE-based risk ratings do not account for financed impacts or dependencies when assigning ratings to the financial sector. As reflected in investor feedback, excluding these considerations could be misleading when assessing the financial sector's nature-related risk, or the risk for other sectors with material dependencies and impacts along the value chain.
- Performing a heatmap only on a sector's direct operations is inconsistent with TNFD guidance that recommends accounting for the entire value chain. This highlights the benefits of supplementing a heatmap approach with more complex risk assessment approaches that incorporate value chain considerations.

To address value chain issues within the heatmapping approach, organisations can construct bespoke risk rating methodologies for upstream or downstream sectors.

Annex 4.6

For example, financial institutions could account for financed dependencies and impacts and downstream consumer goods companies could account for risks linked to deforestation in the value chain.

- One option is to approximate downstream risks by combining ratings for upstream sectors that feed into a downstream sector. This can be done using a global multiregional input-output table, as seen in the WEF's report. The input-output table approach can be supplemented with regional data specific to individual financial assets, as seen in the French Central Bank's working paper, which begins to move from heatmapping to an asset tagging approach.
- A simpler solution may be to look at the dependency and impact ratings assigned to a sector's key supplier industries and devise a methodology to adjust the sector's rating on the heatmap, without the use of trade data. For example, the agricultural products sector is a key supplier for the food and beverage sector. If land use impacts for the agricultural products sector are rated high, the devised methodology might require land use impacts for the food and beverage sector to have an elevated rating to reflect the impacts in its supply chain.
- Using the SBTN's Sector Materiality Tool rather than ENCORE when producing the heatmap will allow qualitative ratings for certain upstream and downstream dependencies and impacts by sector. These could be amalgamated into a single sector rating, based on a methodology devised by the report preparer.
- In all cases, organisations should be transparent about whether or not value chain considerations have been incorporated in the heatmap that they produce.

Selecting dependencies and impacts

Heatmaps are defined by the dependencies and impacts they examine, which is why selection of relevant dependencies and impacts is key.

- Some investors from the pilot expressed a preference for set categories to begin scoping using a heatmap. TNFD guidance lists specific categories of dependencies and impact drivers, with impacts disaggregated in line with Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) drivers of nature change. These can be used as default categories to structure a heatmap. TNFD additional guidance by sector and biome can help to select the most potentially material categories in specific context and allow for more comparability across heatmaps.
- Data sources such as the ENCORE tool can help report preparers select dependency and impact categories. Guidance in the Natural Capital Protocol also offers long lists of dependencies and impacts.

Understanding the rating methodology

Qualitative ratings assigned can depend on choice of methodology and underlying data used.

- The data source most often used for heatmapping is the ENCORE tool, which according to pilot investors is simple to interpret, publicly available and broadly comparable across sectors.
- However, the archetypal heatmap output produced with ENCORE lacks transparency about how ratings for dependencies and impacts are derived because it does not reveal the factors considered when assigning a qualitative rating. For example, according to ENCORE, a high rating for solid waste could refer to the classification of waste if it is hazardous, the material constituents if it is made of plastic or its disposal method if it will end up in a landfill. Looking at a heatmap, it is not immediately clear which of these aspects drive a high rating in a given sector, or how the impacts of a high volume of plastic waste should compare to the impacts of a small amount of hazardous waste when the qualitative rating is assigned.
- This was evident when pilot investors raised questions about why some sector-dependency/impact pairs were scored in a certain way. This makes it difficult for organisations to understand their potential exposure to certain dependencies and impacts without conducting additional research.

Conducting additional research could enable report preparers to modify ratings and increase their usefulness.

- As an option, an organisation may choose to adjust ENCORE ratings to incorporate more considerations or to create its own ratings. For example, heatmap ratings could potentially represent the degree of dependency/impact, consider the state of nature in a particular geography being assessed, or include the likely level of policy or consumer action in specific impact categories to draw out the risk implications.

Striking a balance between comparability and specificity

A heatmap provides broad comparability across sectors, as well as dependencies and impacts, but this is at the expense of specificity and accuracy.

- Investor feedback suggests that greater specificity about supply chains, biomes or geographies could improve the usefulness of a heatmap and help investors prioritise areas for deeper analysis.
- In the same vein, use of the same qualitative rating scale across dependencies and impacts may obscure the relative importance of each impact and dependency. For example, according to the IPBES report,[3] land use change contributes more to nature loss than pollution, but this would not be conveyed on a heatmap, where both land use and pollution impact drivers may have a high rating for a sector.
- Heatmaps are a useful first step, but should be complemented by additional risk assessment approaches that allow for a more granular and robust assessment. Several investors from the pilot study commented that the heatmap was only useful as a basic first step to guide a more involved risk assessment approach.

Linking dependencies and impacts to risks

3 IPBES, May 2019, Global Assessment Report on Biodiversity and Ecosystem Services

An archetypal heatmap shows qualitative ratings for dependencies and impacts, which are linked to risks.

- Conceptually, organisations could link dependencies to physical risks and impacts to transition risks. For example, high land use impacts could be linked to higher reputational risks by causing deforestation or higher policy-related risks as more stringent anti-deforestation legislation is implemented. Water dependency could be linked to risks of water scarcity in specific locations and lead to operational risks.
- This is not, however, a full or accurate representation of the connections of dependencies and impacts to different types of nature-related risks. For example, a physical risk such as water scarcity in one sector may prompt action within another sector that would create a transition risk, such as the implementation of policies to regulate water use.

Prioritising risks according to financial exposure

Depicting both risk ratings and financial exposure by sector on the heatmap for assets under management can enhance its usefulness at very low cost.

- Plotting sectoral or sub-sectoral financial exposure on the heatmap allows organisations to identify rapidly and cross-reference where dependency/impact ratings and sector-level financial exposure may be high and warrant additional investigation. Financial exposure can help determine which sectors merit a deep dive using a more complex risk assessment approach.
- Organisations may need to decide whether to prioritise higher-risk sectors with lower financial exposure or lower-risk sectors with higher financial exposure. For investors in the pilot study, this decision was not always clear.
- Alternatively, reporting organisations could choose to prioritise a specific impact or dependency, such as land use change through deforestation, across multiple sectors, regardless of financial exposure.

B. Asset tagging

i. Inputs, outputs and use cases

Asset tagging deepens the heatmap approach by using data specific to financial or corporate assets to determine the magnitude of nature-related risk. It assesses the degree to which organisations are exposed to nature-related dependencies and impacts through qualitative, quantitative or location-based metrics.

In the financial sector, this approach is usually applied to a sub-section of a financial institution's portfolio or assets, focusing on areas where nature exposure is expected to be material, such as impacts on forests through deforestation. Compared to a heatmap approach, the asset tagging approach offers the potential to move:

- From the sector level to the physical or financial asset level to provide a more granular and specific understanding of risk.

- Towards the use of more quantitative data (at the process, product, geography and/or physical asset level), to improve understanding of the magnitude of risk.

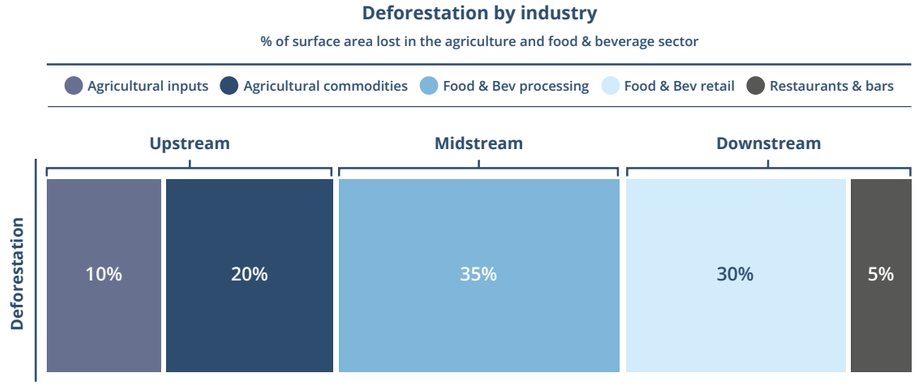
Input data for asset tagging can vary widely and typically falls into two categories:

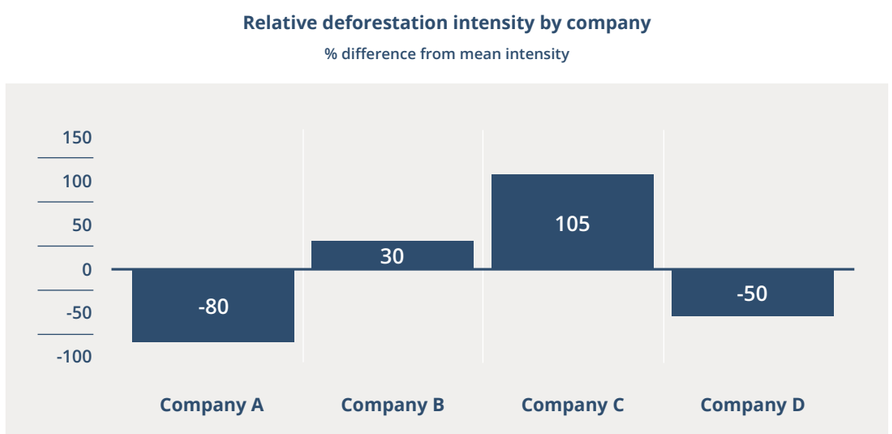
1. **Sector, process, product or location data,** detailing a corporate's operations.
2. **Nature exposure and risk data,** which qualitatively or quantitatively links the above data to nature-related dependencies, impacts or risks.

The specificity of the analysis and the insights gained will depend on the level of data available.

An illustration of two possible outputs from the asset tagging approach is shown in Figure 3.

Figure 3: Asset tagging determines the magnitude of risk using asset-level data within a particular sector, for a particular dependency or impact, at the portfolio level (top panel) and the company level (bottom panel) (illustrative)





0% = the mean deforestation intensity for commodity producers

Asset tagging helps identify individual portfolio companies or corporate assets with high impacts or dependencies on nature, which might be associated with nature-related risks. Individual portfolio companies or business units identified as high risk can then be targeted for further engagement. This is the case for both qualitative and quantitative asset tagging.

Example of qualitative asset tagging – A report preparer could use a qualitative score to indicate dependencies and impacts, first mapping each portfolio company to a particular production process (found in the ENCORE tool) and then summarising the scores at the portfolio level.

Example of quantitative asset tagging – Country-level information about commodity-specific deforestation intensity can be mapped against the countries from which a palm oil processing company derives its palm oil. This can inform on the likelihood of operations contributing to deforestation, which can then be translated into regulatory costs, such as policy-driven fines or reputation-based revenue losses.

A review of published reports shows the advantages and drawbacks of the asset tagging approach:

Advantages:

- The asset tagging approach is relatively flexible:
  - Most reports focus on potential negative impacts, but some, such as BMO's company-level revenue alignment with UN Sustainable Development Goals[4] also consider metrics that demonstrate a positive impact on nature or mitigation of negative impacts on nature. It is also possible to consider specific risks, such as reputational risk in DNB's assessment of companies involved in environmental controversies.
  - Metrics produced can be quantitative and absolute, such as the total biodiversity footprint in terms of Mean Species Abundance loss, related to revenue, such as the biodiversity footprint per million USD invested, or qualitative (high, medium or low). It is possible to compare metrics against external sources to indicate better or worse performance, or measure a metric over time to show improvement.

Drawbacks:

- The financial implications of nature-related risks are not usually considered in this approach.
- Data availability limits the specificity of metrics produced. For example, in the financial sector, many reports from banks apply sector averages to portfolio companies to produce relevant metrics, although more granular data could become available as corporate disclosures improve. Feedback from investors in the pilot also highlighted the limitations of data that is available.

4 For example, this includes SDG 2.4, which involves implementing climate resilient and sustainable food production, and SDG 6.4, which involves increasing water-use efficiency to address water scarcity.

There are four levels of asset tagging that an organisation can conduct, building on the heatmap approach with increasing granularity of data. These are outlined in Figure 4.

Figure 4: Asset tagging can be conducted using a range of qualitative or quantitative evidence, depending on the report preparer's objectives

	Levels of counterparty information									
	Company Name	Sector	Sub industry	Process	Product	Country/ Biome Production	Country Sale	Asset-level Location	Example use cases	Data requirements
Asset-tag level 1 Processes	Company A (example)	Food and Beverages	Agriculture products	Livestock and dairy farming					Initial risk scoping exercise; identification of higher-level patterns of exposure	ENCORE or internal qualitative process risk assessment
Asset-tag level 2 Products	Company A (example)	Food and Beverages	Agriculture products	Livestock and dairy farming	Dairy products				Inform risk strategy and diversification	Company-level revenue/ production data
Asset-tag level 3 Products & country/biome locations	Company A (example)	Food and Beverages	Agriculture products	Livestock and dairy farming	Dairy products	Brazil	China		Engagement with counterparties on procurement/ supplier strategy	Level 2 + Company level geo-revenues + land use spatial data
Asset-tag level 4 Product & physical asset locations	Company A (example)	Food and Beverages	Agriculture products	Livestock and dairy farming	Dairy products	Brazil	China	XY coordinate	Engagement with counterparties on high-risk assets	Level 3 + Company level asset location data

Approaches depicted in Figure 5 increase in depth and data granularity. In particular:

- **Level 1** approaches move beyond heatmapping by focusing on processes that are linked to specific dependencies and impacts. These approaches do not typically differentiate well between different companies (especially companies engaged in the same processes) or locations.
- **Level 2** approaches go a step further by introducing greater company-level variation to give reporting organisations more insight into risks stemming from different products, such as palm oil.
- **Level 3** approaches add location considerations by differentiating in processes and products between producing and selling regions and potentially also incorporating biome-related data, such as data related to forests.
- **Level 4** approaches use physical asset-level data to pinpoint how specific assets interact with nature-related dependencies and impacts, with the possibility of including granular local-level biome/ecosystem specific considerations.

Deeper approaches help organisations unlock more specific metrics to assess dependencies, impacts and risks and be presented externally.

While Level 1 approaches may retain the discrete qualitative dependency and impact ratings seen in the heatmap approach (high, medium and low), they bring additional value by further disaggregating companies into processes. Feedback from pilot testing asset owners also suggests that quantitative metrics produced during asset tagging could be useful to show their investors, and help with accountability, potentially in line with the asset owner's fiduciary mandate.

ii. Considerations for report preparers

Striking a balance between comparability and specificity

There is a trade-off between comparability and specificity when selecting a specific level of the asset tagging approach.

- Use of qualitative data (in the Level 1 approach to asset tagging, seen in Figure 4) facilitates comparison, but does not offer much differentiation between portfolio companies. For example, differentiation between two companies who operate in the same sectors and use the same processes is low, limiting the usefulness of this approach in screening portfolio companies.
- Location-relevant and quantitative metrics add several more layers of insight, especially if informing specific topics for engagement, such as ways to reduce deforestation. They are produced by deeper levels of asset tagging, requiring more data and often increasing the complexity of the analysis. Because the insights produced are highly specific to individual portfolio companies, cross-sector comparability could decrease, especially because certain metrics may not apply to all sectors.
- Organisations could choose to conduct multiple levels of the asset tagging approach to produce some metrics with more comparability and other with more specificity. In making this decision, organisations should keep in mind the aims they have defined for their risk assessment.

Linking assets to locations

Linking financial or corporate assets to high-risk ecosystems involves multiple layers of data that are not always available.

- The first layer of data is a physical map used to identify biomes or ecosystems, especially those meeting the criteria for priority locations, as in the TNFD's location prioritisation guidance. This type of information is often publicly available and increasingly granular, helping organisations understand their nature-related dependencies and impacts in specific locations. For example, physical mapping tools are listed in the TNFD's Tools Catalogue and include Space Intelligence's HabitatMapper, WWF's Risk Filter Suite and the Natural History Museum's Biodiversity Intactness Index.
- The second layer of data is information on a portfolio company's revenue (split by geography) or a portfolio company's physical asset locations. While access to this data increases the accuracy of insights significantly, there are several issues that may prohibit financial institutions from using this data, such as lack of cross-sectoral data coverage, or patchy data within sectors or within companies.

It is possible to use proxies for location-specific data, but these proxies are imperfect.

- One option is to use country-level data, which enables an estimate of risks across countries. However, this approach does not locate physical assets within countries, which is meaningful information.
- Corporate report preparers may have a data advantage, since they would be expected to have location data for their operations available internally.
- In the financial sector, investment and engagement strategies can be informed by knowledge on which countries or regions present high risks without needing the geographic coordinates of a portfolio company's factory. This is especially the case for transition risks, which often apply on a country-level basis.

Obtaining data for public versus private companies

Asset tagging requires financial institutions to accurately describe their financial assets such as portfolio companies in terms of processes, products and (ideally) location.

- This information is more easily accessible for publicly-listed companies and can be obtained through several third-party data providers. For private companies, data availability is much more heterogeneous, and sourcing this data could be a barrier for financial institutions when assessing nature-related risks for their portfolios.

Engagement with portfolio companies can yield more granular data and nuanced asset tagging results.

- One solution may be for financial institutions to request that individual portfolio companies disclose the necessary data. For private companies, this may be necessary to enable deeper levels of asset tagging, and for public companies, this may yield additional insights.
- In the absence of data derived from individual portfolio companies, third-party data, such as a database of company-specific certified farming practices, could be incorporated into an asset tagging exercise.
- Obtaining data for nature-related asset tagging is likely to be a resource-intensive process. In addition, the existence of several data providers with different information about a same company may require report preparers to make an assumed choice of data provider.

Attributing dependencies and impacts across the value chain

Asset tagging is more straightforward for upstream sectors because it is often sufficient to look at direct dependencies and impacts.

- Comprehensive accounting of dependencies and impacts for downstream sectors would ideally include value chain considerations, which brings an additional layer of complexity.
- This could entail (i) defining the value chain, (ii) assessing dependencies and impacts at each stage of the value chain, and (iii) determining a methodology to attribute some proportion of these dependencies and impacts to the downstream company of interest.
- Conceptually, this is analogous to attributing scope 3 emissions in the climate space.

Choosing appropriate output metrics

The aims of the risk assessment should inform the selection of metrics.

- Metrics should be selected based on prior assessments indicating materiality of specific dependencies and impacts, and/or an organisation's priorities. Data availability may also be a factor.
- Simpler approaches to asset tagging that omit location data (see Figure 4) are more straightforward to implement, but limit understanding of nature-related risk exposure to global metrics. Approaches that incorporate location data introduce differences by geography but require more sophisticated assessment procedures.
- Quantifying the impacts or dependencies associated with these assets requires additional data or layers of assumptions to produce metrics, such as hectares deforested per unit of revenue. Because this is a more resource- and data-intensive process, report preparers may need to prioritise a small number of quantitative indicators to conduct this exercise in depth for part of a portfolio. These types of metrics can be tracked over time, and they are necessary inputs into the scenario-based risk assessment approach.

C. Scenario-based risk assessment method

i. Inputs, outputs and use cases

A scenario-based risk assessment method builds upon the other risk assessment approaches discussed in this paper. It translates exposure to nature-related risks into financial implications for organisations.

Conducting this approach requires several additional inputs, compared with the other two risk assessment methods. These are:

i. Economic and financial costs of nature-related risks;
ii. Modelling of changes in dependencies and impacts to allow conversion to, and estimation of, changes in costs and revenues; and
iii. More comprehensive scenario analysis, including how drivers of physical and transition risk could impact transmission channels through which costs and revenues could be affected.

Illustrative outputs from the scenario-based risk assessment approach for a financial institution's agriculture and food portfolio are shown in Figure 5. The primary metric used in the scenario-based risk assessment method is the expected loss under a given scenario. Loss (or gain) is best expressed in net present value terms for individual companies in a portfolio, which can then be aggregated to the portfolio level. An extension of this method for financial institutions is to express changes in value in

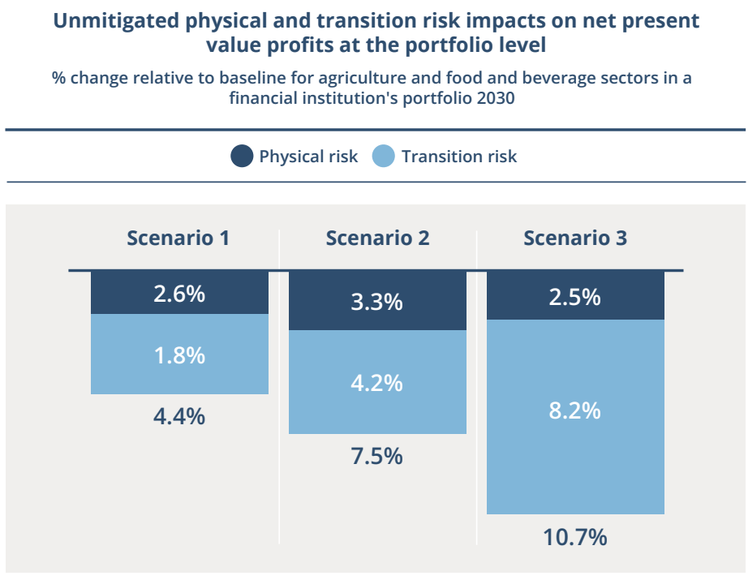
other financial metrics, such as equity or loan value. This requires an extra step in the modelling, since equity pricing models and bond pricing models are required. Similarly, extending the analysis to cover specific risk parameters such as changes in probability of default requires an additional layer of modelling to insert net present value changes into risk-based models.

Several additional metrics could further disaggregate the scenario-based risk assessment numbers to go beyond an average loss or gain across the portfolio and between different scenarios. These could include:

- Share of loss between physical and transition risks;
- Share of loss between sub-sectors, particularly in sectors where impacts are varied, such as in agriculture and food, where impacts can depend on upstream and downstream exposure, or consumer goods sectors, where product variation can be large; or
- The percentage share of companies in expected loss cohorts.

Company-level metrics can also be of high value for financial institutions. Several metrics useful for investors, as well as corporates, are listed in the TNFD's Metrics Annexes (Annex 4.3 in the v0.4 beta release). These include reduction in revenue due to lower demand for products and services or increased costs of natural inputs. These metrics may not form the core of an investor's potential disclosure metrics but are important for disaggregating scenario-based risk analyses to understand drivers of company or sector value.

Figure 5: The scenario-based risk assessment method helps estimate potential change in company-level value due to nature-related physical and transition risks under different scenarios (aggregated to the portfolio level) (illustrative representation using three scenario examples)



The scenario-based risk assessment approach can be used to assess potential financial loss across different scenarios – to determine whether investments or loans could change in value over time, for example. It builds upon quantitative dependency and impact metrics derived from an asset tagging approach. For example, Figure 5 shows a portfolio-level potential value loss of more than 10% under one scenario, split between physical risk drivers and transition risk drivers (related to regulation/policies and demand shifts). This could suggest the need to rebalance the portfolio to reduce risk or engage with portfolio companies to help them address specific drivers of risks. Corporates can also conduct the scenario-based risk assessment and use it to justify changes in strategy.

The scenario-based risk assessment method can also be used to assess certain types of business-related opportunities or identify the need to think more strategically about nature-related opportunities. A scenario-based risk assessment approach could help determine whether an organisation grows in existing markets if, for example, there is growth in demand for alternative proteins or for products from sustainable product lines.

A review of published reports shows the advantages and drawbacks of the scenario-based risk assessment method:

Advantages:

- The scenario-based risk assessment approach allows for a great deal of detail on the estimated impacts of nature-related risks.
- It is also possible to account for certain types of opportunities in the context of this approach, even though current approaches focus mainly on risk. For example, a limited number of reports (Race to Zero, FSD Africa) account for opportunities linked to financial implications, such as cost pass-through or options for risk mitigation that could affect value.
- This approach allows for forward-looking assessment of risk through the use of scenarios, in line with the TNFD's proposed initial guidance on scenarios.
- There is potential to integrate scenario-based risk assessment methods in internal models and capital adequacy assessments.

Drawbacks:

- Off the shelf scenarios to use in scenario-based risk assessments are not always readily available, potentially requiring report preparers to develop their own scenarios. An example of bespoke scenarios can be found with the CISL case study, with Deutsche Bank and UBP. A limited number of reports such as Race to Zero use scenarios that are publicly available.
- Producing a bespoke scenario may require some familiarity with scenario analysis, which may be a limitation for report preparers. The TNFD's proposed approach to scenario analysis starts with a bottom-up approach for corporates to develop bespoke scenarios along a standardised two-axis scenario framework. The

additional detail and rigour the scenario-based risk assessment approach brings is accompanied by additional technical complexity required to robustly apply the approach.

At a high level, the scenario-based risk assessment approach involves choosing a set of dependencies and impacts to assess in terms of their financial implications. Dependencies and impacts are linked to financial implications via risk drivers that act on company-level costs and revenues. Financial outcomes under different scenarios can then be compared to a baseline when producing metrics. Scenarios are an integral part of exploring future financial implications and potential uncertainties.

ii. Considerations for report preparers

Building or choosing a scenario

Scenarios represent pathways of plausible futures and can help communicate a consistent and logical understanding of the future, to explore uncertainties and consider how long-term trends and risks change over time.

- The TNFD's guidance on scenario analysis encourages organisations to focus on exploring critical uncertainties of relevance, such as specific policies that are relevant to products or markets or changes in ecosystem services vital for production. This approach is well suited for corporates.
- Financial institutions, in contrast to most corporates, have portfolios that span many sectors of the economy, so they will need to consider a wide number of variables and uncertainties across different sectors when conducting a comprehensive scenario-based risk assessment. A matrix-based approach, focusing on select critical uncertainties, may not be sufficient for financial institutions, which might need to layer multiple uncertainties and consider their interaction across the whole economy.
- Financial institutions may choose to take a more top-down approach using models to translate assumptions about potential future pathways into projected consequences. The LSE's Grantham Institute provides an overview of models that can be used to produce nature-relevant scenarios for use by financial institutions, touching on input data and assumptions, as well as useability. IPBES has also written a report discussing models of biodiversity and ecosystem services that can be used to produce scenarios, although the report focuses on policy-related decision-making.

For financial institutions, one solution is to employ off the shelf scenarios, although these are at an early stage in development.

- These types of publicly available scenarios exist in the climate space, such as those produced by the International Energy Agency (IEA), Network of Central Banks and Supervisors for Greening the Financial System (NGFS), World Business Council For Sustainable Development (WBCSD) and UN Principles for Responsible Investment (PRI)'s Inevitable Policy Response (IPR). IPR's FPS + Nature is currently the only publicly available integrated climate and nature scenario for use by investors that considers key macroeconomic variables and implications for land use.

- Off the shelf scenarios present a wide array of variables that can be used in scenario analysis and may also be more familiar to financial institutions that have conducted scenario analysis in the context of climate.
- Development of off the shelf nature-relevant scenarios requires considered input assumptions as well as outputs that are relevant to scenario users. Compared to climate, where GHG emissions are a primary variable of interest, nature scenarios may need to cover a greater number of variables.

As a matter of best practice, scenarios used in the analysis should take into account both climate and nature.

Quantifying the portfolio impact through the scenario-based risk assessment

Although scenario-based risk assessment exercises can be undertaken by building up analysis from the company level, many analyses apply sector-level trends to individual companies.

- A sector-level approach can be informative because it allows for the use of data at the country/geography level to derive expected company impacts. This approach can capture different revenue and cost implications between companies based on geographic exposure, but it often does not capture company-specific risks and opportunities from nature for two companies operating in the same sector. For example, a bottom-up approach would be needed to determine whether one of these two companies is certified to be deforestation free. Similarly, companies may differ in their ability to employ innovative technologies or techniques that are less harmful to nature, such as regenerative agriculture.
- Counterparty scenario-based risk assessment approaches require data about company-level products, processes and locations to quantify how changes in costs and revenue translate into company-level financial outcomes. Corporate report preparers have internal access to data about their own operations, but in the case of financial institutions, where such data is not available for private companies or smaller companies, report preparers face a decision about how to proceed.
- One option is to exclude such companies from the analysis. A second option is to conduct the scenario-based risk assessment exercise using proxy company data. A third option is for financial institutions to collect this data themselves using reports and disclosures issued by portfolio companies or by engaging with portfolio companies directly, or to obtain this data through a third-party data provider.

Quantifying physical risks (dependencies)

The financial impact of physical risks could be largely underestimated. The reason for this is twofold:

1. **Uncertainties about how physical risks may manifest and evolve over time:** Scientific understanding of nature-related physical risks is still developing, with uncertainties related to natural feedback loops, tipping points and the interaction between complex nature-related processes. One example is the relationship

between growing pressures on biodiversity and the risks of new pandemics.[5] Another example is the lack of scientific consensus on the tipping point of deforestation that could change the Amazon rainforest into a savannah and create a whole new situation.[6]

2. **Difficulty in measuring the potential damages arising from these physical risks:** Another core area of uncertainty stems from lack of data about how drivers of physical risk could affect costs.[7] For example, assessment of flood risk and damage is a well-developed topic in the realm of insurance, but the same level of understanding does not yet exist for how changes in soil quality affect agricultural productivity.

Additional factors also come into play when assessing financial impacts. These include:

- The use of short risk assessment evaluation time horizons may obscure the full implications of physical risks.
- When moving to longer time horizons, the effect of discounting plays an important role in valuation of risk. Risks further into the future receive a lower weight than risks closer to the present. This is a particular issue for assessing the present value impact of physical risks, which tend to have longer time horizons, versus transition risks, which often occur sooner, and is one reason transition risks typically feature as a substantial share. This issue is also a problem when assessing climate-related physical risks.[8]

Among the options to better account for the uncertainty in physical risk estimates, uncertainty could be accounted for through sensitivity analysis around specific physical risks, such as the potential implications of reaching selected tipping points, as seen in one World Bank report.

Assessment of many physical risks can often be improved by data about local-level physical processes and asset location but can significantly increase complexity.

- Certain physical risks can only be properly assessed by using granular, localised data (such as flood risk)[9] whereas other physical risks such as water stress can be quantified using less granular data.
- Increasing granularity may increase complexity for two reasons. First, assumptions used for valuation would require additional local level variables, in the value of house prices, for example, to ensure granular data is accurate. Second, the need to run consistent scenarios introduces the challenge of downscaling these to granular spatial scales.

5 See for example OECD (2020) or IPBES
6 See for example IPBES, 'Could scenarios and models of biodiversity tipping points and human well-being become a transformative lever?', October 2019
7 Which has also been the case for climate-related physical risks, as seen from NGFS (2020)
8 Financial Stability Board (FSB), November 2020, 'The Implications of Climate Change for Financial Stability'.
9 In assessing localised physical risks, it can be difficult to match localised physical risk data with data available on financial exposure, which is typically found at a much coarser spatial scale. Corporates may have an advantage in that they are more likely to have physical asset level data to use in place of financial exposure data.

- Report preparers could explore whether granular location data will increase insights in proportion to complexity. In some cases, such as for assessing the risk for private infrastructure and mining, additional location data could add significant value. For other physical risks, such as country-level water scarcity, location data may not be needed.

Quantifying transition risks

Transition risks are often linked to organisation-specific nature-related impacts, but they also reflect an organisation's broader context.

- As detailed in the TNFD guidance on the Assess phase of the LEAP approach in v0.3 of the TNFD beta framework, transition risks are affected by factors beyond nature-related dependencies and impacts, such as (i) policies and the regulatory context, (ii) technological innovation, (iii) changing market dynamics, and (iv) changing consumer preferences and demand.
- Before conducting a scenario-based risk assessment approach, an asset tagging approach can give an idea of the magnitude of some of these risks (for example, by understanding asset-level impacts on nature, like deforestation, that could become subject to regulation and increase costs[10]).
- The scenario-based risk assessment approach will then help understand the implications of other transition risk drivers with the consideration of macroeconomic consequences and specific transition risk channels.

Risks related to the broader market context may have significant implications for revenues in the longer-term, compared to risks tied to nature-related impacts, which could act in the shorter term.

- For example, a company may be required to pay a fine for deforestation, which would increase short term costs. Longer term, its market access could also be altered, or its ability to secure mining or forestry concessions could be affected, or market demand could dwindle due to a preference for deforestation-free products. This could translate into longer-term revenue loss, or long-term revenue increase if new markets such as alternative proteins are pursued. These types of assumptions could be integrated into the scenario used to assess overall financial impacts.
- Investor pilot results for the scenario-based risk assessment approach support the idea that costs of regulation could be the largest driver of transition risks in the short term, but market and consumer-related risks could become more significant in the long term as new technologies and social and economic factors emerge.

10 For example, the EU's recent legislation on deforestation-free supply chains prohibits the sale of deforestation-linked products in the EU market. Companies with deforestation in their supply chains may incur fines, experience due diligence costs, and/or bear the cost of upgrading their operations to eliminate deforestation.

Calculating economic and financial value

Translating metrics derived from an asset tagging exercise into financial metrics requires additional layers of data.

- For example, knowing the share of assets near protected areas gives an indicative sense of risk level, but this indicator cannot be translated into a financial implication without applying additional assumptions about how this location might affect costs and revenues. This requires seeking out additional information, e.g. the cost of relocation.

Financial impacts may depend on market dynamics.

- Company value can be affected by whether firms can pass costs through the value chain, either upstream to consumers or downstream – wheat producers could pass the costs of higher input prices to food companies who produce bread, for example. Inclusion of these types of market dynamics may require reporters to develop market-specific assumptions and modelling.

Presenting total financial implications as ranges instead of point estimates could be informative.

- Feedback from asset owners suggests that presenting results as ranges could result in more accurate results. Ranges can also be used to illustrate variation in outcomes across scenarios, as is often done in climate-related risk assessment and scenario analysis.

Incorporating value chain considerations

Fully accounting for the value chain when assessing financial implications for downstream companies requires making assumptions about linkages with nature-related risks affecting upstream companies.

- Downstream companies are directly and indirectly exposed to risk. Direct risk is derived from a company's direct operations, while indirect risk affects a company through its value chain. To account for indirect risk, it is first necessary to assess nature-related risks for upstream companies. The structure of the value chain also needs to be understood.
- Understanding channels of risk transmission is the next step to consider. These could relate to several measures, including cost pass through supply chain disruption and potential reputational or regulatory exposure if, for example, companies are exposed to environmental controversies due to the actions of their suppliers.
- Finally, translating value chain considerations into financial implications for downstream companies means assessing the extent to which upstream financial implications filter down the value chain. In a simple case, if the cost of producing a single agricultural commodity increases, is this cost fully passed through to food manufacturers? And to what extent to food retailers?
- As an alternative option, report preparers may choose to state that they have excluded value chain considerations or only partially accounted for them, if this is the case.

Understanding downstream risks is also recommended and may require a view of attribution mechanisms.

- Quantifying and attributing downstream dependencies, impacts or risks may require developing a view on what happens downstream. For example, a battery producer would need to take a view on how its batteries are disposed of by consumers. A beverage company could face costs linked to legislation requiring to change plastic packaging for non plastic materials.

Quantifying mitigation actions

The scenario-based risk assessment approach becomes more complex if organisations choose to treat the financial or business unit assets they are assessing as dynamic.

- For investors, this would involve the assumption that portfolio companies take specific actions to mitigate the risks outlined in the scenarios.
- Accounting for mitigation actions may make the scenario-based risk assessment approach seem more realistic, but it may be difficult to accurately gauge a company's potential response.
- Organisations could choose to assess financial implications assuming portfolio companies do not take any actions to mitigate risks. This decision would need to be communicated in any report since it could significantly determine the size of impact. At the same time, risks and their related financial implications may be overestimated under the assumption that portfolio companies will make no changes. Report preparers employing this approach should be transparent about this shortcoming.

3. Defining the aims of the risk assessment for each approach

Different risk assessment approaches are better suited to inform certain decisions, and it is important to define the intended aims of a risk assessment before commencing a risk assessment approach. Some examples of use cases of each of the three approaches is presented here:

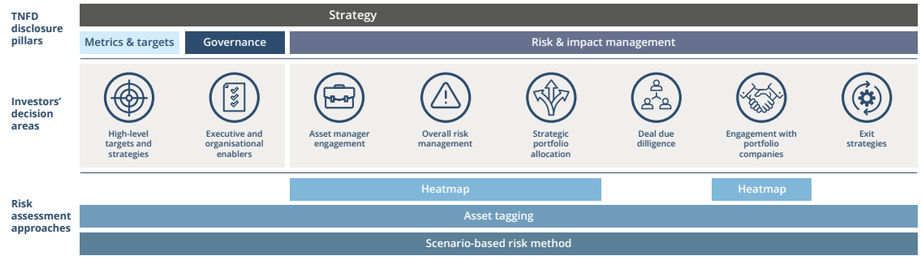
- **Heatmaps:** Heatmaps can be used as an initial scoping exercise to identify the most salient issues. They can be useful in developing exclusion policies. They also are a first step to identify which sectors, dependencies and impacts could be appropriate for a deeper dive analysis. In TNFD scoping guidance for financial institutions applying the LEAP approach, heatmapping is noted as a useful first step for all institutions with investment portfolios. One typical example may include prioritisation of potential areas of focus on specific sectors, products/materials, or specific dependencies or impacts that could be material for a financial institution's portfolio or a corporate's revenue.
- **Asset tagging:** Asset tagging can be used to zoom in on sectors or dependencies and impacts identified as potentially material in the context of the heatmap, for example, by supporting production and tracking of metrics over time or by helping to identify portfolio companies, assets or operations for which to prioritise engagement.
- **Scenario-based risk assessment method:** Scenario-based analysis explores the financial implications of nature risk through the use of scenarios. It can support the raising of awareness across an organisation and its board to help develop a nature strategy and rationale for taking a proactive risk management approach.
  - For financial institutions, it can help when taking decisions about risk appetite, divestment from certain sectors or portfolio companies, geographic diversification or company engagement (as with asset tagging) or decisions about capital allocation.
  - For corporates, it can support the examination of the materiality of changes in specific risk drivers, including regulation and loss/reduced functioning of ecosystems and provision of ecosystem services, as a part of scenario analysis, or justification of investment in risk mitigating measures, such as improvements in operational processes.
  - For both corporates and financial institutions it can accompany stress testing of strategy resilience.

4. Use of risk assessment approaches in decision making

This phase requires identifying and informing strategy and resource allocation decisions as well as setting targets using risk assessment insights.

Figure 6 suggests key junctures where nature could inform investors' decisions, along with the type(s) of risk assessment approach(es) that could be most informative at each juncture. Based on investors' experiences with climate risk assessments in recent years, these decision areas have been informed by climate risk and opportunity insights.

Figure 6: Risk assessments can inform multiple decision areas across all four pillars of recommended TNFD disclosures



High-level targets and strategies: Risk assessments could help determine which dimensions are appropriate and realistic for target setting and inform metrics to monitor progress towards reducing exposure to nature risks. Other strategic action could involve engaging with industry initiatives to make business models evolve collectively.

Executive and organisational enablers: Risk assessments methods are powerful tools to raise awareness throughout the organisation and with board members to explain strategic choices. The exercise could also compel talent management teams to provide staff with trainings on the topic of nature, and if nature-related targets are set, integrate these into portfolio managers' and/or executives' compensation as well.

Asset manager engagement: Risk assessments can also help asset owners to prioritise and engage with asset managers on nature-related topics. Asset owners could start conversations with asset managers to encourage establishment of nature-related risk management processes and emphasise the importance of producing nature-related disclosures.

Overall risk management: Risk assessments, including the three approaches described in this guidance, are critical to enable investors to adjust their risk management structures and procedures. For example, risk assessments could inform the development of exclusionary policies for certain sectors, activities or geographies as well as define metrics against which to track progress. Risk assessment insights can trigger an organisation-wide discussion about risk limits and risk appetite.

Investing in tools or automated process could also help assess nature-related risk more efficiently, potentially leveraging resources cited in the TNFD's Tools Catalogue.

Strategic portfolio allocation: This could entail divestment or diversification from sectors and geographies identified to be high risk or directing capital to new sectors or businesses identified to be making a positive contribution to nature.

Deal due diligence: Similar to what many investors have done for climate, nature-related considerations from scenario-based risk assessments could be incorporated into due diligence processes to refine the valuation and inform value creation plans.

Engagement with portfolio companies: Investors are well-positioned to engage with the companies in their portfolios on nature-related issues. The asset tagging and scenario-based risk assessment approaches could help prioritise portfolio companies to engage with on the management of nature-related risks and opportunities and also help prioritise specific dependencies and impacts for active engagement.

Exit strategies: Nature can be relevant when investors define exit strategies for specific investments. More specifically, nature-related risks can help prioritise companies for early exit, and nature-related opportunities that can be captured by companies could be used as value creation levers to maximise the value of investments pre-exit.

Box 2: Nature-related risk assessments for institutions beyond investors

Understanding the use of risk assessments by investors can inform nature-related risk assessment expectations for corporates. In their disclosures, corporates could proactively provide information that is relevant for investors, such as asset-level data. They could employ best-practice reporting principles, including consistency, transparency, and completeness. Corporates may also consider using internal risk assessments to identify material risks and opportunities ahead of investor engagement.

Other financial institutions, such as banks, asset managers, and insurers, could also incorporate nature into their existing climate-related risk management programs. Similar to investors, this could involve developing exclusionary policies for certain sectors, geographies, processes, or products that have high nature-related impacts or risks. It could also involve expanding climate-related due diligence procedures to encompass nature, including modification of hazard models for insurers. Financial institutions could use nature-related risk assessments to inform high level investment, lending, or underwriting strategies or inform decisions about counterparty engagement. Finally, financial institutions could create new products, such as insurance offerings that target specific geographies or risks, or loans with modified lending rates that reflect companies' nature-related action.

Step-by-step procedure to conduct risk assessment

This section provides a step-by-step approach common to all risk assessment methodologies. Following the LEAP approach, it offers practical examples to help corporates and financial institutions analyse risks and opportunities successfully. Guidance is provided for each of the three approaches: heatmapping, asset tagging and scenario-based risk assessment approaches. For financial institutions conducting a scoping exercise (LEAP-FI) as a first step, the guidance for heatmapping is of particular relevance.

Table 1: The three risk assessment methods follow a scoping phase and six steps that align with the LEAP approach

LEAP phase alignment	Step for risk assessment	Explanation	Heatmapping	Asset tagging	Scenario-based risk assessment method
Scoping	0. Scope the assessment	For financial institutions, consider the type of business, the three entry points (sectors/geographies, asset classes/ finacial products and/or biomes) and the type of analysis. For corporates, consider business operations and aspects of nature that can reasonably be assessed given data availability. TNFD guidance: Scoping the assessment	Choose the appropriate level of sectoral aggregation, define the asset class(es) considered and determine the appropriate geography. At the most basic level, a heatmap can show geography and a global view of dependencies and impacts. It may be useful to account for as many sectors, asset classes/products and geographies as possible, provided that data is available.	Select a sector (or sectors) for deep dive analysis, potentially based on results from the heatmap approach, which can help scope more complex risk assessment approaches. Focus on areas where there is likely to be risk, in order to effectively prioritise use of resources for conducting the assessment.	Select a sector (or sectors) for deep dive analysis, potentially based on results from the heatmap approach, which can help scope more complex assessment approaches. Sector selection can also be informed by results of an asset tagging approach. Focus on areas where there is likely to be risk, in order to effectively prioritise use of resources for conducting the assessment.
Locate	1. Define financial exposure	Use a location-grounded approach to establish the appropriate unit of analysis. This should be informed by the scoping phase of the assessment that helps determine where the organisation interfaces with nature and which sectors and geographies define the organisation. Also define appropriate time frames for the assessment, especially if planning to use scenarios. TNFD guidance: Locate guidance; LEAP-FI guidance; Scoping guidance for corporates	Define financial exposure by sector (or sub-sector, where relevant), according to the SASB classification system or another classification system of choice.[11]	Informed by the scoping phase, choose the appropriate level of geographical and asset granularity, depending on data availability and desired insights, to determine the unit of analysis.	Informed by the scoping phase, choose the appropriate level of geographical and asset granularity, depending on data availability, to determine the unit of analysis. Define the time period for the analysis.

11 The TNFD follows the SASB classification system in developing its additional guidance by sector, although use of this system is not a requirement and correspondence tables can be used to crosswalk different sector classifications.

LEAP phase alignment	Step for risk assessment	Explanation	Heatmapping	Asset tagging	Scenario-based risk assessment method
Evaluate	2. Identify nature-related dependencies and impacts	Dependencies and impacts act as drivers of exposure to nature-related risks. A long list of dependencies and impacts can be narrowed to a short list by thinking about data availability, sector relevance and location-specific information, keeping in mind the aims of the risk assessment. TNFD guidance: Evaluate guidance	Select dependencies and impacts to assess exposure to nature, following emerging guidance from the TNFD that suggests grouping dependencies and impacts according to types of ecosystem services and IPBES drivers of nature change. Define dependency and impact categories in line with the nature-related data source being used, such as ENCORE, or the WWF Biodiversity Risk Filter, or in line with TNFD guidance, which follows UN SEEA-Ecosystem Accounting. Selection of specific dependencies and impacts can be informed by an initial scan of ENCORE or similar data sources to get a preliminary idea for what could be material. Referring to TNFD guidance or guidance from the Natural Capital Protocol could also be informative as part of the selection process.	Select dependencies and impacts to assess exposure to nature based on intial risk scoping (potentially in the form of a heatmap). Filter a long list of dependencies and impacts based on data availability, especially if quantification is desired.	Select dependencies and impacts to assess exposure to nature based on initial risk scoping (potentially in the form of a heatmap). Careful selection (keeping data availability in mind) is critical to ensure robust quantification. Determine the most granular level of data available for the assessment and create a shortlist of robustly quantifiable dependencies and impacts. Consider dependencies and impacts that are likely to be material, potentially informed by an initial heatmapping exercise or findings from an asset tagging approach.
Evaluate	3. Determine exposure to nature-related dependencies and impacts	Organisation-specific financial exposure data and operational data are combined with nature-relevant physical, spatial or qualitative data to determine exposure to nature-related dependencies and impacts. For example, this could include location of assets, specific sectors of operation, processes or products. Nature-relevant data can be obtained from public sources, third-party providers or internal data collection. TNFD guidance: Evaluate guidance; Illustrative metrics for FIs; Illustrative dependency and impact metrics	Financial exposure is mapped according to ENCORE sub-industries to allow for correspondences between financial exposure and ENCORE's dependency and impact ratings. Each sector-dependency/ impact pair is given a qualitative rating corresponding to the ENCORE scoring methodology. This approach may also be appropriate for large corporates that derive revenue from multiple sectors or industries.	Define methods, assumptions and units of measurement for assessment. Sizing of nature exposure can be qualitative or quantitative. For example, an organisation may overlay asset location data with data on the location of protected areas or produce qualitative ratings of dependencies and impacts by mapping portfolio companies to ENCORE processes. Metrics produced should be fully aligned with the intended use case.	Define methods, assumptions and units of measurement for quantification of nature exposure. Assess the scale and severity of nature exposure quantitatively at the most granular level where data is available, such as the production location, for each selected impact and dependency. Qualitative assessment is not sufficient as this is difficult to translate into quantified financial impacts.

Annex 4.6

LEAP phase alignment	Step for risk assessment	Explanation	Heatmapping	Asset tagging	Scenario-based risk assessment method
Assess	4. Select scenarios	Not all risk assessment approaches lend themselves to scenario analysis, but it is a useful tool in any forward-looking approach or in assessing uncertainty. The TNFD recommends the use of integrated climate and nature scenarios to explore the evolution of nature-related risks, related financial implications, and the responses organisations can take in light of evolving circumstances. Scenarios chosen should encompass variables (e.g., location or sector-specific variables) that are relevant for the organisation. TNFD guidance: Approach to scenario analysis	The archetypal heatmap approach does not use scenario analysis and is grounded in current exposure to nature. However, the TNFD's proposed approach to developing scenarios could be applied in the context of heatmapping by defining critical uncertainties (potentially related to specific dependency and impact categories depicted on the heatmap) and qualitatively assessing their effects at the sector level.	Scenarios are not commonly used in the asset tagging approach as assessment is usually based on current exposure to nature. However, a scenario approach could be deployed, in line with the TNFD's draft guidance on scenario analysis, by examining changes in relevant indicators and metrics under different dependency and impact scenarios, such as expansion in protected areas or changes in water scarcity.	Specify a high-level narrative for different scenarios, including a baseline scenario. Clearly specify assumptions about critical uncertainties for the time period assessed. For example, specify policy and regulatory assumptions around financial penalties or incentives and specify assumptions about the physical state of nature and physical nature-related outcomes. Take care to ensure that the transition and physical pathways implied by these assumptions are consistent, based on the latest scientific research.
Assess	5. Assess nature-related risks and opportunities	Identify nature-related risks and opportunities, informed by an understanding of nature-related dependencies and impacts. Also consider the wider context of market and non-market driving forces that could result in additional risks or opportunities. Organisations may consult the TNFD's risk and opportunity registers for inspiration. Determine the effect of risks and opportunities on the organisation, including their financial implications, if relevant to the aims of the risk assessment. TNFD guidance: Risk and opportunity registers; Illustrative indicators for risks and opportunities; Assess guidance; Illustrative metrics for FIs	Dependencies are conceptually linked to physical risks, while impacts are conceptually linked to transition risks, although this is not a perfect dichotomy. Risks are assessed according to a qualitative classification system (high, medium, low) defined in ENCORE or an alternative data source. Opportunities are not assessed as part of this approach.	Dependencies are conceptually linked to physical risks, while impacts are conceptually linked to transition risks, although this is not a perfect dichotomy. Risk is summarised using different categories of nature exposure, defined by scale and severity. These could involve physical impact metrics, such as the quantity of deforestation or proportion of assets near a forest that could indicate higher risk levels or factors more explicitly related to a level of risk, such as the frequency of involvement in environmental controversies.	Convert the dependencies and impacts sized in previous steps into changes in financial value by defining their cost or revenue implications at the company level. For example, a deforestation footprint could be linked to additional costs in the form of a fine. Also consider the broader context to identify additional drivers of risk, such as behavioural changes such as a decrease in meat consumption, which could impact revenue. Convert exposure to behaviour change into potential financial loss at the company level. In addition, consider potential corporate actions to mitigate losses or generate revenues with positive impacts on nature. Compare potential financial losses in different scenarios to the baseline scenario. The TNFD's guidance on identifying risks and opportunities may be a helpful reference when selecting risk transmission channels.

Annex 4.6

LEAP phase alignment	Step for risk assessment	Explanation	Heatmapping	Asset tagging	Scenario-based risk assessment method
Prepare	6. Synthesise metrics	Summarise and synthesise assessment outcomes by producing metrics related to dependencies, impacts, risks and opportunities. These are used to inform strategy, risk management, reporting and disclosure. Use of more granular data throughout the assessment process unlocks more granular metrics. Use of scenarios unlocks forward-looking metrics that can be compared across different possible futures. TNFD guidance: Draft metrics annexes; Illustrative metrics for FIs; Illustrative indicators for risks and opportunities; Illustrative dependency and impact metrics; Approach to scenario analysis	Key metrics to assess nature-related risk exposure based on the heatmap approach include the number of dependencies and impacts rated 'high' across the portfolio and for each sector, and the total financial exposure to sectors with several impacts or dependencies rated 'high'. Ratings for individual dependencies and impacts across sectors can help inform the focus of more sophisticated assessment approaches after the heatmap has been completed.	Key metrics to assess nature-related risk exposure based on the asset tagging approach include the number of assets or quantity of assets under management rated high for specific dependency and impact categories across the portfolio; quantified nature-related dependencies or impacts, such as amount of deforestation or quantity of water used; or location-based risk metrics such as the proportion of assets under management located in proximity to key biodiversity areas.	Key metrics to assess nature-related risk exposure based on the scenario-based risk assessment approach include potential loss from transition risk or physical risk or potential loss mitigated, relative to a baseline.

Useful resources

More than 25 nature-related reports were examined as part of a rapid review of risk assessment approaches currently in use. Reports that relate to the financial sector are listed here, in alphabetical order, along with a brief description of their risk assessment approaches.

Table 2: A variety of risk assessment approaches are used in published reports

Organisation	Description
ABN AMRO	Asset tagging: Aggregates direct and value chain biodiversity impact drivers into a single metric, monetised based on the value of ecosystem service loss, using data from the Global Impact Database. Shows improvement in this metric over time.
Allianz	Asset tagging: Assigns qualitative risk score based on location of portfolio companies in relation to IUCN critically endangered species and important bird and biodiversity areas. Also scores companies based on the proportion of revenue derived from activities that impact biodiversity. Also scores companies based on their management of biodiversity risks and exposure to controversies.
Axa	Asset tagging: Quantifies biodiversity footprint across 27 industries, focusing on nature-related impacts to calculate km^2 mean species abundance (MSA) per million EUR invested. Uses the corporate biodiversity footprint (CBF) tool, which also considers companies' value chains.
BMO	Asset tagging: Produces a metric for intensity of water use per unit of revenue and compares this against the same metric for the MSCI World Index. Discusses individual companies with high intensity. Also maps how company-level sources of revenue map to SDG targets.
BNP Paribas	Asset tagging: Quantifies biodiversity footprint of 70% of assets under management using revenue and sector exposure of issuers rather than more granular data. Uses the CBF tool to determine relative biodiversity intensity per capital employed. Categorises this metric qualitatively (high/medium/low) by sector. Mentions both TNFD and LEAP, but with limited detail.
CISL (with Deutsche Bank and UBP)	Scenario-based risk assessment method: Develops bespoke scenario related to reduced fertiliser usage to assess valuation of two fertiliser companies. Extrapolates value loss to total equity value across the fertiliser sector. Assumes no mitigating actions are taken. Does not consider opportunities.
CISL (with HSBC)	Scenario-based risk assessment method: Assesses credit risk rating for heavy industry companies in an East Asian country with areas of very high water stress, under a scenario of water curtailment. Selection of the sector accounted for its water-related ecosystem service dependencies.
CISL (with NatWest)	Scenario-based risk assessment method: Uses two scenarios to assess profit implications for an average farmer facing land degradation, which is related to credit risk. Assumes no mitigating actions are taken. Does not use specific loan book data.
CISL (with Robeco)	Scenario-based risk assessment method: Uses scenario that assumes severe and longer-lasting yield reductions on degrading land due to extreme weather, focusing on Brazil. Considers effect throughout the food supply chain (from pre-production to consumption). Assesses change in market value of listed companies.
DNB	Multiple approaches: Uses three scenarios of protected areas expansion to assess exposure to companies active in protected areas. Also calculates biodiversity footprint based on companies that comprise 80% of the share portfolio. Also considers exposure to companies with environmental controversies and exposure to companies with products and activities related to deforestation (and their reporting practices).

Annex 4.6

Organisation	Description
French Central Bank	Multiple approaches: Assesses dependencies at the sector level using ENCORE data in a heatmap format. Also computes sector-level upstream dependency scores by using a weighted average of dependencies in value chain sectors, based on asset-level data. Quantifies biodiversity footprint (MSA.km^2) for total securities portfolio of French financial institutions and breaks this down by sector, using data at the sector-region level. Assessed the dependencies and impacts of each issuer by measuring its footprint and aggregating up. Also looks at share of portfolio comprised of companies with different levels of dependency on a different number of ecosystem services.
FSD Africa (with McKinsey)	Scenario-based risk assessment method: Applies five scenarios and a baseline scenario to 2030. Considers both equity and loans. Measures change in asset value and financial performance as well as changes in expected losses for lending. Also considers opportunities in the form of cost pass through. Explicitly shows how approach follows LEAP.
Impax Asset Management	Asset tagging: Identifies proportion of portfolio company revenue attributed to SDG-aligned activities as part of an asset tagging approach. Also looks at data availability for key impact metrics at the company level. Includes positive metrics in this assessment.
ING	Heatmap: Considers both physical and transition risks over a 5-year time horizon, assessed qualitatively at the sector level in the form of a heatmap. An image of the heatmap itself is not published.
LFDE	Asset tagging: Assesses biodiversity footprint in MSA in part per billion. Uses sectoral data and ratios to produce company-level footprints. Compares fund-level footprints to an index to show better/worse performance.
Moody's	Heatmap: Creates a heatmap that includes five categories of risk and one overall risk score, assessed qualitatively at the sector level. Risk levels are influenced by sector-wide mitigating factors, but opportunities are not included.

Organisation	Description
MSCI	Asset tagging: Used MSA to determine locations sensitive to adverse impacts and found share of index constituents with at least one physical asset in these biodiversity-sensitive areas. Also created an industry-average biodiversity and land use risk management score, including environmental controversies. Discusses both TNFD and LEAP.
MSCI	Asset tagging: Assesses potential contribution to forest loss based on location of physical assets in WWF Deforestation Fronts. Also considers deforestation-linked commodities in the supply chain. Also looks at company-specific policies related to deforestation.
Netherlands Enterprise Agency	Asset tagging: Produces four biodiversity footprint case studies using pressure-impact model ReCiPe combined with Life-Cycle Impact Assessment to determine how environmental pressures contribute to biodiversity impact. Uses EXIOBASE data when it is not possible to collect company-specific environmental data. Briefly mentions TNFD.
Race to Zero	Scenario-based risk assessment method: Applies publicly available integrated climate and nature scenario along with a baseline scenario to estimate change in value of 40 food and agriculture companies to 2030 due to transition risks. Also considers opportunities in the form of market, operational and commercial responses.
Robeco	Heatmap: Does not explicitly produce a heatmap, but uses Encore data to assess dependencies and impacts, which are then summarised in a chart that shows EUR exposure to sectors that have high dependencies and impacts for specific ecosystem services, demonstrating a heatmap-type approach.
Swiss Re	Heatmap: Assesses the state of ecosystem services by geography (per square km of land and at the country level) to create a heatmap. Combines 10 ecosystem services into a single qualitative risk score, underpinned by various quantitative metrics.
WEF (with PwC)	Heatmap: Does not explicitly produce a heatmap but maps direct and supply chain GVA at the industry level to high/medium/low nature dependency scores in a heatmap-type approach. Also qualitatively assesses nature dependency at the regional level.

Organisation	Description
Waldron et al. (2020)	Scenario-based risk assessment method: Develops multiple scenarios to explore the costs and benefits of implementing a 30x30 target. Estimates financial implications, including changes in sector-specific revenues.
World Bank	Scenario-based risk assessment method: Develops multiple scenarios, also accounting for nature-related tipping points for three ecosystem services and uses them to estimate potential GDP loss to 2030. Also uses scenarios to estimate positive GDP effects of coordinated policies that could benefit biodiversity and development, incorporating climate-related considerations.
World Bank (Brazil)	Multiple approaches: Uses a heatmap-type assessment to identify share of total credit with none to very high dependency on 21 ecosystem services, based on ENCORE data. Determines share of financial assets potentially operating in protected or priority areas. No use of scenarios but recognises that priority areas could become protected areas in the future. Also assesses exposure to companies with environmental controversies. Uses publically-available BAU and ecosystem collapse scenarios (that estimate effect on GDP) combined with a GDP to non-performing loan (NPL) ratio to extrapolate potential increase in corporate NPLs. Makes mention of TNFD.
World Bank (Malaysia)	Multiple approaches: Uses a heatmap-type assessment and ENCORE data to assess both individual dependencies and impacts at the NACE sector level. Also produces a composite sector-level score. Determines proportion of commercial lending to sectors with high or very high dependencies or impacts. Maps location of commercial residential and non-residential purchase lending in relation to protected areas and non-protected Key Biodiversity Areas. Creates 21 physical and seven transition risk scenarios linked to dependencies and impacts identified in a heatmap-type assessment. Determines proportion of total commercial loans outstanding that would be exposed under each scenario (via identified dependencies/impacts).

Annex 4.6

Taskforce on Nature-related Financial Disclosures

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